ATTENTION: A VIEW SUGGESTED BY SYSTEMIC AND CYBERNETIC CONSIDERATION

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A B S T R A C T

Current views and models about attention regard man as a 'transmitter channel' and try to characterise the properties of that 'odd channel'. Another characteristic of the current views is that attention is regarded as a specific mental operation in a person which can be described, irrespective of the purposes of the subject.

By contrast we examine attention as an activity at the service of the purposes of the person. Attention is examined as an activity by means of which the field of consciousness is structured around the 'object of attention'. This object of attention is not a specific 'stimulus' but a system in the sense of General System Theory. Hence, the approach is mainly holistic in character. Activity is looked upon as an INTERTRAFFIC between the person and his relation with the world. And where there is relatedness, information theory, in a cybernetic sense, can be used. The approach developed benefits of the advantages from previous models allowing also for a better explanation of the limitation present in the cognitive realm without appeal to some 'filter mechanism' in the physiological structure of a person.

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C O N T E N T S

In the present chaotic condition of attention theories an attempt, however modest, to harmonise the known facts with one another needs no apology.

W.B. Pillsbury: Attention (1908)

420. Seeing a living human being as an automaton is analogous to seeing one figure as limiting case or variant of another; the cross-pieces of a window as a swastika, for example.

422. What am I believing in when I believe that men have souls ? What am I believing in, when I believe that this substance contains two carbon rings ? In both cases there is a picture in the foreground, but the sense lies far in the background; that is the application of the picture is not easy to survey.

Ludwig Wittgenstein: Philosophical Investigations

The concept of a person is logically prior to that of an individual consciousness. The concept of a person is not to be analysed as that of an animated body or of an embodied anima.

P.F. Strawson: Individuals

CHAPTER I

I N T R O D U C T I O N

When I first undertook the task of considering the phenomenon of attention as the one for analysis and consideration I was not totally aware of all its implication. Besides, coming as I do from the medical sciences, specifically neurophysiology, my first impulse was only to look for some useful correlations between 'attentive behaviour' and some electrophysiological responses worth looking at.

My 'immersion' in a cybernetics department changed my perspective of the subject, but certainly not immediately. The study of attention in the modern interpretations of Broadbent, Treissman, the Deutsch, Moray, etc., (mainly 'filter theory') and its relation to cybernetics seemed to me so interesting that at the beginning I was blinded to seeing alternative useful interpretations as well as to the possibility of challenging the premises.

All the above mentioned theories make use of concepts and techniques borrowed from information theory which gives some respectability, conciseness and consistency to the field. But I learned from my logical studies that to cast doubt upon an argument is either to dispute whether the conclusion follows from accepted premises, (that is, the soundness of the inferences from premises to conclusion) or to challenge the assertion of the premises. This task seemed enormous, so I retreated to re-study both the fundamentals of cybernetics and the bases of the so called mental activity.

It was not until sometime later that I started to see alternative ways of approaching the problem. But again a host of interrelated questions in both fields crop up (causality, teleology, intentionality, goal, purposes).

The present work even when mainly concerned with an analysis of attention ought to start by introducing the conception of cybernetics

and mental activity upon which the analysis is based; if only because the study in isolation of the phenomenon of attention has reduced most of these studies to rather trivial mechanisms. It is desirable to adopt a framework in which apparently separable higher mental faculties are seen as various manifestations of a single more inclusive phenomenon, namely cognition. The separation of one cognitive faculty from the totality of cognitive processes results in the abandonment of the original problem and to the search for mechanisms that implement entirely different functions that may or may not have any semblance to the processes that involve the totality of the organism.

The basic approach, we suggest, is to look at the organism as a totality even when this totality belongs to one type and is limited by other totalities. The organism constitutes a whole. The work in system analysis (von Bertalanffy, 1968) and Cybernetics (Wiener, 1948) has pointed to the idea that, for the study of a complicated sort of system as the whole organism, we require an holistic view. This view in itself is not very encouraging. The study of the 'whole' is a daunting prospect. But the nature of the whole is such that it cannot be studied as a whole any more than the physiologist can study the human body as a whole. We start with a tentatively 'isolated' part. In order to understand the part, however, we must go on to other parts. As we extend our investigations and as the relationships which the part has to the whole become clearer, we are compelled to modify our original conclusions about the nature of the part when it was considered in relative isolation. For example, whatever we know about audition or vision as a consequence of analysing its function in isolation assumes a different significance when it is studied as an instrument of the organism as a whole. This involves a continual revision of our knowledge

as it goes from part to part until the systematic nature of the whole is revealed. The development of knowledge is from the abstract to the concrete. The part is an abstraction, the whole is concrete. It may be conceivable that our sense of the complications in the study of the whole is itself one of the consequences of being educated in an intellectual climate where the accepted scientific method is atomistic rather than holistic.

It is quite common in attempting to produce a conceptual analysis to look into logic and mathematics as an ideal. This task impels us to take only logico-semantical relationships in establishing the articulations of concepts and their outer boundaries. From this point of view the relations among the concepts is fixed a priori, we are led to pay attention only to semantical considerations, without any reference to extra-conceptual, empirical fact. The search is only for precision and logical necessity.

The sort of reflection which we call "cybernetic" cannot simply precede empirical discovery and lay out the field of the possible and impossible (contra Ashby). It can only be a reflection on empirical findings, raising questions about their interpretation, about the connections between them, about the problems they raise or help to solve.

This kind of enterprise, looking only for precision and logical necessity, has led into special difficulties. The difficulties have to do with the fact that in the characterization of a phenomenon a variety of determinants are involved, the most important of them being regularity (general laws) and consensus, general agreement. Both are crucial in the standard concept of any phenomenon. Most of the time we take any one of them not only as necessary but as

sufficient. There is no logical link between the above two factors. The two factors can, in principle, lead separate ways. There is no reason, in logic, why the two factors have to go together. Normally it is asked which of the factors is the decisive one. If both are conjointly required, then it may be asked "just what are their relative roles and contributions ".

In most of our everyday psychological concepts we cannot make a tidy demarcation ruling as to what relative contribution or conceptual weight is to be carried by each one of several factors linked together in one of common concepts.

Many of the concepts used in thinking about a phenomenon are of a mixed character and this concurrence in a concept rests on empirical foundations. Some examples of this are:

a) *PERSONS*, as a fusion of mind and body. Quoting from Strawson (1959) "... the concept of a person is the concept of a type of entity such that both predicates ascribing states of consciousness and predicates ascribing corporeal characteristics, a physical situation etc are equally applicable to a single individual of that single type. What I mean by saying that this concept is primitive can be put in a number of ways. One way is to return to those two questions I asked earlier: viz. (1) why are states of consciousness ascribed to anything at all ? and (2) why are they ascribed to the very same thing as certain corporeal characteristics, a certain physical situation etc ? I remarked at the beginning that it was not to be supposed that the answers to these questions were independent of each other. Now I shall say that they are connected in this way: that a necessary condition of states of consciousness being ascribed at all is that they should be ascribed to the very same things as certain corporeal characteristics,

a certain physical situation etc. That is to say, states of consciousness could not be ascribed at all, unless they were ascribed to persons, in the sense I have claimed for this word. We are tempted to think of a person as a sort of compound of two kinds of subjects: a subject of experience (a pure consciousness, an ego) on the one hand and a subject of corporeal attributes on the other".... "The concept of a person is logically prior to that of an individual consciousness. The concept of a person is not to be analysed as that of an animated body or an embodied anima".

b) *BELIEF*, as a blending of mentalistic dispositions to think and overt dispositions to action. Quoting from Armstrong (1973) "... (Ramsey) attributes two characteristics to belief: it is a map, and it is something by which we steer."..."If we think of beliefs as maps, then we can think of the totality of a man's beliefs at a particular time as a single great map of which the individual beliefs are sub-maps. The great map will embrace all space and all time, past, present and future, together with anything else the believer takes to exist, but it will have as its central reference point the believer's present self." "This great map, which is continually being added to and continually being taken away from as long as the believer lives, is a map within his mind." "The belief-map will include a map of the believer's own mind, and even, as a sub-part of this sub-part, a map of the believer's belief-map (that is, his beliefs that he holds certain beliefs). But this entails no vicious infinite regress. If you try to make a complete map of the world and therefore try to include in the map a complete map of the map itself, you will be involved in an infinite series of maps of maps. But since the belief-map is not a complete map of the world, and since the map of

itself that it contains is even more incomplete, the situation is no worse than those actual pictures which contain, as part of the scene pictured, little pictures of themselves.

"In the case of ordinary maps a distinction can be drawn between the map itself, and the map-reader's interpretation of the map. No such distinction can be drawn in the case of beliefs. We do not read off our interpretation of reality from the data supplied by our beliefs. Our beliefs are our interpretation of reality"..."Beliefs are to be thought of as maps which carry the interpretations of reality within themselves.

"Beliefs are maps by which we steer. Unlike entertained propositions, beliefs are action guiding. Entertained propositions are like fanciful maps, idly scrawled out. But beliefs are maps of the world in the light of which we are prepared to act."

Several of our critical psychological concepts are polymorphous (Ryle, White) or multicriterial (Rescher, 1973) and fact-organized.

(1) They are polymorphous or multicriterial because a plurality of in principle separable components enter in.

(2) They are fact-organized because the theoretically separable facts are held together in an integrative fusion by facts or purported facts (i.e., by a view of how the world actually works).

In our specific case - attention - both factors: a mutual state and a behavioural activity, must come together before it is proper to speak of 'attending'. The ascription of a mental state alone is not sufficient to establish that a person attends to something if his every act denies this. But on the other hand behavioural activity alone will not settle the matter either, for if there is sufficient evidence that his mental state indicates in every conceivable way

that he is not attending then the behaviour is irrelevant. All of the appropriate facts must be co-present before we can unproblematic speak of attention. Otherwise we could not appropriately say purely and simply that X attends to S, but would have to use some suitably complex circumlocution, "X while not perceiving or thinking about S acts as though it were" or "X, though perceiving or thinking about S does not behave in an accordant fashion", or something on these lines.

In nonstandard cases such circumlocutions are always necessary. In the standard cases the various criterial factors must work together. At the base of such a concept, lies an empirically implicit co-ordination that places the various critical factors into a reciprocally corroborative relationship. Our concepts are, in general, "theory presupossing". The theory at issue is such that, things being as they are, certain factors always or standardly work together in mutual presence.

Concepts of the kind noted above rest on presuppositions whose aim is factual, reflecting a view of how things go in the world. Such concepts are developed and deployed against a fundamentally empirical background. In this way the theory does not impel us to make up our mind as to which of the plurality of factors involved is ultimately determinative or decisive.

In conclusion we can say that many of the psychological concepts of central interest are "collage-like": they are internally diversified combinations of logically separable elements that are held together by the bond of a theoretical view of the empirical facts. Such concepts rest in an essential way on an empirically based, fact-pervaded vision of how things work in the world.

When the analysis of such fact-organised concepts is at issue we cannot make a neat separation between analytic and empirical truths. With these concepts (i.e., attention) semantical and factual considerations become intertwined. Of course, pure analysis can bring the fact-request aspect of the concept to light, but it can in no way lessen or remove this empirical aspect.

The acceptance of this conceptual scheme means that our concepts are not framed to suit every possible world but in significant measure are adjustable to this one. Such inseparability of empirical from logico-conceptual considerations constitute an important theme in Kant (cf. Strawson, 1966).

One important consequence of the above view is that if we are serious enough about the descriptive clarification of the way in which we standardly use certain psychologically central concepts, we cannot avoid the task of investigating the 'view of reality' that underlies them and provides their indispensable foundation. And this inquiry is in significant measure empirical and not purely semantico-analytical.

[2]

The classical approach to study mental activity consists in the study of the processes of cognition, will, sensation, etc. In this way it is considered that all these processes are given directly and initially, and that a detailed analysis of mental processes can lead directly to the knowledge of the laws of human mental life and to the elucidation of the distinctive features of our behaviour.

Although the active participation of the subject is acknowledged, the psychologist's and layman notion of personality, is constructed out of the concepts of mental processes. In a sense the subject's

personality is an arbitrary concept, deduced from the special concepts of human mental activity, but nevertheless it is proclaimed as the origin and basis of a subject's mental life.

There is no doubt, however, that it is the subject himself, and not the individual mental acts, that takes part in his active relationships with the outside world. If this fact is taken as the starting point, we must start not with the concept of individual mental processes, but with the concept of the subject himself as a whole - who when taking part in some form of interaction with the outside world, becomes forced to employ his individual mental processes.

The starting point in the study of cognition has been the concept of mental states, which are not phenomena of concrete mental activity, but which are undoubtedly abstract, radically separate from the living reality of the subject's activity. However, our primary task should be the study of this activity for it is the basis out of which arises the whole structure of mental function.

We are compelled to undertake the analysis and study of the principles of the subject's activity insofar as this activity is the basis on which mental life grows and develops. With this interpretation of the subject's mental activity, we must begin the task by investigating the subject (the person-ality) as a whole and not the individual elements of his mental activity. The study of this sphere of reality will show us that the mental activity of a subject, essentially, consists of further specifications or definitions of the subject, definitions of his integral personality, i.e., definition of a person. (Strawson, 1959).

[3]

In examining the problem of attention and cognition in general, we have to consider the significance of the notion of activity in any interpretation of how these processes are determined.

Two approaches are generally used to tackle this question. One of them postulates the direct dependence of those phenomena on the various influences exerted upon a subject receptive system. The main task of researching this approach is to establish the quantitative dependence of sensations on the physical parameters of the stimuli affecting the sense organs. This research is thus based on the 'stimulus-response' pattern.

The limitations of this approach lie in its model of a passive subject influenced by a world of objects. In other words, this approach ignores the significant element of the actual relations of the subject with the outside world; it ignores his activity. Such abstraction is, of course, admissible, but only within the bounds of an experiment intended to discover certain properties of elementary structures and functions contributing to the realization of certain mental processes. The moment one goes beyond these narrow limits, however, one realises the inadequacy of this approach, and it was this that compelled some early scholars to explain psychological facts on the basis of special forces; such as that of active apperception (Leibnitz). According to Leibnitz 'apperception' must be added to perception to produce a conscious sensation, and he repeatedly mentions 'attention' as a factor determining what will and will not be 'apperceived'. This appeal to the active nature of the subject, even in its later elaborated form (Wundt), was made only in a mystical form.

In order to overcome the difficulties created by the postulates of immediacy underlying the approach mentioned above, some scholars have stressed that the effects of external influences are determined not immediately by the influences themselves, but depend on their 'refraction' by the subject.

In other words, it is emphasized that external causes act through the medium of internal conditions. But this notion can be interpreted in various ways depending on what is meant by internal conditions. If they are taken to mean a change in the internal states of the organism, the notion offers us nothing new. Any object can change its states and hence manifest itself in different ways in its interaction with other objects. A hungry animal reacts to food differently from one that is well fed. It is another matter if by 'internal conditions' we mean the special feature of processes that are active in the organism. But we can ask: what are these processes that mediate the influences of the outside world reflected in the brain ?

The answer to this question lies, we would say, in acknowledging that these processes are those that realise an organism's actual life in the world by which he is surrounded, his social being in all the richness and variety of its forms. In other words, these processes are his activity. By activity, we do not mean the dynamics of the nervous, physiological or machine process that realise this activity. A distinction must be drawn between the dynamics and structure of mental processes and the language that describes them, and the dynamics and the structure of the person's activity and the language describing them.

The life of each individual is made up of a system of successive

activities. It is in activity that the transition or 'translation' of the object into the subjective mental state takes place; at the same time it is also in activity that the transition is achieved from the subjective mental state into activity's objective results. Regarded from this angle, activity is a process of intertraffic between opposite poles, subject and object.

Activity is a non-additive unit of the corporeal, material life of the material organism. In the narrower sense, i.e., on the psychological plane, it is a unit of life, mediated by a mental state whose real function is the orientate the organism in the world.

[4]

Reports of cognitive functions fall into different groups. Some report something of a dispositional nature - they do not imply anything about the person's present state of consciousness. Such reports could be true of them even if they were not conscious at that time at all - for instance, if they were asleep.

But other cognitive reports do seem to report something about a person's present state of consciousness. Reports that someone is now paying attention (though not necessarily all reports that may be called attentional reports) seem to be of this latter kind. To pay attention is to be in a certain phenomenal state of mind.

We can consider attention from a merely phenomenal point of view. We can talk about the physical effects attention have on those persons paying attention. But then we notice that these phenomena differ from other phenomenal states of mind such as bodily sensations, in that they are in some way directed. So we can ask what is involved in this. What do we mean when we say that a mental activity such as attention

has a directionality but a sensation does not ? In what way is someone's activity directed ? How does the directedness come in ? What determines the particular direction ?

If we approach the question in this phenomenal setting, we seem to be looking for some feature of the mental activity themselves, some feature of the phenomenal states of mind. What is this feature ? It was this sort of question that led Brentano to formulate his theory of intentionality. Brentano says:

"Every mental phenomenon is characterised by what the scholastics of the Middle Ages called the intentional (and also mental) inexistence of an object, and what we could call, although in not entirely unambiguous terms, the reference to a content, a direction upon an object (by which we are not to understand a reality in this case), or an immanent objectivity. Each one includes something as object within itself, although not always in the same way."

But again we can ask: what does it mean to say that a mental state refers to a content, or is directed upon an object ? How does it do this ?

Brentano allows that the object need not exist, and this seems quite natural if we approach matters in this way. When we try to analyse mental activity as thinking, where sometimes the object does not exist in the outside world, the directedness still seems to be there. This leads us to conclude that the existence of an appropriate item in the world and the relation of the mental activity to this item is not really relevant to the inquiry. We have been considering mental activity from a phenominal point of view, and then asking what its object-directedness consists of. We have taken the mental activity, and tried to discover when and how it hooked onto an object. The

fact that it makes no difference to the mental activity whether the object exists or not, tends to lead to an internalising of the object, with the consequent difficulties about the relation between the internalised object and items in the outside world. Indeed, the fact that mental activity relates to items in the outside world at all may appear mysterious.

The alternative approach we advocate, which may prove more profitable is to start with a person and an item in the world, and explore the relation between them. Persons and items in the world may be related in all sorts of ways. But sometimes a person and an item in the world are so related that the person has an actual present concern with that item. We can ask what has to be the case for this to be so. For example, if the item is an event, we can ask what has to be the case for the person to be reacting or responding to that event. Given that a person does have a present concern with an item in the world, we can look to see what determines the nature of that concern. We can ask what the particular force is of calling that item the object of the person's mental activity. Even if an event elicits a response in a person, the event cannot necessarily be called the object of that activity. Thus we take as our starting-point a person and an item in the world, and sketch in the relation between them.

Now, items in the world - people, objects, events, states of affairs, etc., - may bear different relations to one another. Thus any two people may be related as teacher to student, father to son or in many other ways. In our case, we are interested in the nature of a person's activity: object relation. There are many sorts of relations; for example spatial and temporal relations, relations of similarity and difference. But we are more interested in exploring

relations that explain what it is for two items in the world to be related as a person's activity to object.

In summary we maintain: the view of attention which considers only its phenomenon aspects lead to blind alleys, when we come to consider how some of the attentional characteristics i.e. directness - can have a relation to items in the outside world. The approach that looks more profitable is to study the relation of a person with the world - his activity - to explain the phenomenon better. Important as it is, the analysis of activity must not rest only on logic-semantics relationships. The analysis always 'refers-back' to a view of how things 'go on in the world'. It is empirical facts which hold together and keep an 'invariance' in any purported analysis of a phenomenon.

CHAPTER II

C Y B E R N E T I C S

[1]

Cybernetics was the term coined in 1948 in the publication of Norbert Wiener's Cybernetics or Control and Communication in the Animal and the Machine. Of course, many of the procedures and theories which are today considered part of cybernetics (e.g., data transmission, control theory) had been developed prior to this time. We can indicate as a first approximation, that cybernetics deals mainly with control processes and with the reception, transmission and processing of messages in complex, dynamic systems, whether they be technological systems, animals or social systems, and this is done with the help of scientific methods. (This characterization is similar to the one advanced by Wiener). 'Messages' has to be taken in its most general sense, viz., as processes or things with particular structures which play a role in these systems.

The development of cybernetics and the extensive use of his mathematical apparatus has proved successful in different areas. In psychology in particular one of the central notions of cybernetics, that of information, has been widely used to analyse different aspects of cognition: learning, perception, memory and so on. Further elaboration and refining of the notion of information resulted in an interpretation of other cybernetics notions like goal and feedback into 'informational terms'. Hence the notion of information is rather central to cybernetics. Sayre (1976) has expressed the above idea explicitly "(information)... concepts are appropriate for the explanation of both physical and mental events, and they provide the basis for a conceptual framework in which activities of both sorts can be coherently related (p 14)".

Questions about information have not only arisen in the context

of cybernetics or information theory. They have also come up in diverse contexts. One often hears information mentioned in reference to the natural and social sciences, and in technology. As a result there are many meanings - some technical, some from ordinary language - for the term 'information'. And this ambiguity brings with it a whole series of problems. We ought to start then with a short account of the notion of information.

In Latin 'aliquid informare' originally meant to form, to shape, etc. 'Informatio', therefore, indicated the activity of giving form to something.

In a figurative sense 'aliquid informare' also means to form an image or representation of something, i.e., to imagine something. In reference to the result of this imaging, then 'aliquid informatum habere' means to have an image of something. The original and derived meanings of informare have this in common - that an image of someone or something is designed, presented, depicted.

Accordingly, the word 'informatio' means image, derivatively representation and concept - both meanings being rooted in the notion of forming, plus the more specialized meaning of explanation or interpretation.

Besides, 'informare' can mean to educate or to instruct. This is why 'informatio' had the sense of instruction in medieval Latin.

In ancient French, the word 'information' was used in the singular 'une information', to mean both the process of collecting and ordering facts in an investigation, and the result, the legal document. All contemporary meanings of 'information' derive from the medieval and early French usages.

In ordinary language 'information' means knowledge, details,

'news', instruction. When in ordinary language it is said 'more information is needed', the idea is of something that can be accumulated and added. The idea underlying this quantitative mode of expression is made more precise in information theory. In everyday expressions information is always bound up with actual knowledge: 'to have information of something' and 'to receive information of someone'.

Already in ordinary language, information is connected with a human situation, with a communication situation. (Kirschenmann), 1970. Because a communication situation is most of the time a conscious human act, information is at least implicitly related to human consciousness. That partially explains why 'information' used in its ordinary sense is accompanied by elements of concreteness in the form of analogies to things and actions, of relations to men with consciousness and the ability to know, and of quantitative aspects.

Communication between people happens for the most part with the help of speech and writing. It is an exchange of information. If we start with an analysis of what information is in human communication as a fundamental one, we can always understand those aspects of information not directly connected with natural language as special cases, or extrapolations of the relations between language and information. As Kirschenmann has pointed out: "Language can be considered as 1) a psycho-physical activity which makes use of meaningful, articulated and graphically fixable acoustic signs, and 2) as a system of signs subjected to certain phonological, morphological, syntactic and lexical semantic activity. The essential characteristic of all linguistic phenomena is their sign-nature, i.e., meaningful structures signs which mean, name or represent something irrespective of why the designation was undertaken. It is only because linguistic phenomena

represent something that they can carry out the varied functions of human communication. One can understand (the concept of) sign as a generic concept for linguistic phenomena.

The study and importance of (the concept of) sign has been emphasized by Nauta: "The objective of a comparative study of Information in its full sense is not achievable without a thorough analysis of Semiotics (the general science of signs and of sign systems) in its modern coherence with System Theory and Cybernetics (the science of control and of the organization of goal-directed behaviour)"..."We will show that semiotics has a central place in the analysis and classification of information phenomena. To put it in other terms: Semiotics is a kind of "physiology of information processes". The theoretical apparatus of semiotics will be shown to furnish the most important framework for the classification of information (and its complex of cognate notions) in all its diversity, and for the understanding of relevant phenomena"..."But in order to equip semiotics adequately for its appointed task, we have (had) to modernize it by relating it with such congenial new disciplines as system theory and cybernetics", (1970).

SEMIOTICS - According to Morris (1946) Semiotics is the study of a comprehensive doctrine of signs. Its main subdivision being semantics, syntactics and pragmatics. Peirce (1960) defined it as the 'formal doctrine of signs' which is identified with logic, in its general sense. (Peirce Vol I, 1960).

We can consider a sign as a sense-perceivable physical event, a material entity (sign vehicle) or a spatial temporal process (signal). But for the event being a sign it has to fulfill two further conditions: 1) it is a sign only if it indicates, or stands for something else,

and 2) an event is a sign only in a sign situation or in a sign process (Semiosis)[1]. The two above factors can contribute differently from case to case.

In a semiotics, pragmatically oriented,

the sign situation includes three components: material events (sign vehicles) which play the role of the sign; in its function as a sign, the sign vehicle refers to something, the *DENOTATUM*; it also has a special *EFFECT* on the attitude of the interpreter; this alteration is called the *INTERPRETANT*. One can include as a fourth component - closely bound up with the third - the interpreter himself.

As a summary we can describe a sign situation, sign process or semiosis (ZS) as a relation of several terms. Designating the event by "S", the *DENOTATUM* with 'D' and the interpreter with 'I', the semiosis or sign situation can be formulated as:

$$ZS(I,D,S)$$

This relation is to be read as 'S stands for D to I'.

It is normally stressed that if one treats I as a black box (an open system) and S as its input, one has to be very careful and regard the effect of the interpreter as a change in the inner state of the system, involving an alteration of the pattern of future outputs of I. This idea of (open) system and inner states is tremendously important in Cybernetics (see Chapter IV, Section 3).

Most of the time 'single' signs are elements of a system of signs. Thus words are always components of a language. According to Morris (1960) we distinguish three dimensions of the sign:

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(1) The term semiosis was introduced by Morris to define a process in which something is a sign to some organism.

(1) The relations of signs to each other. This dimension is the syntactic one.

(2) The relations between signs and what they stand for. This dimension is the semantic one.

(3) The relations between the signs and the users (interpreter and interpretant). This dimension is the pragmatic one.

Of course, because of the very complex nature of sign situations, it is not always very easy to distinguish these relations in a unique way. For example, if a sign designate another sign this relation is mainly semantic. Sometimes the semantic and pragmatic dimensions are hard to separate.

We have been taking as a sign the whole make up of the sign vehicle and semiotic relations. But it is worth mentioning that some authors hold that only the designational role of an event should be called 'sign'. There are some peculiarities of signs which seem to justify this view:

a) Signs are always phenomena of mediation: they always mediate what they stand for (nothing is a sign of or for itself) and most signs are also mediational events in the social life of the users.

b) It is not the whole sign vehicle but only certain aspects or structures of it which fulfill the sign role. For example, two identical signs can always (as physical entities) differ and yet can mean the same thing.

c) All signs imply sign users to whom the signs stand for something and who carry out the abstractions. It is people, persons who decide that two different physical signs are to be seen as identical.

If one neglects the details of the pragmatic dimension of the sign, one often tends to describe the relation between the sign and

that which it represents in an inaccurate way. For example it is commonly said: language is the 'carrier of meanings' or 'transmitter of information'. In such expressions, information or meaning is seen as something independent which is 'contained in' the linguistic sign, is 'transmitted' from place to place and 'received' by someone. But only the user and the perceptible sign vehicle are really autonomous and independent of a special role in a communication sign situation. It is only through the mental acts of the user that the sign stands for something. The connection between meaning and 'carrier' results from their being associated with one another by the user. The illusion of 'carrying' and of 'transmitting' is based on the usually great determinancy of this association.

[2]

Information theory (or communication theory) is connected with the developments of telecommunication engineering in the first half of the present century. The semiotic origin of the modern information concept can be traced back to the second half of the last century in the work of Pierce (Vol I, sections 537 and 539). Its main task is to make communication and signal processes available to structural and quantitative approaches where statistical viewpoints play an essential role. Hence, it deals with certain aspects of the linguistic and semiotic processes. The quantitative treatment of Information, and of the diversity of current information concepts, is based on the ideas of the analysis of physical signals published by Hartley in 1928 which in turn can be traced back to a paper by Nyquist (1924). In dealing with communication processes using the mathematical theory of information, factors like value, utility, relevance, meaning, are

not examined. The term 'information theory' is deceptive if 'information' is taken in its ordinary sense. Basically, information theory is a general theory of signals and their transmission (Hartley). However, as Bar-Hillel (1964) has shown, the ambiguity of the word information has daunted information theory from the start:

> [Hartley's amount of information of a signal sequence was meant to be just] a certain function of the relative frequency of this sequence amongst the set of all possible sequences of the same length... However it is psychologically almost impossible not to make the shift from the one sense of information, ... information = signal sequence to the other sense, information = what is expressed by the signal sequence ... Therefore, we see over and over again, that ... 'amount of information', officially meant to be a measure of the rarity of kinds of transmission of signal sequences, acquires also ... the connotation of a measure (of the rarity...) of the kinds of facts ... designated by these signal sequences. And ... it turned out to be humanly impossible not to believe that one has got some hold of this important ... concept on the basis of such a simple procedure as say counting frequencies of letter occurrences in English (p 283).

> [Hartley] points out the important connection between this measure of information and certain processes of selection. The larger the set of signals from which the sender chooses [his message signals] ... the more complex the ... selection. At each selection there are eliminated all of the other symbols which might have been chosen... As the selection proceeds more and more pssible symbol sequences are eliminated and we say that the information becomes more precise. For example, in the sentence, 'apples are red', the first word eliminates other kinds of fruit ... and all other objects in general ... the third eliminates other possible colours'.

The fallacy is that the 'first word' eliminates other words (other signal sequences), even other words for apples, instead of eliminating other kinds of fruit or objects.

The problems dealt with in information theory in the narrower sense relate to situations where communication processes take place. Besides of dealing with linguistic elements, information theory has to deal with communication devices which intervene between communication partners.

The process of communication can be broken down into several operations:

M: the production of an original message (including all the conditions of production); E: the encoding of this message into a symbol sequence; S: the transformation of the symbol sequence into a signal; T: the transmission of the signal through a channel; S*: the reconversion of the signal into a symbol sequence; E*: the decoding of the symbol sequence into the original message; and R: the reception of the message (including the understanding of the message or the reaction to it.)

The whole communication process consists in the sequential carrying out of these operations, i.e., the total operation 'RE*S*TSEM'. (Any operation standing to the left affects the result of the previous operation, standing to the right). In information theory the central position is the most important i.e. 'E*S*TSE'. Procedures that use abstract mathematical models for the communication process or its individual members belong to statistical information theory.

It is a characteristic of statistical information theory that messages or their production are treated as random processes. The basic idea is that messages, in which the symbols follow each other in a familiar order provide no information. Information measures are defined on this basis. Hartley was the first to consider message transmission from a mathematical point of view. He conceived the message source as an emitter which equipped with a setM of n symbols successively selects symbol after symbol with identical probability. The result is a symbol sequence of a finite length of N symbols. He set himself the task of finding for such messages an *INFORMATION*

MEASURE which continuously grows with the number z of the symbol sequences and which is proportional to the length N of the message. He showed that these conditions are satisfied by

$$H_o = \log_z = \log_n{}^N = N \log n$$

The measure sought by Hartley is determined by the stated conditions only to a multiplicational constant K. Hence, one can write: $H = K. \log z.$ If one takes the logarithm to the base 2 it makes K = 1. One then obtains $H = \log_2 z$ as information measure. This unit of information is defined as the amount of information of a selection of equally equiprobable alternatives and is called 'bit', an abbreviation of 'binary digit'.

The problem that Shannon set himself to solve can be described in the following way: How can one encode or represent the messages of the source by means of electrical signals so that despite disturbances which can lead to transmission errors, one attains the fastest and surest transmission of them ? The solutions presupposes to find mathematical descriptions for the source, the channel, the signals, the disturbances in the channel, and the encoding operations, which can be related to one another. Shannon conceived the production of symbols as a stochastic process, i.e., as a random process subject to certain laws of probability and to take the message source itself as an ergodic source. An ergodic source is a special case of a stationary source. A stationary source produces symbol sequences with a constant frequency of each symbol in any subsequence, that is with constant time averages. A stationary source is called ergodic if every possible average of ensembles of symbol sequences produced by the source separately at different times (ensemble average), is equal to the corresponding time average. If one takes a message production as a

stochastic process, Hartley's ideas are generalized and is no longer assumed that the selection of the different symbols occurs with the same probability. Mathematically to every symbol i of the set M of n symbols is assigned a production probability p_i and these probabilities can be different from one another.

A complete exposition of information theory is beyond the limits of this short sketch. There are many good books dealing with it (Shannon and Weaver, 1962; Abramson, 1963). We can only aim to give a short account of the fundamentals of the theory: Let a situation S define a set M of n events (elements of this set). For the set M let a measure P be so defined that every element i of M is assigned a real number p_i between 0 and 1 as probability, where $\sum ip_i = 1$. The following solutions are given in an interpretation of the mathematical formula: S is a message source. The production of a symbol i is an event; M is made up of the symbols contained in the inventory of the source; p_i is the relative frequency with which symbol i will, over sufficiently long periods of production, be produced by the source. The magnitude defined by formula $I_i = -\log_2 p_i$ is a logarithmic measure for the improbability of event i. The entropy, $H(M) = -\sum ip_i \log_2 p_i$, is the mean value of the measure I_i - weighted with the corresponding probabilities p_i - of all events i of the set M, i.e., a measure of M itself.

[3]

From the beginning, the conceptual tool of Cybernetics has been used to elucidate some of the problems associated with organisms and the directedness of their behaviour, hence the introduction of the concept of negative feed-back i.e, 'the behaviour of [the organism] controlled by the margin of error at which the [organism] stands at

a given time with reference to a ... goal' (Rosenblueth Wiener and Bigelow, 1943). This concept (of feedback) was used by Wiener and his collaborators to 'introduce a weak concept of purposeful behaviour and a stronger one of teleological behaviour' (Bennett, 1976). Wiener's account of the former is: "the term purposeful is meant to denote that the act or behaviour may be interpreted as directed to the attainment of a goal - i.e., to a final condition in which the behaving object reaches a definite correlation in time or in space with respect to another object or event" (p 18 loc. cited). Richard Taylor, (1950) has pointed out that this definition is so broad as to be vacuous. The aim is to account for the purposes of systems in terms of where 'they end' rather than in terms of how they get there (Bennett). Weiner calls purpose behaviour teleological if it involves negative feedback. Negative feedback allows an agent to handle an environment which changes faster than the agent can act. But not all teleological behaviour requires the existence of feedback as Wiener himself admits: "A snake may strike at a frog, or a frog at a fly, with no visual or other report from the prey after the movement has started. Indeed, the movement is in these cases so fast that it is not likely that nerve impulses would have time to ... modify the movement effectively". Nor is any system with feedback a teleological one. Compare the many and sophisticated feedback existent in a radio device for example.

It seems that what is needed is to clear up the notion of teleology and then see if it helps to understand and explain the directedness of organisms. One of the recent attempts to deal with this problem is the one initiated by Sommerhoff (1950). Nagel's theory of directive organisation was based on it. Sommerhoff uses

the notion of 'directive correlation' to explain aiming goal directed behaviour (Woodfield, 1976). The exposition of teleological behaviour given by Charles Taylor in the Explanation of Behaviour (1964) is a direct descendent of Sommerhoff's view. An exposition and critique of both theories can be found in Woodfield (1976).

Perhaps as a first approximation to the elucidation of teleology we ought to consider the logical structures involved in teleological explanations[1]. Most people would take the idea of natural science, as mainly and only deductive as a very sound one. Natural science being organized in Euclid-like deductive systems. But the feature of reasonings that relate to efficient causality is different: "In geometrical reasoning if from a figure's having characteristics P, Q, R it follows that the figure has characteristic S, then no added characteristics of the figure can defeat this conclusion. But if from the action of causer X, Y, Z there would follow an effect E, the following may be nullified if the further causal factor W is present". (Geach).

In order to account for efficient causality notions like prevention and interference has to be brought in. That is why it is not possible to assimilate the following of effect upon cause to entailment. The notions of interference and prevention allows to look at causal laws as stating what happens if nothing interferes and not what de facto always happens. But if this is the case, the notion of tendency - 'how things go on in the world' - is important in any account of efficient causality, and tendency is a teleological notion. If we try to describe the characteristic behaviour of an agent in a coherent

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(1) I have been influenced by Les Johnson in my view about this subject. He has drawn my attention to the works of Kenny (1966) and Geach (1972, 1975).

way, the only possibility open to us is to describe it as acting in order that so-and-so happens.

When we consider sentences we distinguish, following Frege, between sense and reference. With no change in reference, sense is the heart of the matter when we are concerned with knowledge, opinion or supposition. But the achievement of a state of affairs is independent of the mode of presentation. Because of the relative indifference to sense we may expect this indifference to be complete in pure teleological statement. The logical form of a teleological statement might read 'p in order that q' with 'p' and 'q' to represent prepositions. As Geach (1975) maintains 'p in order that q' is not a truth-functional compound of 'p' and 'q' and what is present here is a kind of limited extensionality. The logical role of 'q' is analogous (connected with) the role of 'q' in 'a brings it about that q'.

Taken teleology, final causation, seriously means that 'p in order that q' must not be reducible to the form 'p because a desired, intended, wanted that q'. This last form is rather a special sort of efficient cause not a special sort of causation. The systematization of teleological thinking is linked to the pattern of human practical reasoning, in its skeleton that is, (Geach, 1975). The limited extensionality of teleological propositions comes about from the connection between teleological reasoning and practical reasoning, reasoning with directives (fiats) as premises and conclusion.

There is an important distinction between standard logic and practical reasoning: the conclusion can be *DEFEATED* by the addition of new premises. In standard logic the addition of a premise cannot invalidate a previously valid inference: if a conclusion is drawn

from a set of premises, then it is validly drawn from any set of premises containing those premises. That is not the case in practical reasoning unless the premises setting out a goal are not only correct but *COMPLETE*. But only in restricted context can we approach completeness, if any. This sort of reasoning needs the support of something like decision theory (Johnson, 1978): "Where an agent's goals are consistently realizable, then consideration of the advantages and disadvantages of particular actions can be seen as the search for conclusion fiats derivable from the goal fiats which incorporate all events which provide the standards of advantage and disadvantage for the case in point. But, there is no guarantee that the ends are capable of joint attainment, and thus we need something like decision theory".

In teleological explanations we are concerned about what tendencies will exist when certain agents operate; what actually happens is the resultant of the operating tendencies. We need in this realm the same skill needed to solve conflict of goals. We cannot avoid teleological thinking and we need to be more conscious when we are engaged in it.

CHAPTER III

C O N S C I O U S N E S S

[1]

Since the appearance of Gilbert Ryle's book 'The Concept of Mind', an attempt to analyse the meaning of consciousness as it is ordinarilly used would have to face the objection of Ryle who argues, that the word is ordinarily used in a number of different contexts for a variety of purposes. In Chapter VI (Self-knowledge) of the mentioned book, Ryle analyses different uses of the word 'conscious' in real life. It is perhaps useful to quote him at large:

"a) People often speak in this way; they say 'I was conscious that the furniture had been rearranged', or 'I was conscious that he was less friendly than usual'. In such contexts the word 'conscious' is used instead of words like 'found out', 'realised' and 'discovered' to indicate a certain noteworthy nebulousness and consequent inarticulateness of the apprehension....

"b) People often use 'conscious' and 'self-conscious' in describing the embarrassment exhibited by persons, specially youthful persons, who are anxious about the opinions held by others of their qualities of character or intellect....

"c) 'Self-conscious' is sometimes used in a more general sense to indicate that someone has reached the stage of paying heed to his own qualities of character or intellect, irrespective of whether or not he is embarrassed about other people's estimation of them....

"d) Quite different from the foregoing uses of 'conscious', 'self-conscious' and 'unconscious', is the use in which a numbed or anaesthetized person is said to have lost consciousness from his feet up to his knees. In this use 'conscious' means sensitive or sentient and 'unconscious' means anaesthetized or insensitive. We

say that a person has lost consciousness when he has ceased to be sensitive to any slaps, noises, pricks or smells.

"e) Different from, though closely connected with this last use, there is the sense in which a person can be said to be unconscious of a sensation, when he pays no heed to it. A walker engaged in a heated dispute may be unconscious, in this sense, of the sensation of his blistered heel, and the reader of these words was, when he began this sentence, probably unconscious of the muscular and skin sensation in the back of his neck or in his left knee. A person may also be unconscious or unaware that he is frowning, beating time to the music, or muttering.

"Conscious in this sense, means 'heeding' and it makes sense to say that a sensation is hardly noticed, even when the victim's attention is fixed very strongly on something else....

The use of the word 'conscious' in all the previous senses is not the matter of discussion. It seems more important to see if any of the senses can be taken as basic, the other being derived or defined in terms of the basic sense. Ryle seems to assume that these several uses are all on a par with one another - none being more basic than any of the others.

Another important analysis of the term 'conscious' was made by John Wisdom (1963/1934) and because of its importance we will quote it at large too:

"I cannot analyse what I mean by 'conscious', but I want to make known to you what I attribute to a thing when I call it 'conscious'. When using the word in this special sense, I will write it *CONSCIOUS*, and I will now set down the clues to what I mean by conscious.

"(i) *CONSCIOUS* implies either feels or is aware

"(ii) Consider the change which comes over a man as he comes round from choloroform or from dreamless sleep. You know quite well the change I mean. That kind of change I call 'becoming *CONSCIOUS*'. Of course, as you come round from chloroform, all sorts of bodily changes are taking place - the nerves are recovering from the chemical poison; and as you come round from sleep, more blood flows to the brain. So that, strictly, there is nothing that can be called 'the change' which takes place when one comes round from chloroform and sleep. Nevertheless, these bodily changes are not ones you thought of when I spoke of the change; you never thought of blood and brain. That kind of change which you immediately thought of when I spoke of the change from sleep or chloroform, is the one I express by 'becoming *CONSCIOUS*'.

"(iii) *CONSCIOUS* does not mean alive. A tree is alive but not conscious. An amoeba is certainly alive, yet quite likely not conscious.

"(iv) *CONSCIOUS* does not mean living and sensitive. A man in a dreamless sleep is a living and sensitive being; but he is not at that time conscious in my sense, i.e., *CONSCIOUS*. Of course, such a man is conscious compared with a tree or a dead man; more accurately, there is a sense of 'conscious' in which it is correct to say that he is a conscious being. He is conscious in the derived and hypothetical sense that, if he were shaken, he would become *CONSCIOUS* (fundamental sense).

"This hypothetical sense of 'conscious' is less fundamental than that in terms of which mental facts are to be defined that is *CONSCIOUS*. For 'conscious' (in this hypothetical sense) has a meaning derived from, i.e., defined in terms of *CONSCIOUS*. In other words, if we split up the meaning of the hypothetical sense, we find that one of its elements

is *CONSCIOUS*....

"(v) S is *CONSCIOUS*, implies neither (1) that S is conscious of his environment nor (2) that S is conscious of himself. As to (1) a man is conscious when he is dreaming... and therefore when unconscious of his environment. I do not deny, on the contrary, I assert, that there is a usual and therefore perfectly respectable sense in which 'conscious' is used, which does imply 'conscious of his environment'. Thus when we say 'Is he conscious?' meaning 'Has he regained consciousness?' (after an accident) we do mean 'Is he now again conscious of his environment?' But it will be seen that this third way of using 'conscious' is yet another sense derived from our first, that is, the sense we write *CONSCIOUS* (sense 3) means 'conscious of environment'.

"As to (2), a man may be conscious and yet unconscious of himself... It is important to add clause (2) because some psychologists use 'conscious' in a sense which implies consciousness of self. Thus they would deny that animals are conscious, because, although they would admit that dogs smell bones and are therefore *CONSCIOUS*, they would deny that a dog ever thinks to himself, 'I shall do so and so', e.g., 'take a bone'. In other words, they deny that an animal is ever conscious of itself and they express their view very misleadingly by saying that animals are not conscious. This fourth sense of 'conscious' is obviously also derived from *CONSCIOUS*. So we may write:

"(vi) *CONSCIOUS* is the fundamental sense of 'conscious' - that is the sense in terms of which all other senses are defined."

We must notice that Ryle's list of the possible usages of the word 'conscious' in ordinary language, is a different type of list from Wisdom, who reveals a number of possible philosophical distinctions if we take 'conscious' in various senses. On the other hand,

Wisdom analysis allow to correct the ambiguities in Ryle's description of sense (d) ('self-conscious' and 'unconscious').

Wisdom believes that a fundamental sense of 'conscious' may be distinguished. Besides he asserts that the other senses of consciousness can be defined in terms of the fundamental sense. We must, along with Evans, assert that the other senses entails the basic sense, but they are not entailed by it.

[2]

We must work along some line to see if we can find a workable definition of consciousness. First we must remember that the denial of consciousness (Hamilton) or its 'reduction' (Ryle, White) for others more appropriate terms, should not be looked upon as denying the 'existence' of consciousness, but rather some particular theories put forward for it.

In a passage of one of his books, James Mill when talking about consciousness, says:

"It is easy to see what is the nature of the terms conscious and consciousness, and what is the marking function which they are destined to perform. It was of great importance for the purpose of naming, that we should not only have names to distinguish the different classes of our feelings, but also a name applicable equally to all those classes. This purpose is answered by the concrete term conscious; and the abstract of it consciousness. Thus, if we are in a way sentient; that is, have any of the feelings whatsoever of a living creature; the word conscious is applicable to the feeler, and consciousness to the feeling; that is to say, the words are generical marks, under which all the names of the subordinate classes of the feelings of a sentient

creature are included. When I smell a rose, I am conscious, when I have the idea of fire, I am conscious, when I remember, I am conscious, when I reason, and when I believe, I am conscious; but believing and being conscious of belief, are not two things, they are just the same thing I can name at one time without the aid of the generical mark, while at another time it suits me to employ the generical mark".

I hasten to say that the faulty example at the end of the passage is due to the lack of distinction between dispositional and episodic senses of mental states.

Mill's definition of consciousness is in terms of the experiences of seeing, hearing, feeling, thinking, imagining, etc. The relation between consciousness and the variety of conscious phenomena can be explicated in terms of a technical term used for Ryle - polymorphous concept. Accordingly, consciousness is a polymorphous concept.

[3]

White, (1964, 1967) following Ryle (1951) distinguishes between a specific concept, such as singing, presenting arms, or counting, and a polymorphous concept, such as working, practicing, or obeying. "A concept X is polymorphous - that is, one that takes many forms - if there are many different things one or another of which can, in certain circumstances, count as X, and yet none of which activities in other circumstances count as X. It is the second of these two conditions that distinguishes a polymorphous concept such as obedience, from a generic concept, such as perception... "Any word that expresses a polymorphous concept does not name some specific thing; it indicates the relationship of that thing to its circumstances, and thereby signifies what, on this occasion, it is a form

of"..."A very simple example of a polymorphous concept is the concept of repetition. What makes anything a repetition cannot be any feature that is peculiar to the specific thing done.. For, first, anything whatsoever, if it is done for the second time, is a repetition, and nothing whatsoever, if it is done for the first time, is a repetition. Secondly, whatever counts as a repetition of X cannot itself differ from X. What makes 'repetition' a true description of anything is the circumstances in which it is done - namely, that it has been done before".

To give an explanation of a term using 'verbal' definitons is quite common if we can produce some good examples where the term plainly applies. Plato represents Socrates as objecting to this procedure: unless we already know quite well what the term means, there will be no unexceptionable examples to show us; so examples are useless anyhow. The truth is that if misunderstanding arises it may be resolved either by producing criteria for using a term, or by giving good clear examples: we can work from examples to get criteria that will fit them, and we can use criteria to apply the term to new examples. In any case, the terms used in the definitions consist of terms already understood by the hearer. This 'verbal' definition can only be given to practiced language-users. (cf. R. Robinson's book Definition O.U.P. 1972). Thus following Mill, we can say that to be conscious is to perceive, to feel emotions and sensations, to have images and recollections, and to have desires, intentions and thoughts.

As we are using consciousness - a polymorphous concept - of several instances of our experience, we are dispensed of thinking that there are something more to consciousness that our actual

occurrences. But there is the temptation to think of consciousness as the sum of determined experiences at any moment consciousness conceived as a mosaic of particular experiences, as it were. If we go along and equate consciousness with the name of a class of mental 'events', then it must be possible to define the class extensionally by denoting all the members belonging to it. This view of consciousness is the classical atomistic view of consciousness. We must maintain the distinction between objects as a class and concepts (see Geach, 1972).

It is difficult to find a topic-neutral word to refer to the experiences of which consciousness is comprised. Evans uses the expression 'element(s) of consciousness - 'elements' for short -' but even this term suggests a certain atomistic independence of one element from the next. Besides the need to refer to the 'elements' of consciousness it is also necessary to refer to their temporal relations to one another. This twofold manifestation of consciousness has been termed different by different authors. Grice (1941) has referred to the contemporaneous elements as a 'total temporary state' of consciousness. A continuous succession of elements, Grice refers to as a series of total temporary states. Grice defines a total temporary state as follows:

"A total temporary state is composed of all the experiences any one person is having at any given time. Thus if I am now thinking of Hitler and feeling a pain, and having no other experiences, there will be occurring now a total temporary state contining as elements a thought of Hitler and a feeling of pain. Now since total temporary states may be said to occur at various times, they may be said to form temporal series".

The above account allows for a total temporary state the possibility of containing but a single element, but that is left open as a theoretical possibility. The normal state of affairs is one in which total temporary states have a plurality of elements. It is indisputable to state the plurality of elements in a temporal state. In one sense, the efforts in artificial intelligence and related subjects of explaining and realising parallel and concurrent processes is but one of the expressions of this assumption. In everyday life we continue to have visual impressions when we hear a sound or when we have thoughts, or tactile sensations and so on. But even granting that a total temporary state contains a plurality of elements there remains the possibility of a series of identical total temporary states. In this case it would be perfectly normal to talk of a perfectly static consciousness in which no existing element dies out and no new element appears.

But the series of total temporary states are, normally, a series of changing elements where some elements 'will persist' from one state to the next, others will be new. The thesis that the series of total temporary states - consciousness - are dependent on change is not new, but it has been neglected one and again in the history of the subject. Ribot expresses it in the following way:

"All our organs of perception are at the same time sensorial and motor. To perceive with our eyes, ears, hands, feet, tongue, nostrils, movements are needed. The more mobile the parts of our body, the more exquisite is their sensibility, the less perfect their mobile powers, the more obtuse their sensibility. Nor is this all; without motor elements, perception is impossible. We will call to mind a previous statement that if the eye be kept fixed upon a given object

without moving, perception after a while grows dim, and then disappears. Rest the tips of the fingers upon a table without pressing, and the contact at the end of a few minutes will no longer be felt. But a motion of the eye or of the finger, be it even so light, will re-arouse perception. Consciousness is only possible through change; change is not possible save through movement. It would be easy to expatriate at great length upon this subject, for although the facts are very manifest and of common experience, psychology has nevertheless so neglected the role sustained by movements, that it actually forgot at last that they are the fundamental conditions of cognition in that they are the instrument of the fundamental law of consciousness, which is relativity, change. Enough has now been said to warrant the unconditional statement, that where there is no movement there is no perception."

More recently Kenny (1963) has expressed similar view: "On the other hand, not every part of the body which is necessary for a particular mode of perception is an organ of perception. Damage to the visual area of the cortex will make a man blind; for all that, the cortex is not an organ of sight as the eye is. What then is an organ of perception ? The concept is not entirely precise; but it seems that we shall not be far wrong if we say that an organ of perception is a part of the body which can be moved at will in ways which affect the efficiency of the sense in question. Thus, part of what is involved in the concept of sense-organ is expressed in such remarks as: 'you can see it if you look through this crack'. 'You can hear them if you put your ear to the wall'. 'If you don't like the smell, then hold your nose'.

The movement claimed to be necessary to consciousness cannot be understood as a simple physical movement. It must be looked upon as an aspect of action - of what the organism does. Our movements in this

sense, necessarily enter into descriptions of what we are doing. The sense organs must be identified in relation to their functions. It must be understood as that with which certain sorts of activity can be performed. Thus having a particular sense organ necessarily enters into a full description of a certain sort of doing. By relating consciousness to what we do - to our sense-organ activities - we can offer an explanation of the Kantian point that consciousness exhibits temporal succession. Our doings take time and involve a sequence of changes themselves, and in being aware of what we are doing, we are aware of some of these temporal changes. In this way, consciousness reflects temporal change.

CHAPTER IV

A C T I V I T Y

[1]

The account of what is traditionally referred to as our 'apprehension of the external world' uses the key notion of *CONSCIOUSNESS* which is the basic concept in all the traditional theories of mind. In his book 'The Concept of Mind' (1949) Ryle has attempted to show that 'heed' is the basic concept for the above account. In the same vein White (1964) has given support to the Ryle thesis.

It is because of the historical and conceptual links between attention and consciousness that we ought to start with a characterization of consciousness, i.e., the way we look and regard the phenomenon of consciousness. This short account will clear the path to a further consideration of attention and how the historical and conceptual link is going to be considered.

We must remember that in analysing the world, man has seen himself in a special status in the world. Man is distinct from the world around him. But that distinctive characteristic has been regarded differently by various thinkers.

Some have seen the difference as a static difference i.e., as a difference in the kind of elements man is composed of, and the kind of state it could be in at any particular time. Others have regarded the differences as a dynamic one i.e., as a difference in the laws which govern the alterations and their interactions with other things.

Contemporaneously we can discern two main views. Each view sees the difference not as a difference of degree of complexity of organi sation but as a difference in kind. One view considers that what marks off man from the inanimate objects around him is a matter of the elements of which he is composed, or the states which he can instantiate. Besides body and its different physical states man has a mind, or at

least mental states. This view is historically associated with Descartes and is termed the Cartesian view. The main assertion is that mental is not a form of the physical and is not reducible to the physical.

The other view gives an account of the differences between man and the world around him in terms of the laws which govern his behaviour and his interactions with other things. Man's distinctness is emphasized from a dynamic point of view, because his behaviour and reactions are governed by different principles and to be understood in different terms.

These two views of the special nature of man are not held together, although they are not inconsistent. It can be looked upon as a way of asserting that one of the determinants (material stuff or dynamic law) is not only necessary but sufficient (see above). We have already emphasized that in everyday concepts we cannot make a tidy ruling about the relative contribution of factors linked together in our common concepts. We assert that depending on the context we give more weight to one or another factor. In fact, in explaining the nature of man we must evaluate in each branch of enquiry: biology, sociology, etc., the relative importance of those factors.

We think that a better way of approaching the problem is through the useful notion of activity which allows us to explain the behaviour of the subject and his mental state at the same time. We regard activity as a process of *INTERTRAFFIC* between opposite poles, subject and object, and the one in which the transition or *TRANSLATION* of the object into a subjective image takes place. At the same time it is also in activity that the transition is achieved from the subjective

image into activity's objective results (see above).

The life of a subject is made up of a system of successive activities. Activity is a non-additive unit of the corporeal, material life of the individual. In the narrower sense i.e., on the psychological plane, it is a unit of life, mediated by an *IMAGE* whose real function is to orientate the subject in the world.

The word 'activity' is a very general word used to describe all sorts of goings on. This would lead one to expect that it did not possess a very strict logic of its own. However, activity in the generic sense of describing very specific kinds of change which cannot be described as precisely by means of any other concept, has been the concern of some thinkers (cf. Kenny, 1963; von Wright, 1963). The search is for a sense of the word 'activity' in which it is not implied that an activity is composed of a number of 'doings' that are not themselves activities. A definite distinction must be made between an activity and an action such that it is not the case that an activity consists of a succession of acts.

Sometimes 'activity' is used in a sense in which it has 'goings on' and 'doings' as instantiations which are not themselves activities. One example of this position is found in D.S. Shwayder, The Stratification of Behaviour (London 1965) "The activities of life are distinguished from acts one might do, possible when engaged in those activities. The background field of activity engaged in often provides the setting against which we may fix units of action. Also, we may begin to analyse a field of activity by specifying kinds of action necessarily or characteristically done when engaged in that activity". We are ruling out this sense of the word activity and are more concerned with activity in the generic sense depicted previously, i.e., a system of

activities.

We must draw a distinction already made by von Wright between the result of an action and the consequence of an act. The purpose of this distinction is to bring out two totally different ways in which an act may be connected with the changes affected by it. When the connection between the act and the change is intrinsic or logical, von Wright calls the change the '*RESULT*' of the act. When the connection is extrinsic (von Wright regards this extrinsic relation as primarily a causal one), the change is the '*CONSEQUENCE*' of the act.

For example, if the act is an act of opening the window, it is logically necessary for the window to be opening. The fact of the window opening is the result of the act. On the other hand, if the opening of the window caused the door to slam, the slamming of the door would be a consequence of the act of opening the window and not the result of an act.

von Wright gives two possible interpretations that may be given to the use of 'result': either the change corresponding to this act or, the end state of this change. Thus, by the result of the act of opening a window we can understand the fact that the window is opening (changes from closed to open) or the fact that it is open. This distinction has been labelled by C.O. Evans as $RESULT_c$ the change corresponding to the act and as $RESULT_e$ the end state of the change. Two possibilities present themselves: the agent may either bring about $result_c$ or $result_e$.

An activity may be identified in terms of these possibilities (Evans). An agent or subject is engaged in an activity (in the basic or generic sense) when he brings about a $RESULT_c$ and he does not stop as soon as $result_c$ comes about. An agent or subject is engaged

in a performance when he brings about a $RESULT_e$ and it takes time for $result_e$ to be produced.

In this way the contrast between an activity and a performance can be put: the result in an activity holds at all times from beginning to end; in the case of a performance the result is only fully realized at the termination of the performance.

Kenny (1963) gives logico-grammatical criteria to distinguish between activities and performances. If the verb describing the activity or performance is represented by 'has ϕed' then the distinction is possible as follows: in the case of an activity 'A is ϕing' entails 'A has ϕed', in the case of a performance 'A is ϕing' entails 'A has not ϕed'. Performances are completed; activities just stop. Performances take time, while activities go on for a time.

Another important distinction to be drawn is between an activity and a state. An activity is a sort of doing of an agent; a state is not a sort of doing at all. We talk of the state of a subject or thing or conversely, of a person or thing being in a certain state. A person is in a state when he is undergoing something or something is happening to him; and 'undergoings' and 'happenings' are not 'doings'. It must be granted that a person may be able to induce a state, or put himself in a state, but this only means that he is able to bring about the conditions that give rise to the state; it does not mean that he brings about the state itself.

We must recognize non-dispositional as well as dispositional states. In the case of a dispositional state a person may be said to be in a state under conditions in which he is undergoing nothing in connection with it at the time. In contrast there are occurrent states which a subject can only be said to be in when he is actually undergoing a

certain experience at the time.

The concept of state also implies the idea of its persistence through time. States last for a time. Activities and states have in common that they are both continuous through time, but activities may be said to go on for a time, whereas states last for a time. It is possible to distinguish a thing's state from its circumstance. A state is always a state relative to some prior classification of the thing under consideration. In relation to that classification the state is an accidental or changeable feature of the object.

[3]

We have been considering activity as a very important notion in the explanation and understanding of the life of a subject and we have emphasized the fact that the life of an individual is made up of a system of successive activities (the elements of that succession are themselves activities). The important thing to notice is the emphasis of the concept *SYSTEM* because it brings to light the whole tool and methodological considerations of General Systems Theory (G.S.T.) In the same way by remarking the notion of activity as an *INTERTRAFFIC* between subject and object we bring to light the whole consideration of cybernetics and particularly the notions of information and control.

The methodological principles for the study of systems originally evolved within the framework of 'organismic' ideas in biology. In the late 1920's von Bertalanffy wrote: "Since the fundamental of the living thing is its organization, the customary investigation of the single parts and processes cannot provide a complete explanation of the vital phenomena. This investigation gives us no information about the co-ordination of parts and processes. Thus the chief task of

biology must be to discover the laws of biological systems (at all levels or organization). We believe that the attempts to find a foundation for theoretical biology point at a fundamental change in the world picture. This view considered as a method of investigation, we shall call "organismic biology" and, as an attempt at an explanation, "the system theory of the organism" (in von Bertalanffy 1972, pp 24-25, Chapter 1 of Klir, G.J. 1972). The organismic program was the germ of what later became known as general system theory. The replacement of the term 'organism' by other 'organized entities' such as social groups, personality, technological devices led to scientific approach, often referred to as the systems approach. A lot of evidence (Klir, 1969, 1972) has been found which suggests that certain properties of systems do not depend on the specific nature of the individual system, that is, they are valid for systems of different nature (physical, biological or social). Some of these properties were first understood as simple system similarities. The view of Bertalanffy of regarding (biological) organism as open systems in contrast with 'closed systems' studied by classical thermodynamics led some authors (Prigogine, 1955) to develop a rigorous formal theory of those open systems in terms of statistical thermodynamics.

In statistical thermodynamics a closed system are those systems which do not exchange matter with the environment and which involve reversible processes. Closed thermodynamic systems left to themselves approach a state of equilibrium characterized by minimum free energy and maximum entropy (disorder or randomness). Open systems are systems open to the environment in terms of interchange of matter and energy. They have no minimum free energy or maximum entropy. The system remains in a steady state under conditions of input of energy for the work in

the maintenance of organization. Thus General System Theory (G.S.T.) used the concept of open systems to express a new world outlook (cf. Bertalanffy, 1968). The new outlook rejected the reduction of all phenomena to the physical and replaced it with a concept of various 'spheres of reality' interconnected but relatively independent. Hence, the possibility of founding a unified science on the basis of laws applicable to each level or sphere. In fact, the theory of open systems (along with control theory and feedback models) is the part of General Systems Theory most widely applied in physical chemistry, biophysics, simulation of biological processes, physiology, pharmacodynamics and so forth (Bertalanffy, 1968).

From the viewpoint of the interaction between systems and their environment absolutely closed, relatively closed, and open systems are sometimes categorized (Klir, 1969 p 70). A relatively closed system is a system where the paths of interaction between the system and its environment are accurately defined; 'system' and 'environment' being understood as defined on some level of reality. An open system is called an object in Klir's terminology. An object is never completely isolated from its environment. In terms of the system this results in the fact that the behaviour of the system need not be (and as a rule, is not) determined exclusively by some internal properties of the object, but may be influenced by something in the environment of the object as well. Different classification of systems according to the viewpoint adopted are summarized in Klir (1969).

We have been talking about activity in the generic sense. In reality, however, we have to deal with concrete, specific activies, each of which is oriented, i.e., the activity has a directedness, an end. The main thing that distinguishes one activity from another lies

in the difference in their directedness. It is this directedness which gives to the activity certain orientation.

To give an account of some phenomena 'in terms of ends' is to give a 'teleological explanation'. But if we ask ourselves: what are ends ? we may go stray on the wrong tack. As Geach (1975) has expressed: "By a sort of linguistic original sin, human beings engaged in abstract thought have a tendency to turn constructions of a non-nominal kind, predicative phrases for example or again sub-clauses of a sentence, into noun-phrases; and then, if we are philosophers, we may ask what objects these noun-like or name-like constructions (Kotarbinsky has called them 'onomatoids') correspond to in rebus".

If we use the word 'object' to refer to the directedness of mental states we must concede we are stretching the word object beyond its everyday meaning which refers to items in the world. Some mental states, thinking for example, has a directedness, but the 'object' of thought may not exist at all. We want to restrict the range of application of 'object' to items in the world. What account can we make about some mental states like malfounded emotions based on a mistaken existential belief, emotions like fear that something is the case, beliefs and dispositions which even when not having an 'object' in the above sense still have some directedness ? Some theorists have used the notion of intentionality to talk about the various types of mental states and dispositions and have explained this notion by the use of the object terminology. Following Wilson (1972) we must offer an alternative account.

Intuitively it is accepted that beliefs, desires, many emotions, intentions have something in common which they share with other mental states. The most usual explanation is to refer to the fact that a

belief must be a belief that something is the case, a desire must be a desire to do something, anger must be anger with someone, to pay attention is to pay attention to something and so on. In Geach (1975) own words: 'Ends includes at least the things we want'. But in order to give a more systematic explanation of these various states we need to explore better the issues at stake. It is desirable to resist the temptation of explaining intentionality of mental states in terms of the language we use to describe them or to refer to certain logical feature all those statements have in common. It is mental states like beliefs, desires, etc., which are intentional and we must give substantive account of these issues.

Some writers have used the term 'content' instead of 'object' to explain intentionality. So Brentano in the passage already quoted talks of *REFERENCE TO A CONTENT*. But if we say that some mental states are characterized by reference to a content, we seem to be suggesting that a relation of some kind is involved. It seems better to say that some mental states have content, or are contentful.

We mention before that when we ascribe a state to a thing, we always have in mind a prior classification of the thing. Now there are different ways in which particular items can be grouped or classified. We can classify the items by the possession of similar qualities. For example, thoughts can be grouped together on the basis of introspectible or observable qualities, according to what occurs in each case is qualitatively similar or different. Another ground for making classifications of items is in terms of relations, for example in terms of spatial and temporal relations of one item to another. But some classification of mental states are neither qualitative nor relational.

When we say about a number of persons that they are paying attention

the basis of classification is neither qualitative nor relational if the paying attention at reference is a thought about something. Different people can be paying attention even when their attitude or behaviour are not at all qualitatively alike. What goes on in each case is not at all the same. So there is a way of classifying mental states together which is not straightforwardly qualitative or relational and those mental states can be grouped together with other mental states in such a way. Following Wilson we think that this is part of the force of saying that mental states have content. If the beliefs of two people are grouped together as instances of the same belief-type, this is not by virtue of the introspectible or observable similarity of their present states, nor is it by virtue of the qualitatively similarity of the behaviour which manifests their belief. Nor is the basis of the classification relational.

Other mental states, acts, dispositions, capacities that are intentional - judgements, doubts, decisions, wishes, etc., - share this feature, that they can be classified and compared to states, acts, etc., of the same kind on a basis which is neither qualitative nor relational. Some human activities fall into classes with a similarly non-qualitative, non-relational basis. We can group together human activities by reference for example, to the intention with which they are performed. Thus a few people can be said to be doing the same thing, like preparing for rain, even though their actions are not qualitatively similar.

Not all mental states fall into classes with a non-qualitative, non-relational basis. Sensations is one case at point. Pain being suffered by different people can be compared and classified according to intensity or any other characterization we choose. It may also be compared and classified in relational terms, for example, in terms of

its cause. Sensory states, on the other hand, can be classified in the appropriate way. If it is asked what it is about thoughts or beliefs that provides a basis for classification other than qualitative or relational similarity, it would be a mistake to assume that there must be a single answer to this question. If we can classify some mental states on a basis not qualitatively or relational, it does not follow that they must have something further in common. As Geach (1976) remarks in the context of explanation: "...coincidences of events in general call for no explanation; if the separate events are explained, that may be that..."to look for further reasons-why is a typically superstitious attitude".

Sometimes we can classify together some mental states even though they are qualitatively dissimilar and bear no common relation to any other item or items. Of course the basis of classification is connected with the qualities that a specific state has, and the kinds of ways in which they can be related to other items, but the connection is a highly complex one. For example, sensory states of the same type are related to one another through the common potential for a certain relation with an item of a certain type.

If we take the case of a mental activity such as a decision to do something, we can say the following: If a subject decides to do A and then does A as a result of the decision, he performs a mental activity bearing a certain relation R to his doing A. What actually happens when the decision has been made varies from occasion to occasion, but particular decisions can be classified together as of this type, i.e., as decisions to do A, because they could in certain circumstances bear relation R to an act of doing A. What allows us to mark off different decisions instances of the same type is that they could

bear relation R to an action of the same type. The example is not, of course, a complete account of the nature of decisions or of the relation of decision to action.

A similar account - in its formal aspect - can be given for each kind of mental state to which we attribute intentionality or content. That is, for each kind of mental item there is some relation such that mental items of that kind typically bear that relation to items in the world - things, persons, events, etc., such that mental items of that kind need not be so related to anything, but such that they are classified into types according to their potential for bearing the relation in question to items of the same type. The account of the relation in fact or potentially of dissimilar mental items to an item of the same type will depend on the kind of mental item in question - i.e., is contextual -. The explanation may concern, for example, the variety of aspects in the experience of a subject or the many different ways in which an item can be symbolised.

CHAPTER V

C L A S S I F I C A T I O N
O F A T T E N T I O N

[1]

In his analysis of attention White (1964, 1967) states that (all) attention concepts share three important characteristics: "First, they all demand an object. It makes no sense to speak of someone as just enjoying or taking care or being interested; his enjoyment, care and interest, like his attention, thought and awareness, must have an object. Secondly, while we can describe all that happens when we cry or smile without mentioning what we are crying or smiling about, we cannot say exactly what someone is doing who is in any way paying attention without mentioning the object of his attention any more than we can specify his expectation or wishing without mentioning their objects. A careful engine-driver does not differ from a careful surgeon merely in the instrument in whose exercise he displays his care; he differs in what he does. Thirdly, one cannot give one's attention in any way to anything without knowing that one is attending and also knowing under some description what one is attending to"..."These three characteristics of attention, which we may call being 'object demanding', being 'contextually bound' and being 'self-cognisant', are possessed also by such notions as hope, fear, expectation and wishing" ..."Notions like fear and expectation have also a fourth characteristic, namely that their objects need not exist except in one's fear or expectation; so that one may expect what will never happen or fear a creature of one's own imagination. This characteristic is sometimes called 'intentionality'. Attention-concepts, however - with the exception of thinking - are not 'intentional'."

The large quotation is important and necessary for contrasting our own position. If as we claim, perception is a sort of attention-laden activity, thinking is not the only intentional attention-concept.

Even more, perception and thinking seem to embrace most, if not all, of our attention-concepts.

[2]

Because of the many meanings in everyday sense of the word attention, from very early on several authors have tried to classify attention in various ways. Boring (1970) specifies ten uses according to a chronology of events in the history of the subject:

"(1) The personal equation, the individual differences among astronomers in observing the instants of stellar transits (1814-1863), the discovery that led to the study of reaction times. It began as a discovery of individual differences and ended with the finding that the expectant attitude affected reaction time (Sandford, 1888; Boring 1950, 134-151).

"(2) Individual reaction times, quantities which emerged from research on the personal equation when electrical means for measuring absolute times (chronograph; chronoscope) had become available (1858 on to the present; see Woodworth and Scholsberg, 1954, 8-42).

"(3) The complication experiment, which also grew out of the study of the personal equation, and which examined the interaction, as to time of observation, of two synchronous stimuli from different departments of sense (1861 and on; see Titchener, 1908, 251-263; Boring, 1950, 142-147).

"(4) Compound reactions, in which were noted the changes in reaction time, when the stimulus to the reaction had added to it an additional mental act, like discrimination, choice or association (1868-1893; Donders, 1868; Boring, 1950, 147-149).

"(5) The span of attention, the number of items or objects

simultaneously clear in perception (Hamilton, 1859; Jevons, 1871; Titchener, 1908, 259-263; Fernberger, 1921; and on).

"(6) The degree of attention, as to how attention varies in concentration and whether it is limited to two simultaneous levels, focus and margin (in a sense from Herbart, 1825; Titchener, 1908; Geissler, 1909; Fernberger, 1921).

"(7) The unconscious as a lower level of attention when attention is equated to reportability (1895 on).

"(8) Such conditions of attention, as intensity, suddenness, movement, novelty, and familiarity which determine what enters the focus of attention (Muller, 1873; Titchener, 1908, 188-206, 356-359).

"(9) The duration of attention, the rapidity of change of mind in flux and the question as to whether an attention can ever be sustained at all (Urbantschitsch, 1975; Ferree, 1906; Geissler, 1907; Pillsbury, 1913).

"(10) Attention as predetermination or set in respect to reaction time (1888) and also with regard to thinking and goal-directed consciousness and behaviour (Watt, 1904; Ach, 1905; and on).

Ribot (1890) and James (1890) make a clear distinction between two different types of attention, one of which they call 'spontaneous' attention and the other 'voluntary' attention. Ribot states the difference as follows:

"There are two well-defined forms of attention the one spontaneous, natural; the other voluntary, artificial. The former - neglected by most psychologists - is the true, primitive, and fundamental form of attention. The second - the only one investigated by most psychologists is but an imitation, a result of education, of training, and of impulsion. Precarious and vacillating in nature, it derives its whole being from

spontaneous attention, and finds only in the latter a point of support. It is merely an apparatus formed by cultivation, and a product of civilization"; and William James: "Voluntary attention is always derived; we never make an effort to attend to an object except for the sake of some remote interest which the effort will serve". A modern exponent of this view is Luria (1973).

The classification of attention in terms of 'voluntary' and 'involuntary' is not unproblematic. 'Involuntary' not necessarily means non-voluntary. This pair of concepts is used in a very confusing way: (see Anscombe: 'Intention' p 12).

Berlyne (1970) classifies attention into two classes: "There are, first of all, *INTENSIVE* aspects which are a matter of how much attention the organism is giving to the stimulus field as a whole. Then there are *SELECTIVE* phenomena, which are a matter of how attention is distributed among elements of the stimulus field". Besides Berlyne differentiate among intensive aspects:

"1. Attentiveness - the degree to which a higher animal is responding to its external environment fluctuates from moment to moment, which means, put more precisely, that the amount of information transmitted from external stimuli to the motor organs fluctuates.

"2. Degree of concentration - when information from several sources is being poured into the input of a channel at a rate that oversteps the channel capacity, there will be what information theorists call 'equivocation'.

"3. Arousal - the word 'attention' has sometimes been used as a synonym for 'arousal' since the notion of a psychophysiological dimension of arousal (Hobb 1955; Malmo 1957; Berlyne 1960; Duffy 1962) has come to attract wide interest".

Turning to selective processes Berlyne distinguishes three different ones:

"1. Selective attention. A stimulus selection is often based on spatial location. That is to say, the motor response is determined by stimuli impinging on certain receptors, while stimuli impinging on other receptors do not affect it..."This is the process to which I propose that the term 'attention' be confined"..."Three separate problems of selective attention can be outlined as follows:

"a) When an organism is receiving a number of stimuli associated with incompatible responses, which will be stimulus whose response is performed ? We shall call this the problem of attention in performance.

"b) When an organism is receiving a number of stimuli while performing a response in reinforcing conditions, i.e., conditions conducive to learning, which stimuli will become most strongly associated with the response ? We shall call this the problem of attention in learning.

"c) When a human being is receiving a number of stimuli, which stimuli will he be able to remember on future occasions ? We shall call this the problem of attention in remembering.

"2. Abstraction. Quite frequently, the word 'attention' is applied to selection not among stimuli entering through different sectors of the sensory surfaces, but among stimulus properties that belong to one and the same stimulus object, and thus must be apprehended through the same receptors (Mackintosh, 1965).

"3. Exploratory behaviour. Exploratory responses (Berlyne 1960, 1963, 1966) have the function of bringing sense organs into contact with stimulus objects and events that were not previously accessible, or of intensifying stimulation from sources that are already acting

on the sense organs."

Berlyne himself (1960) pioneered a comprehensive treatment of the intensive aspects of attention. He studied the so called collative properties of the stimuli such as novelty, complexity and incongruity which cause stimuli to be more arousing than others. But most of the psychologists relegated those studies in the use of 'involuntary' attention. In the work of Kahneman (1973) he tries to account for the study of 'voluntary' attention linking the intensive and selective aspects devised by Berlyne. His approach consists in suggesting that the intensive aspects of attention correspond to effort and then proceed to equate attention with effort. Kahneman provides an alternative to theories which explain man's limitation in attention by assuming the existence of structural bottlenecks in terms of a capacity model. Accordingly, he assumes that there is a general limit on man's capacity to perform mental work. He also assumes that this limited capacity can be allocated with considerable freedom among concurrent activities (Moray 1967).

We must notice some important points in relation to the task of several authors to deal with the different types of attention: 1) Most of the authors discuss attention quite by itself as though it described something that could be done on its own, even if we were doing nothing else at the time. If attention were a sui generis act, then it would be interesting to know whether it could be done voluntarily or not. We claim that attention is an activity and not a special mental operation, meaningfully divorced from the things we do attentively or otherwise. In this context is not whether attention itself is voluntary. The question of the voluntary nature of attention would depend on the general question of the voluntary nature of our doings in general. It

could partially explain why the attempt to distinguish between types of attention in terms of the presence or absence of acts of will, the presence or absence of automatic processes, the presence or absence of effort is not completely successful. A different distinction between the different types of attention can be sketched along the lines of a different conception about the nature of attention. We will deal with this later on.

2) The other thing to notice is the vagueness in the use of the word 'stimulus'. This word is used to account for different types of element: it is used for the various objects in the field and their cue properties, e.g., a red triangle or the shape of the figure; it can be used for, say, the light-waves emitted from the distant stimulus which impinge on the sensory organ; it is sometimes used to specify the pattern of excitation on the receptors, e.g., the pattern of the retina; it can be used, as well, to refer to the (postulated) different impulse sent by the receptors to the brain.

Even acknowledging the fact (Taylor 1964), that this sort of uncertainty is not a disadvantage at an early stage of the science, because we may not yet be clear for which of stimulus element the regularities hold, it is essential to be clear, for any type of stimulus, what will count as a stimulus element. If we are aiming to predict behaviour we must be able to give a definite sense to the stimuli which 'the situation contains or produces'. We cannot simply single out a certain kind of stimulus and characterize a situation as consisting of such and such stimulus objects. Any object or set of objects can bear an indefinite number of descriptions. In order to specify what the stimuli are we have not only to name the objects in the situation, but also the descriptions under which they operate as stimuli. Any set of

objects can be classified in an indefinite number of ways and if any of these descriptions can count as the 'stimuli produced by the situation', there is no finitely enumerable class of things which falls under it in any situation. And, if some selection must take place between these to occur, (in learning for example) this does not have to be accounted for by a 'filter' hypothesis, in terms of cue-properties of the objects themselves. For the shift from one type of discription to another could take place simply because no solution to the problem can be found in the first type. That is, the fact that reward varies randomly with position, will be enough to induce an animal to abandon the 'attention' to position and adopt one say to size. For a critic of the concept of stimulus as used by behaviourist psychologists, see Taylor (1964) and Chomsky (1959).

CHAPTER VI

A T T E N T I O N

[1]

The information available to us in any situation is indefinitely rich but we seem to apprehend only part of it. Some theories have been put forward to explain why we notice what we notice. But modern theories about attention seem more prone in trying to explain why we do not notice all the information available. The answer most frequently offered, theoretically seductive but quite misleading, is that we 'filter it out'. The seductive aspect of this suggestion is that, from a formal point of view, it is correct. The formal framework is no other than the mathematical information theory. In it, a filter is any input-output device such that, some of the information reaching the input has no effect on the output. As Neisser (1976) says: "Formally speaking, every human being filters out cosmic rays, insect pheromones, and every other kind of information that does not affect his behaviour. Psychologically or biologically, however, this notion makes no sense. There is no mechanism, process, or system that functions to reject these stimuli such that they would be perceived if it were to fail. The perceiver simply does not pick them up, because he is not equipped to do so"..."Selection is a positive process, not a negative one".

However, under the influence of the classical cybernetic paradigm in regarding man (or his brain) as a passive processing system, along with the support offered by various psychologists (Broadbent, 1958; Treisman, 1960; Deutsch and Deutsch 1963 and others), the filter theory of attention has an increasingly popular view (see Posner and Snyder, 1975). Several reviews of attention have appeared in the literature, but only three contain well-formulated theories. Several do little more than to systematize experimental results (e.g. Egeth 1967).

The three models which have received most discussion have been the ones of Broadbent (1958), Treisman (1960) and Deutsch and Deutsch (1963). Neisser (1967) provides a review and a model of what he called 'analysis by synthesis'. Norman (1968) has elaborated the approach of the Deutsch incorporating memory in his model.

The first modern model for attention was the filter theory proposed by Broadbent in Perception and Communication (1958). He was attempting to put together a model of human capability in a wide range of tasks. Broadbent suggested that the human operator is a limited-capacity information channel in the sense of information developed by Shannon and Weaver (1949). The peripheral nervous system is able to analyze and identify only a limited amount of the information which arrives at the sensory inputs. At some point in the nervous system,it is proposed, there is a bottleneck a 'selective filter' in the flow of information, since the central channel has a lower capacity than the combined capacity of the peripheral receptors and neural input lines. A limited-capacity channel can carry information in parallel providing the maximum capacity of the channel is not exceeded, but even so with the massive amount of information arriving at the body's surface, the central processor is frequently overloaded. Broadbent proposes that in order to handle the situation the brain makes a sequential sample of the various input channels. The order in which they are sampled varies and the fraction of them which are sampled is variable. This sampling converts parallel input to serial transmission, so that the serial transmitter is protected from being overloaded. At the end of the input lines a short memory store is proposed. When two messages arrive simultaneously one of them is transmitted immediately, while the other is held in store until the line is free. During its time

in store the representation of the message fades, because of autonomous decay and interference from other material that arrives, so that by the time it is handled it will be degraded. If the message is rejected it does not need to be handled. A diagram of the Broadbent model is sketched

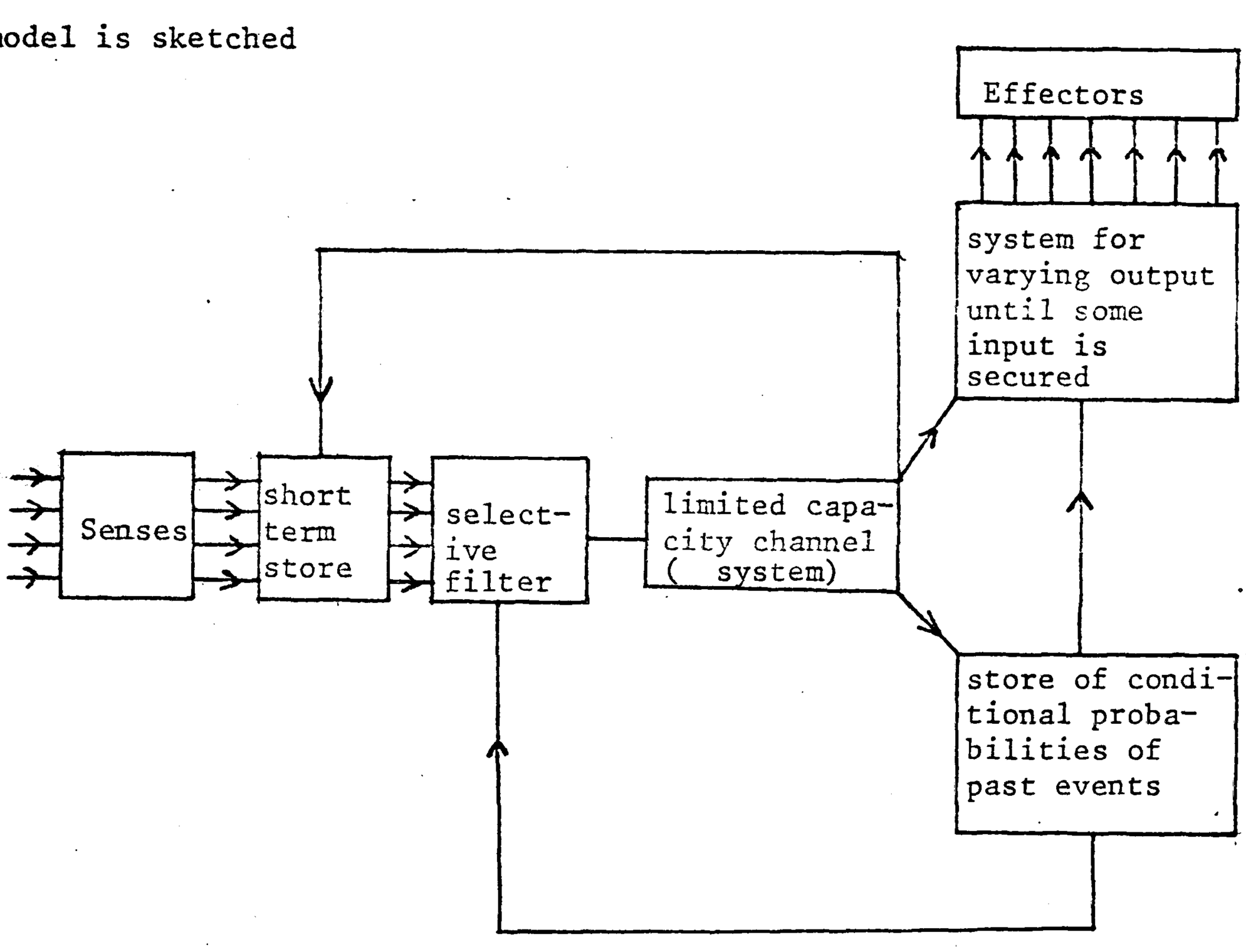

Fig. 1. Broadbent's Model (After Norman, 1969)

Broadbent's theory has strong implications for people's behaviour. Some of these implications were tested and proved wrong. Grey and Wedderburn (1960) suggested that the selection of sensory channels is based mainly on psychological attributes and not physical properties. In a listening experiment they presented to subjects one word, divided in different syllables, alternately to different ears. At the same time another word is decomposed in a similar fashion and presented to the complementary ear. If the attention switches from

ear to ear it is possible to recreate each word correctly, but the result was a nonsensical mixture of syllabes. Treisman's discussion of this problem using different techniques led to her model of selective listening, although it can be made to apply to other modalities as well.

Several messages arrive at once over different input channels and the listener must accept one and reject the others ('shadowing' experiments). She found a graded effect on the ability of the subjects to reject an irrelevant message. When there was a distinct physical difference between relevant and irrelevant channels, subjects had no difficulty in shadowing one without being bothered by the other. When the messages had similar physical characteristics but belonged to different languages, they were much less successful. The better the subjects knew the irrelevant languages, the more it interfered. The most difficult task was to maintain shadowing one message when both were read in the same language and spoken with the same voice. To explain these results, Treisman postulated an analytical mechanism that performs a series of tests on incoming messages. The first test distinguishes among the inputs on the basis of sensory or physical cues; later tests distinguish among syllabic patterns, specific sounds, individual words, and finally, grammatical structure and meaning. The pattern recognizer consists of 'dictionary units' which respond to patterns of input, providing the input is intense enough to pass the threshold of the appropriate recognizer. Treisman suggested that the tests at different levels must be flexible, so that if a particular word is expected all the tests relevant to selecting that word might be prebiased or presensitized toward it. Thus analysis is much simplified for items that are expected to occur. The separation

between channels is made by attenuating the irrelevant channel so that it no longer interferes with the later testing procedure. Treisman suggests that all incoming signals are analysed to some extent by a sequence of operations. Signals are separated from one another by their physical features when that is possible and by their grammatical features when that becomes necessary.

The model proposed by Deutsch and Deutsch is based on similar experimental evidence from that used by Treisman. They state that the 'physical characteristics' analyzers early in the system are redundant. All messages are fully analysed at the level of pattern recognition. The result of analysis is to produce an output from 'dictionary units' which is proportional, not to the signal strength of the input, but to its strength weighted by its importance to the organism. The weighting can be altered by several factors. A detailed account of the weighting mechanisms can be found in Deutsch (1960). The selection mechanism is 'moved back' a bit. In Norman (1968, 1969) an elaboration of the Deutsch model is presented which incorporates memory factors as well as attention. We copy a diagram of Norman model and his own description (fig. 2):

> "All signals arriving at sensory receptors pass through a stage of analysis performed by the early physiological processes. Then, the parameters extracted from these processes are used to determine where the representation of the sensory signal is stored. Thus, as shown in Fig. 2, all sensory signals excite their stored representation in memory. Now, at the same time, we assume that an analysis of previous signals is going on. This establishes a class of events deemed to be pertinent to the ongoing analysis. The set of pertinent items also excite their representation in memory. The item most highly excited by the combination of sensory and pertinence inputs is selected for further analysis (the shaded item in Fig. 2).
>
> Given the selected item, the attention process now completes its analysis, adding the newly acquired information to

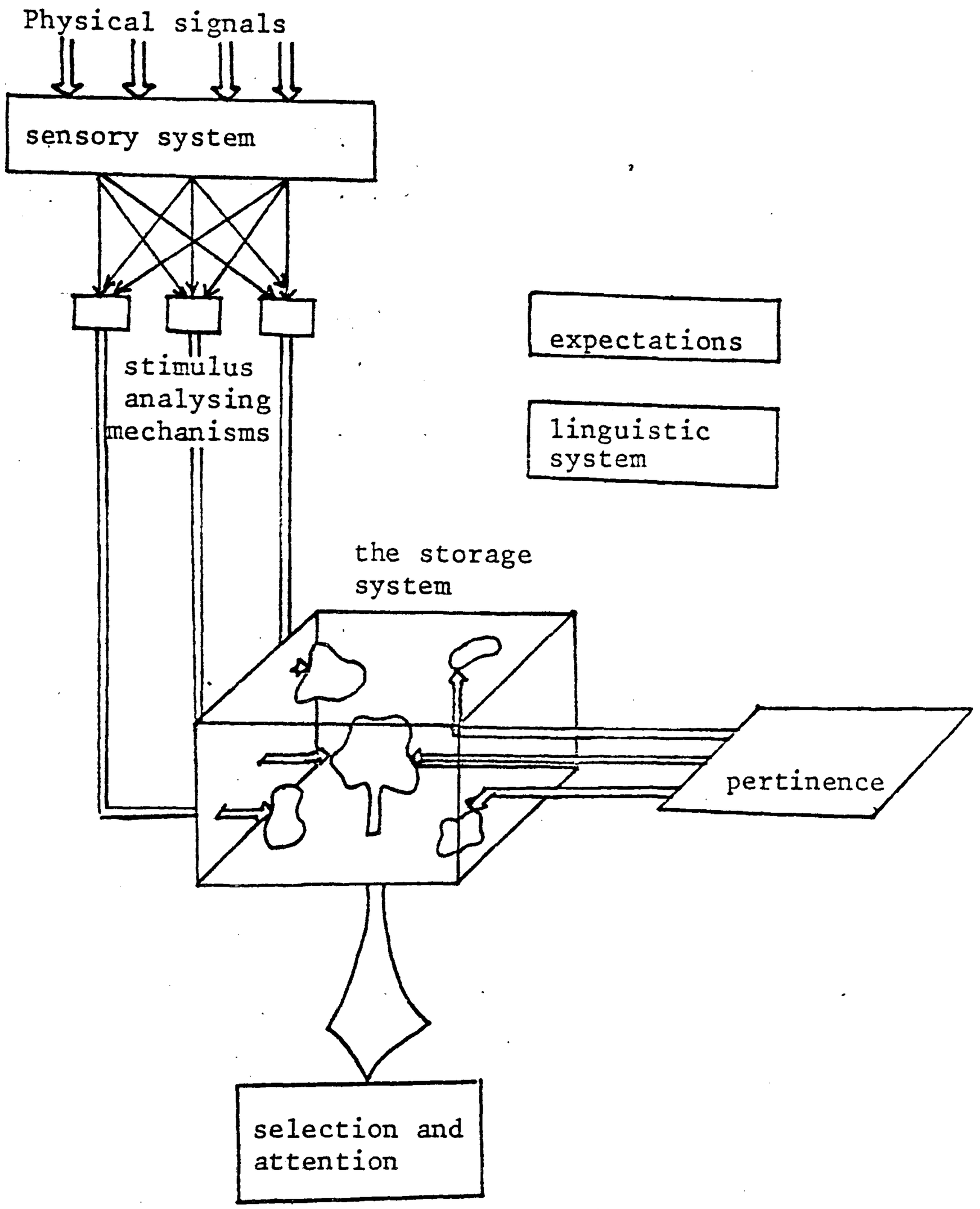

Fig. 2 Norman's Model (After Norman, 1969)

what has come before and bringing the pertinence judgements up to date. This scheme is capable of describing the existing experimental data as well as the attenuation model of Treisman, especially if we allow physical cues to be included in the determination of the set of pertinent items."

Before we continue trying to express our views about the phenomenon of attention, it is useful to take a look at the experimental paradigm and the problems of the modern psychologist who were the initiators of the theories of attention now widely held. One of the

first studies was carried out by E. Colin Cherry (1953) in America. Cherry addressed himself to the problem of 'selective attention' or the 'cocktail party problem' as he put it. It is the relative familiar task of trying to follow one speaker rather than another in crowded rooms. His experiments were designed to the following questions (his own words): 'how do we recognise what one person is saying when others are speaking at the same time (the "cocktail party problem?") On what logical basis could one design a machine ("filter") for carrying out such an operation?' The technique used by Cherry requires a subject to repeat a message which is presented to him - to shadow the message - while at the same time he is presented with other material, either auditorally or visually. Cherry reports that the task of shadowing is easy. But the task can be made either easy or difficult, depending upon the details of the way it is performed. In the shadowing experiments two main variables are analysed: the instrutions given to the subject and the type of material that is being shadowed. The type of material is important, for it is easier to shadow meaningful material than nonsense. The grammatical aspects of the material are very important as Cherry has showed: in the absence of physical cues, two different speeches mixed together can be disentangled if there are sufficient grammatical constraints involved. In his experiments Cherry reported that his subject's 'words are slightly delayed behind those on the record to which he is listening'. This type of response is called 'phrase shadowing', and it simplifies the task for the subjects as is observed in skilled typists. The difficulty in the shadowing can be increased by instructing the subject to repeat each sound as he hears it, without waiting for the completion of a phrase, or indeed,

without waiting for the completion of a word. This procedure is called phonemic shadowing and is very difficult to do. It takes a lot of practice for subjects to learn how to do it.

Shadowing then, can be as complicated a task as the experimenter wishes. Cherry suggests several measures of variables which can influence the shadowing: how much effort the subject uses in performing the shadowing, the possibility of shadowing interfering only with *MEMORY* and not with *PERCEPTION*, etc. In a later series of experiments Moray (1959) tried to determine exactly how much information humans retain of the rejected channel. He found that even when English words were repeated as many as 35 times in the rejected ear, there was absolutely no retention of them. Even when the subjects were told that they were later to be tested on their retention of material from the nonshadowed ear, it made little difference. One explanation that was given for these results was the one of invoking masking: the sounds of the message which is to be shadowed combined with the subject's voice as he repeats that message suppress, silence or mask the voice which speaks the other message. Neisser (1967) makes reference to the possibility of following two meassages when both messages are presented on one loudspeaker at equal volume. Still, another difficulty in the observation that little or nothing is remembered of the nonshadowed task was put forward by Norman (1969): he mentions the fact that the Cherry and Moray experiments waited for a while before asking their subjects how much they remembered of the non-attended material. Is the material which receives no attention remembered briefly before the subject forgets it ? By simply interrupting the subject while he is shadowing, and demand of him a response about what was presented in the ear which the subject is

not shadowing, Norman tried to give an answer to the experimental question. He himself called it the "what-did-you-say" phenomenon. His results showed that there is a temporary 'memory' for items to which we are not attending. As a final matter of technicality it is useful to give some explanations about the terminology used in those experiments. It is necessary to distinguish the various ways in which the information might be presented to a sense modality: if we consider two sources of sounds, A and B, which are presented simultaneously to a listener, we can present them to one ear only; in this case the presentation is monaural. If A and B are mixed together and then presented to both ears, so that both ears hear exactly the same material, the presentation is binaural. If the two channels are fed into separate ears, each ear with a different channel, the presentation is dichotic. Similar distinctions can be made for visual material: monoptic, dioptic, steroescopic. (Norman).

The advent of the computer and the spread of the notion of information - in Shannon sense - make possible the interpretation of the above experiments in terms that are now standard in cognitive theories. Computers accept information, manipulate symbols, store items in "memory" and retrieve them again, classify inputs, recognise patterns, and so on. A new vocabulary soon becomes common place to deal with that sort of activity: information, input, processing, coding, subroutines, memory or storage, and so on. The internal information-processing model of cognition was postulated to explain the real cognitive activities. The old philosophy had created unsurmountable problems by its views about the 'seeing' of the retinal image. The modern doctrine regards that image not as looked but as processed. 'Detectors' initiate neural messages in response to certain specific

features of the image. Information about these features is then passed on to higher stages of the brain. At higher stages it is combined with previously stored information in a series of processes that results in perceptual experience. That is in essence the information-processing model of cognition that was put to work to explain the experiments about attention. With some added modifications (a "filter") to this information-processing model the 'attentional phenomena' was nailed down into a computer. It is a matter of looking into the different variables influencing the experimental paradigm and trying to account for one of them as the 'basic' one that explains the differences among diverse theories. We have seen already that the theories of Treisman and the Deutsch place the "filter" at different levels. Kahneman's theory emphasizes the aspect of the effort given to the task and tries to account for attention in terms of a capacity model which performs 'allocation policies' on the grounds of effort to spend.

Another characteristic of all those models is the sharp distinction between perception and memory (Neisser, 1976). Any use of information a few milliseconds after it was presented, any anticipation is regarded as dependent on memory rather than perception itself. Norman's theory of attention, for example, states that we continuously 'register' and then forget a lot of incoherent sensory fragments. Evidence to back up the processing theory comes from experiments where more information is obtained from an 'unattended' voice than the early experiments had suggested and from studies that show that knowing where (to what ear, in what sense modality, at what place) a brief stimulus will be presented, does not help subjects to detect it. (Shiffrin and Gardner, 1972; Shiffrin and Grantham, 1974). But as Neisser (1976)

says: "they (the experiments) are just as irrelevant to natural attention as traditional tachistocopic research is to perception. We do not attend to ears, modalities, or points in the visual field, but to objects and events: we do not do it in an instant but over time".

Theories like the one of Tréisman and Norman are unnecessarily complicated. Behind them there is the implicit assumption of man as a passive processor. When attention is treated as an activity, as something we engage in actively, we do not need to look for the existence of different internal mechanisms which would implement the diverse manifestations of attention.

Selection requires no special machinery. This could be shown if that selection occurs for every sort of perception, even where neither practice nor evolution is likely to have provided a selective mechanism. Neisser and Becklen, 1975; Neisser, 1976 devised a visual analogue of the selective listening paradigm. They videotaped two kinds of 'games', and then used a mirror to show them in full visual overlap, rather as if a television set were somehow showing two channels at once. Subjects were asked to attend to one of the games and ignore the other, pressing a response key at every occurrence of certain targets events in the attended game. The results were clear. At an event rate of about 40 targets per minute, it was nearly as easy to follow one game when it was superimposed on another as if it was shown by itself. The error rate was only three percent, (3%) and subjects had no difficulty even on the first trial. In the same way that a subject can shadow a primary message in the presence of an irrelevant voice, so it is possible to follow a visually given primary event and ignore another equally present to the eyes.

In examining the above models critically we ought to mention only some unsurmountable "technical" points that the different models are not able to cope with. However, our main claim is that the analysis of attention under those approaches is misleading in looking for different mechanisms which would implement different 'stages' of the processes. In the next section a different approach under more realistic and productive lines is sketched. The other general comment worth mentioning is the ambiguity of the terms 'stimulus', 'signal' and 'channel' which are non consistently specified in the different models.

In Broadbent's model it is proposed that the probability that a certain channel will be sampled when it eventually contains a signal increases with the length of time which has passed since the last time that it was sampled. The 'channels' were originally thought of as being fairly closely identified with sensory pathways, but this is no longer acceptable since, language or voice quality can be used as criteria for selection, even verbal classes have been used. If the 'filter' acts on peripheral inputs it is hard to see how the verbal classes which have meaning and not phonemes or frequency components can be implemented. Not even Moray (1969) modified version can explain all the data.

In Treisman's model the 'attenuation' of signals has not been made very clear. For example, the properties of the attenuation and how it works are not specified. In later versions of the model Treisman incorporates 'analysers' to describe how the various features of a signal may be independently processed. No predictions can be made as to what will happen if the listener is asked to handle two simultaneous input, accepting them both. As Norman (1969) puts it: "The main argument against Treisman's explanation concerns the

complexity of the operation she proposes."

Similar difficulties face the model proposed by Deutsch and modified by Norman. A source of difficulty is probably the use of shadowing as the method of presenting stimuli. It is virtually impossible to measure in this experimental set up the effect of slight timing differences that could be crucial in the understanding of the phenomenon. On the other hand as a general deficiency in all the models is that they concentrate entirely upon competiton between inputs. The likely 'competition' among outputs, and between inputs and outputs is not easily handled by any of the models. All the above difficulties seems to call for a better experimental set-up and more quantitative measures in order to reach for some clarification of the issues involved. Our claim is that most of the analysis carried out in this area are the product of a conceptual muddle. As Geach (1957) has put it: "No experiment can either justify or straighten out a confusion of thought; if we are in a muddle when we design an experiment, it is only to be expected that we should ask nature cross questions and she return crooked answers."

[2]

How can we conceive or explain the phenomenon of attention ? We must remind ourselves of the context in which we are pursuing our enquiries - cybernetic and system theory -. We ought to look for a holistic view even when the prospect seems so daunting. The quotation from Wittgenstein at the beginning of this work in his distinction between a foreground and a background and the more recent works of Atkin (1974) who differentiates in a holistic structure a dynamic related part (the foreground in Wittgenstein term) and a related part regarded as fixed or static, adequate to 'support' the dynamic part:

the backcloth (the background in Wittgenstein term). It is necessary to remark that the 'backcloth' or 'background' is not static in the strict sense of the term, but it only means that its *DYNAMIC* is slower than the 'foreground'. William James in a description of the phenomenon of attention makes use of a similar distinction: "Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others, and is a condition which has a real opposite in the confused, dazed, scatter-brained state which in French is called distraction, and Zerstreutheit in German.

"We all know this latter state, even in its extreme degree. Most people probably fall several times a day into a fit of something like this: the eyes are fixed on vacancy, the sounds of the world melt into confused unity, the attention is dispersed so that the whole body is felt, as it were at once, and the foreground of consciousness is filled, if by anything, by a sort of solemn sense of surrender to the empty passing of time. In the dim background of our mind we know meanwhile what we ought to be doing: getting up, dressing ourselves, answering the person who has spoken to us, trying to make the next step in our reasoning..."

In the above passage it is possible to spot an ambiguity in the way James talks about the object of attention "in clear and vivid form". If the object of attention is itself vivid and clear, even the 'minimal' attention given to it will show it with clarity and vividness but that characterization is the one of the object of

attention. On the other hand, if the object of attention is itself vague and amorphous, the more clear and vivid we see it the more vague and amorphous it is seen to be.

We must notice that most of the theorists who try to describe attention make use of visual metaphors: focalization, concentration, etc. It is useful to use the visual analogy because its description is richest and more elaborated than their alternatives. But as Evans (1970) remarks: "we must be watchful not to be deceived by the analogy into thinking that what is true of the analogue is true generally; for it might be that we are unwittingly dealing with a non-analogous feature of the analogue".

If we concentrate or focalize our attention on something, that concentration and focalization takes place around a centre. In this way the 'centre' stands out of its 'surroundings': the centre being the foreground and the surroundings the background.

The sort of attention present in all the above experiments is a conscious selection, i.e., is deliberate; but it is wrong to suggest that all attention is deliberate. Even when the attention paid to an object is compulsive, it does not mean that the subject could not turn his attention to other 'elements' of his consciousness if he were able, that is, we are aware of other objects or events present in consciousness at the same time we are paying attention to an object or event, otherwise we would have no contrast between attention and non-attention. Our attending to A cannot be fully described without some mention of a concomitant awareness that we are not attending to B, C, or D. The existence of elements of consciousness to which we are not paying attention provides a background or back-cloth to those elements to which we are paying attention. We can

account for consciousness as consisting in the existence of a plurality of 'elements' some of them occupying the foreground (object of attention) and others providing the background. When we change our attention one object of attention is replaced by another, but the structure of consciousness is still the same. So in the view fore-shadowed by James (1890) and Ribot and made important by Evans (1970) attention polarizes consciousness into a foreground and a background. In the special case of the attention paid to an object which catches our eyes by a sudden movement, the foreground and the background stand in consciousness in a relation of juxtaposition. No special relation between the two is present. It is this characteristic that allows some people to talk of 'spontaneous' attention in this specific instance, however we are able to spot an incipient state of differentiation even when the relation between the two seems to be quite irrelevant in most of the cases.

The situation is different when we look to other types of attention - the case of a search (in the literal sense). In a search we have an *IDEA* of what we are looking for, even when the *IDEA* is not necessarily clear. For example, sometimes we come across the object of searching and we do not recognize it. This sort of attention does not have its success guaranteed. We must not think that because the attender can give a rough indication of the object of his search, the object of the search is also the object of attention at the time of the search. If that were the case, the attender, we would say, would be thinking about finding as opposed to being actively engaged in looking. The object of attention are either the places consecutively searched or the searching activity itself. We have some other factors in the searching like the expectation and the 'set', that is,

beliefs about the place to search, the probability of success, etc. One important factor in the search is that the attender may have some idea of the state of affairs that would constitute the successful termination of the search. Such an idea can play an important part in determining the manner in which the search is carried out. If will partly determine the things we do and the things we notice or not while searching. It is a sort of 'informant' idea and is this what can be compared to a 'filter' in the sense that it determines what gets through and allow us 'noticings' apt to the search. We can see a difference in the conception of 'filter' in the classical view of attention and the present one. In the current models the filtering is carried out by some 'mechanisms' inside the brain. In the present account, the 'filter' is no other than the *IDEA* 'informing' the search.

How can we conceive the 'informant' idea ? Is the 'informant' idea the object of attention ? The answer to these questions are important because if we allow to the idea to be the object of attention during the search, we are not talking any more about the search itself, but about the thought of an idea or it may well be about the planning of the search. On the other hand, if we conceive of the 'informant' idea as a disposition in the sense of a memory of previous acts we miss the point. On that account in order that the idea be actual in the search, it has to be recalled from 'memory'. But the actuality of the 'informant' idea in the present account does not derive from it being recalled. The 'informant' idea is present during the search as an element of the background or back-cloth of consciousness. In this sense the idea though being actual at the time of searching is not itself the object of attention.

In the whole structure of consciousness the backcloth "supports" (Atkin, 1974) the dynamics even if people are not aware of it. It explains the fact that some people become surprised when they realise that an 'informant' idea is guiding the search. Is that what in one sense constitutes the intentionality of most of our activities (see above). However, there is a point in conceiving the searching activity as a disposition: if in the middle of a search one forgets what one is looking for, the forgetting must be understood dispositionally because the object of the search is neither in the foreground, nor is an element of the background, and we have very good behavioural elements how to settle the matter: the search either stops searching, or he fails to recognise the object of his search when he comes across it. This account allows us to look at the expectation and 'set' of the subject not in terms of a disposition but in terms of an organization present in consciousness: a foreground and a background.

Another characteristic of the current theories about attention is the postulation, implicitly or explicitly, in the limited subject's capacity for processing information. As Neisser (1976) says: "Acceptance of this assumption frequently goes along with some form of filter theory: a special mechanism is postulated to protect the limited capacity from overload". How the belief in a fixed cognitive capacity comes about? In the case of the current theories of attention it stems from an argument derived from the mathematical theory of information: a theorem in this theory asserts that when the rate of information input to any finite channel exceeds a certain value (called the channel's capacity) not all of it can be transmitted without error. If we put forward the idea of the brain as a transmitter of information, and bearing in mind that the brain is finite,

the above theorem is a proof of the limit to human capacity.

We have to go along into this argument because nothing, in principle, seems to attest against the validity of it. However no-one has ever demonstrated that the facts of selective attention have any relation to the brain's real capacity. Besides, there are a lot of activities which we can continue doing without danger of overloading a cerebral storehouse: we can continue visiting places, and meeting people, as long as our energies (and money) last. However human abilities do have limitations. Some of them are explained by limiting factors specific to the combinations of individual activities and skills involved. As Neisser (1976) has put it: "Consider our physical abilities: they are obviously finite, but their limitations do not arise from any single source. The limits on how fast we can run is not based on the same factors as the maximum weight we can lift; the sharpness of our visual acuity is not constrained by whatever sets the minimum oculomotor reaction time..."

Most of the time the performance in a dual attention activity can be tremendously improved according to practice. There are differences between skilled and unskilled subjects that the current theories fail to explain. Moray (cited by Underwood, 1974) improved his own detection rate in the secondary channel to 83 percent in a task where naive subjects average 4 percent. The sophistication of the subject, his age and his culture (Lackner and Garret, 1972; Mackay, 1973), produces different results in the assigned task and these differences are not explained in the current theories of attention. Some of the difficulties which arise when people try to do two things at once has to do with incompatible movements required by the body. In some of these tasks a re-organization in the execution of the task may produce improvements.

However, we must not fool ourselves thinking that all the limitations are explained by limitations in bodily activity. Some real limitations arise in the cognitive realm when we try to attend to more than one object at the same time. It is common and acceptable to say that it is not possible to pay attention to too many different things at once. The impossibility or difficulty of following two separate conversations at once as used in the paradigmatic experiments, is but a common example of this limitation. It is fair to say that in the experimental case, there is a conflict for a subject trying to pay attention to the two messages at once. It is that conflicting situation which obliges the subject to settle in paying attention to only one message and "reject" the other. (In the experiments it is usual to ask to pay attention only to one message anyway). But not every case of attending to more than one thing at once are cases of a conflict of attention. How can we settle the matter ? Empirical contrivance seems to be the best answer for it. This belief has arisen a lot of experiments in order to discover the switching time of attention (Cherry and Taylor, 1954; Schubert and Parker, 1955; Broadbent, 1958; Kristofferson, 1967; Moray, 1969). If we examine the question more closer we notice that we have not settled yet what is to be understood by "attending to one thing at a time". Since our view is holistic and not atomistic, we suggest that part of the problem in answering this question arises because of the implicit pressuposition in atomic objects such that we could make decisions as to what is one object or another, quite irrespective of the purposes of the subject. In fact, that which constitutes the object of attention resembles one of the characteristics laid down in the functioning of a concept i.e., fact organized (see above). The

object of attention, whatever it be, gives rise to the organization of consciousness around it. Whatever the object of attention - a person, an event - it is still a complex object, but we do not pay attention to the 'ultimate fundamentals' (if any) of a person or an event, though we notice a variety of things of the object of attention. To know about the object of attention we need to know about the purposes behind attention. The activity is dependent of the purposes of the attender. This account opens up the possibility of explaining several things present in the attentional phenomena.

If the organization of consciousness produced by one object of attention is in conflict with the organization produced by another object of attention, then we have conflict and the attention is "divided" between the task or there is a "switch" between one and another task or we settle ourselves in one task "rejecting" the other. The resultant organization must be looked upon as a system. It is that system and the complexity inherent in it which allows us to explain the incompatibility or compatibility if different objects of attention present at the same time. When two objects of attention compete for the subject's attention and they do not belong to the same system, we can only attend to the one at the expense of the other. If several objects of attention belong to the same system, we can pay attention to all of them. The system itself and its complexity, depends on the sophistication of the subject and that allows to explain differences in age and culture. The degree of attention paid to an object of attention is greater if that object belongs to a well defined system occupying the foreground of consciousness, and if the connectedness between foreground and background of consciousness is soundness. If foreground and background

merge together in a system the concentration of attention is maximal.

We have said nothing about the content of the foreground and background of consciousness. Are they cognitive or sensory ones ? The answer is in the affirmative in the cognitive case, as when the subject is immersed in the solution to a problem (the object of attention) and an "informant" idea in the background, guides the solution like in the example of search given above. But the content of consciousness can be sensory too, as when we are engaged in performing a manipulative task that requires great skill (the object of attention) and our kinaesthetic sensations give us control over our movements without paying attention to them (the background). In fact, if we pay attention to our kinaesthetic sensations, that would disrupt the task being carried out as everyday common experience testifies.

The classification of types of attention in terms of voluntary and involuntary attention (Ribot, James, Luria) is unsatisfactory, but besides, it accounts for the differences in attention according to differences in its origins in motivation. Now it is undeniable that any type of attention must have certain motivation, but it does not imply that the evolution of the phenomenon must retain the same motivation. In logic this sort of argument in which the antecedents of something must be the same as their consequent, is known as the Genetic Fallacy. The nerve of the argument, and it is an argument which comes up all over the place, is that if X evolved from Y, then X must always be Y; or at least, it must always be really or essentially Y. Yet this argument is absurd. For to say that X evolved from Y implies that X is different from Y, and not the same.

A classification in terms of the connectedness between foreground

and background seems to be more sound. Evans (1970) has suggested a classification on this line: a) unordered attention - where the relation between foreground and background is almost non-existent, or at least not necessary to explain the attentional phenomena; b) executive attention - the one present when a performance is carried out, and c) interrogative attention - the attention paid to an object in order to enlarge our knowledge. In this latter case the connectedness between foreground and background is maximal. Of course, this classification must be regarded as tentative and incomplete. In any case it requires experimental support.

We have been regarding attention as an activity by which consciousness is structured in terms of a foreground and a background. The foreground has been identified as the object of attention, and the background as the 'support' of the dynamics of the foreground, which in some sense is determined by them. Now we seem to face a difficulty here. In the specific example of searching given before, we emphasized that the object of attention is the different places being searched, and not the 'search' itself. Likewise, when we see a person or listen to any sound in the environment, the object of attention is the person in the first case, or the specific sound in the second. But none of them can be an 'element' of consciousness. Certainly no specific place, person or sound is 'inside' consciousness, being one of its 'elements'. The solution suggested to overcome this difficulty is to regard the places searched and the persons looked at "as-they-are-seen-by-the-subject", the sounds listening to "as-they-are-heard-by-the-subject". In this way we have a difference between the object itself (whatever that is) and the object as seen, heard, sensed, etc., by the subject. We can the explain why, in some cases, the subject does not 'see',

'hear', etc., the 'real' object of attention. The foreground is occupied by the object of attention as experienced by the subject. The technical term used by Evans is awareness. Thus, the object of attention is always an awareness of the subject but not every awareness implies the existence of a 'real' object. Once again, it is well to remember that the experience or awareness we are talking about has to be understood in an occurrence sense and not in a dispositional sense. When we come to consider awareness in a dispositional sense, the word is used as a synonym for 'know'. For example, a person can be said to be aware of the way of solving a specific problem, even though he is not at the time thinking on them. Equally, we can say of the person that he knows the way of solving the problem.

[3]

We come now to make a short survey of some of the enormous literature about attention and to see if our view can claim experimental support. The first thing to notice is that the term attention still embodies a lot of "nebulous empirical and conceptual difficulties". (Vaughan and Ritter, 1973). Already in 1969 Berlyne commented: "Hitherto, there has been a tendency for neurophysiologists to assume that the psychologists know what attention is, and for psychologists in turn to assume that the neurophysiologists know".

We have sketched before the different connotations that the phenomenon of attention has for the psychologist (selective attention, arousal, vigilance, search behaviour, eet, etc.). Recent demonstrations of 'secondary pickup' have turned out with the fact that more information is obtained from an "unattended" message than the early experiments had suggested. In the analogue selective looking experiment

mentioned above devised by Neisser and Becklen (1975), the subject is able to follow the attended game (the object of attention) but does not see the irrelevant game, although "there is a sense that something else is there" (an 'element' of the background). The traditional theories make no distinction between skilled and unskilled subjects, between adults and children, or between those who are trying to pick up information from the secondary message, and those who only want to ignore it. Even more, assuming that the 'filter' becomes more efficient with age or experience, old and sophisticated subjects should pick up less information than younger and naive ones. Hawkins (1973) is a modern exponent of that point of view, but the success of this view is very little. In our theory an attentive activity either a performance or a 'pure' cognitive one is prone to improvement if we re-arrange our skills or try different strategies or policies. Moray (cited by Underwood, 1974), improved his own detection rate in the secondary channel to 83 percent in a task where naive subjects average 4 percent. In experiments with subjects doing two things at once, (cited by Neisser, 1976) the subjects reading stories silently while copying words that the experimenter dictated one after the other (each word was presented as soon as the preceding one had been copied) the results showed that at first the dual task was found difficult, the subjects read much more slowly than under normal conditions. After about six weeks of practice, however, their reading speeds had returned to normal. Careful tests showed that they were also reading with full comprehension.

The picture that seems to emerge from the diverse experiments is that attention is not a 'fixed mechanism' but must be seen upon "as a collection of acquired skills" (Neisser, 1976) - that - "will

adjust itself to the requirements of the task at hand, and only rarely will fundamental limits be observable" (Moray and Fitter, 1973). The latter authors have postulated a model of attention in the following way:

"We must cease to regard the properties of attention as fixed. They are largely task determined, either directly (through the interaction with transients), or indirectly (by means of the construction of an internal model of the statistical properties of the sources). There may be a few cases in which limits on performance are found, owing to the observer switching continuously at his maximum possible rate, but they are rare, and the evidence for them is distinctly thin. Attention is dynamic, with changing temporal parameters, and directed by the following:

"1) the observer's model of the temporal statistics of the information source or sources he is processing, the model generating a distribution of expectancies as to the likely time of arrival of the next target;

"2) the observer's model of the costs and values associated with the detection or missing of targets from the various sources;

"3) (perhaps) his sensitivity to transient changes in the autocorrelation function of the physical signs.

"Attention thus is seen to be rather the employment of dynamic strategies than the operation of a fixed mechanism - strategies, moreover, determined by a continually updated assessment of the informational demands of the sources being monitored. Attention thus is seen to be intimately connected with the acquisition of skills, expectancy theory, decision theory, and probability learning. The man who successfully pays attention bears a resemblance to the virtuous

man in the moral theology of Aguinas: it is not by his struggle to overcome temptation that we detect his virtue, but by the untroubled achievement of his aim".

The large quotation is necessary: the authors are psychologists who have worked extensively in attentional experiments, their views thus, are important. The theory has a lot of advantage over the current theories of attention: for example, it rejects the idea of a 'fixed mechanism' and besides it allows for improvements and variations according to the task. If we can come to grips with the theory we can better appreciate its claim and have a good anchor from which we can measure the differences with our view.

The theory is scattered with the use of terms borrowed from information theory, probability and statistic theory, etc. There is nothing intrinsically wrong with that. The sampling theorem of information theory states that if we have a signal of bandwidth W Hz, then an ideal transmission line can transmit all the information in the signal, provided that 2W samples of the signal are taken per second. Senders (1964) made extensive use of information theory in the earliest analytical theories of attention. He argued that when an observer is required to transmit information from a number of sources of visual information, he is behaving as such a transmission line. It follows that there is an optimal strategy for such an observer. The model has undergone evolution. Elkind and Gringetti (Senders et al, 1966) argued that the task was not really one in which the signal was transmitted. It was designed to notice the moments at which the value of the signal exceeded some defined value and that the observer used the latest observation as a base line from which extrapolate in time to make the different samples. Carbonell (1966) later developed

a model where he made explicit the role of costs, values and payoffs. The sources queue for attention. The observer uses his knowledge for decisions as to which source to be sampled, he learns how to assign values to several sources, etc. The mathematical approach to the solution of this sampling problem is intractable unless restrictive simplifying assumptions are made. Sheridan (1970) has presented a general model which incorporates Bayesian statistical decision theory, and again is concerned with the calculation of an optimal sampling interval, or distribution of intervals, providing the observer knows the statistical structure of the source.

In analysing the implications of these results, Moray and Fitter (1973), state that they imply that the observer knows the value of W, the bandwidth of the signal, with considerable precision for each source he observes. He must therefore have learned the statistical properties of the source and using such knowledge to control his sampling behaviour, he has constructed an internal model of the environment to which he must pay attention, and that model controls his attention.

We must notice that all the experiments consist of an 'information flow' situation. No wonder may arise if the subject 'behaves' as an 'information transmitter' and it is of value in this context to apply the formal apparatus of information theory to know the characteristics of that 'channel'. Where the thing goes wrong is in equating attention with information transmission. We have been arguing that attention is an activity of the organism by which the field of consciousness is structured in a foreground and a background. Most or all of the experiments deal with the "structural information" characteristics of the foreground. They do not take into account the

background and the connection between the two in explaining the attentional activity and how the background can "sustain and support" the dynamic activity.

We have to elaborate about this criticism to make clear our claim: the use of awareness or 'expérience' - in the technical sense that we have been using them - allow to refer to any proper object of perception without having to list the different modalities - visual, auditory, etc.). Thus, it resembles the word 'consciousness' except that the latter brings in elements to which attention is not being paid in addition to those to which attention is being paid. The object of attention - the awareness of it - is a whole, a system and cannot be regarded as 'constructed out' of sense-data. The awareness has the property of continuousness. How long can an awareness last ? If we keep bearing in mind the connection between awareness and activity - bodily activity - that goes with it, the answer is that the awareness lasts as long as its sustaining activity lasts. If this contention holds, as we assume it does, a single awareness or experience exhibits qualitative changes because of changes in bodily activity, the activities in question must be attentive activities. Attentive activities are those which cannot be fully described without mention of the sense organs used in that activity. The point of the activities in question is to keep the awareness (be it visual, auditory, or any other) in 'check'. For example, in order to keep the awareness of looking at X we have to see X, listening to Y entails hearing Y. The two activities: seeing and hearing, entail a corresponding awareness. Some specific bodily activities functions in order to sustein perceptual awareness. Of course, the 'sustaining' of all awareness is not dependent upon bodily activities alone, as for example in the aware-

ness of a fleeting event. Most of the sense-activities are exercised attentively: looking, listening, feeling and so on are attention-laden concepts. So also are other higher order concepts like perceiving, thinking, enjoying, where the activity in question requires that concomitant present activities might be detected. On some occasions engaging in an activity attentively necessitates engaging in another activity - thinking, for example - at the same time. But the second activity is not itself a sui generis activity of attending.

[4]

When we come to look at attention from the physiologist's point of view, we notice that they have taken a fairly casual view toward the need for a precise definition of attention. For the physiologist, attention has to do with whether or not stimulus information reaches some unspecified level within the nervous system. As Vaughan and Ritter (1973) state: "It is assumed that the afferent activity generated by unattended stimuli gets suppressed somewhere along the way, and, conversely, that activity generated by attended stimuli is likely to be enhanced relative to neutral stimuli. Thus, physiological contributions have been limited to speculation on the neural structures involved in the enhancement or suppression of sensory input, and attempt to demonstrate the existence of the postulated afferent modulation". The physiological approach to attention has been dominated by the important ideas generated from the knowledge of the role of the reticular formation in the modulation of arousal. The experimental evidence gathered by several authors (Moruzzi & Magoun, 1949; Lindsley, Schreiner, Knowles, & Magoun, 1950) demonstrated the role of the midbrain reticular formation in the EEG and behavioural manifestations of arousal. Subsequently the cerebral

extensions of the brain-stem reticular formation - the 'non-specific' thalamic nuclei -, were postulated to control focal and phasic shifts in cortical activation related to selective attention (Jasper, 1960). However, it is not known what sort of modulation has to be accounted for by the mechanism of attention attributed to the thalamic reticular system.

Hernandez-Peon (1961) and his co-workers were involved in experimental studies in this field. He employed two basic experimental procedures: 1) Recordings of sensory-evoked potentials to monotonously repeated stimuli. It was presumed that the EP amplitudes might covary with fluctuations in attention. 2) Recordings of evoked responses to the presentation of repetitive stimuli and its amplitude variation while another, highly significant stimulus was delivered before, during and after the presentation of the former repetitive stimuli. It was presumed that the repeated stimuli were not attended during presentation of the distracting stimulus.

His findings suggested attenuation at the first nucleus of the respective sensory pathways when the stimuli were presumed to be unattended. It was postulated a centrifugal inhibitory action of the reticular formation on the specific sensory nucleus. In fact, experimental evidence has showed that in the cat, for example, fibres arising in the medulla pass along the auditory nerve toward the cochlea (Rasmussen, 1946). Electrical stimulation of these fibres is followed by a reduction in the response of the auditory nerve to an acoustic stimulus (Galambos, 1956). But as Horn (1965) has stated: "There is nothing inherently improbable in the hypothesis that these centrifugal fibres play an important role in selective perception... but the question is whether there is any physiological evidence to

support it. Not all the evidence claimed to support the hypothesis does so in any direct way".

The experimental findings of Hernandez-Peon have been criticized not only by Horn but by Worden (1966) in an extensive and effective way: the magnitude of the changes observed was extremely small, and of the same order of size as found in spontaneous fluctuations. There was no averaging of responses to increase the reliability of the records. On the other hand, the experiment has proved remarkably resistant to efforts to repeat it. Thus, the role of centrifugal modulation of afferent activity in sensory and attentive process remains undefined. The evidence from psychological studies (Moray, 1959) is not consistent with the hypothesis of afferent neuronal inhibition. Most of the responses of a subject are dependent not upon physical parameters, but rather on the cognitive significance of the stimulus, therefore peripheral input attenuation would seem at most to represent but a limited feature of attentional mechanisms.

Other efforts to detect evidence of attentional effects on input have observed evoked potential (EP) at the cortical level, including human averaged EP, and used that as physiological index. The experimental approaches again have employed changes in the size of the EP as a criterion of loss of attention. In a review of the literature, Moray (1969) refers to this criterion in the following way: "Compare for example, the magnitude of the voltages which can be recorded in the EEG of sleep, and the waking EEG.. The huge synchronized discharges of deep delta-wave sleep are among the highest non-pathological voltages which can be recorded, and yet the organism is almost totally unresponsive. If we were to assume that size of evoked potential was an index of activity, we would have to conclude that the human

observer is intellectually most lively when he is fastest asleep".

Other cortical potentials has been used like the association cortex potential (ACP), (Vaughan, 1969; Vaughan and Ritter, 1970) a long-latency positive component of the EP which appears whenever a stimulus is presented unexpectedly or a sensory discrimination is required. The ACP differs from the EP in relation to the factors determining their latency and amplitude. EP parameters are defined primarily by stimulus variables, and the ACP by task variables or stimulus significance. The EP is stable in latency for given stimulus parameters, the ACP show remarkable fluctuations in latency. But these studies as previously stated, suffer from the validity of EP amplitude measures. Potential shifts of greater duration that the transients of the EP (that is >500 msec) commonly called steady potential shifts, has been correlated with changes in arousal level (Caspers, 1963). However, the most important steady potential shift was described by Walter and colleagues (Walter, Cooper, Aldridge, McCallum & Winter, 1964) as a cortical sign of conditioning. This negative steady potential shift is the contingent negative variation (CNV) which appears in the conditioned response to the pairing of a "conditional" and an "imperative" stimuli. It was described initially as a cortical sign of expectancy and was alleged to originate from widespread sources in frontal cortex. Subsequent investigations by Walter and others have led to a number of modifications and qualifications of the early descriptions. In view of the possibility that a number of intracranial sources as well as extracranial sources of potential shifts (skin and corneoretinal potentials) may be contributing to the scalp-recorded steady potential shifts, a good deal of work remains to distinguish fact from artifact in human scalp

steady potential shifts recordings. At present, most authors admit that all in all we know little of importance at the physiological level in connection with selective attention (Moray, 1969; Vaughan & Ritter, 1973). The latter authors state that: "Once it is acknowledged that attention must be viewed as a manifestation of extraordinarily complex and varied neural transactions, the fruitless search for simple 'neurophysiological correlates of attention' finally will be abandoned".

[5]

We ought to mention, though briefly, our position in the mind-brain identity theory of the mind-body problem, if only because in recent years a number of scholars have put forward the thesis to the effect that mental events are identical with certain physiological events, (Place, 1970; Smart, 1963; Nagel, 1970; Armstrong, 1970). The theory attempts to show that an event considered typical of the mental, like a sensation or the having of an after-image, can be considered to be identical with a process in the brain, or some physiological process in the body as a whole. Granted that further research in neurophysiology, biochemistry and so on will produce results which will confirm the thesis beyond further objection, the search is for a set of correlations between the having of after-images, and so on and brain process. Those correlations are the 'ground' of identity theories. Every mental event must be invariably accompanied by a given brain process. Some authors have used as analogues for the identity theory, the lightning and the electric discharge, but because the identity in this case - namely, sameness of location - is not applicable in the mind-brain identity since mental events cannot be given as precise a location as physiological

events, the weight for the thesis rests in the ability to correlate events of the two kinds - mental and physiological.

It has seemed to many materialists that the discovery of those correlations is plausible because the only alternative of explanation is to hold some sort of 'interactionist' view, that is, mental and physical events being happenings of fundamentally different kinds which are in causal interaction with each other.

One way of deciphering the difference between the two views is as follows (Taylor, 1970):

(1) On the non-interactionist view, human behaviour is explainable using only laws and conditions governing events on the physical level. On the 'interactionist' view mental events are sometimes causes of physical events.

(2) On the 'interactionist' view, it is possible (both logically and ontologically) to be mental happenings, not linked with any physical happening. On the non-interactionist view the ontological possibility is denied and though not denying the logical possibility of disembodied mental happenings, the possibility is denied as far as human mental happenings is concerned.

The interactionist view is on the wane now. The idea of disembodied thought or feeling is not very credible these days (see however, Eccles and Popper, 1977). Thus, if all behaviour can be explained in physiological terms, then the thoughts and feelings we have will be by-products on those physiological conditions to which we must refer to explain behaviour. So if we discover correlations linking thoughts, emotions, etc., to physiological happenings, we must consider them as identical with the physiological conditions with which they are linked. The idea seems more plausible because

of the implausibility of interactionism. But, can we discover correlations between certain mental happenings and the holding of certain physiological conditions ? The answer requires some elaboration: even granting the possibility of explaining behaviour by laws and conditions expressed in physiological terms, it does not follow that we can discover correlations between thoughts, or emotions and physiological happenings. We have no guarantee that the same phenomenological thought will be accompanied by the same brain state or a finite disfunction of brain states in the same person, not to mention all human beings.

The existence of law-like regularity at the physiological level which enables control at the psychological level, does not mean that we can discover one-one or one-many correspondences between the two terms. It pressuposes the existence of a definite range and only one exact mode of classification of a set of phenomena. We can, certainly, explain any behaviour at the psychological level by concepts and laws at the physiological level, and that can give a more fruitful explanation.

However, granted the discovery of explanation of behaviour in physiological terms, and that mental events are not independent of the physiological but susceptible of explanation themselves in physiological terms, it does not mean that we can discover correlations between mental events and brain states, even a finite disfunction of them. The validity of this assertion must rest on empirical discovery. But the use of some mental events like an after-image, or a heel-pain being correlated with specific neurophysiological happenings has led to the idea that the same type of correlations can be found for some mental happenings as: hatred, dicision, love and so on. The more inclusive or universal the mental event, the less plausible is to suppose a correlation. That may explain the stock of examples used by the identity theorists which

reflects back in their empiricist tradition. But even if theories of general identities between mental and physiological events are not invulnerable, a given mental event will be mediated by some physiological happening and particular identities can be established. But the possibility of a systematic replacement or 'reduction' of phenomenal vocabulary by physiological terms is a very far-fetched possibility. Mental events can occur only if mediated by the physical events of which they are the reflection, or on which they are dependent in some way. This relation between the physical and the mental can be described using the concept of 'embodiment' (Taylor, 1970), and in this sense even when no mental event can occur without the corresponding physical embodiment - for example thinking in terms of a corresponding pattern of excitation in the brain - the physical embodiment may differ from case to case, and for phenomena which can be described at more than one level, in more than one mode of classification, it is not possible to determine a priori which level will yield explanations of the phenomena which will enable us to predict and control them, or which level will yield the most fruitful explanation.

In any of our experiences - looking at some picture, for example - more than one neuronal event is involved. But if several neurones are involved in the process it is extremely unlikely that the same events will be involved in any other experience of looking at the same object. We can have diverse conditions at the peripheral level: lighting conditions may be different, the height at which the picture is being hanged may be different, we can see it through glasses or without glasses, with one eye closed and so forth. In this case, we have different neuronal events involved and yet phenomeno-logically the

experience is indistinguishable. Of course, it is possible to maintain that the processes are identical at upper levels - the visual cortex, say - but as is well known from physiological experimentations (Lashley, 1929; see Bartlett & John, 1973) the destruction of a small amount of neural tissue of any area in the cortex is compatible with the normal functioning of the area - in our case we have the same phenomenological experience. On the other hand, the events that condition the firing of neurons in the cortex are so complex that it is extremely unlikely that the same set of neurons would fire under any two or more perceptual situations. Some aspects of human activity, as in the case of certain pathological conditions, no doubt, can be more successfully explained on a physiological or biochemical level, but there are many other groups of behaviour where this is far from being the case, and it may be that a better explanation can be given in psychological terms which can have a teleological form: such and such in order that so-and-so (p in order that q).

Identity theory as a thesis asserting particular identities - a heel pain explained in terms of tissue damage or nerve excitation, for example, is unquestionable and could be seen as identical with the thesis of a universal embodiment (Taylor, 1970 p 240), that is, all mental events are mediated by physical events - but once accepted in this form the identity claimed by the theory turns out to be relatively uninteresting. The theory has the virtue of being one of the most serious attempts to come to grips, conceptually, with a continuously increasing body of neurophysiological knowledge. Its implausibility cannot be seen as expressing the view that the only way out is to accept interactionism. In fact, an alternative more plausible view under the name of information processing theory (IP theory) has been

put forward by Sayre (1969). According to this theory, "neuronal events constitute the channels by which information deriving from sensory stimulation is processed into conscious responses. Consciousness is the processing and not the activities in the nervous system by which the processing occurs. One might say also that the neural events between receptor stimulation and cortical response are the code elements by which information is passed along for processing. To assert that consciousness is identical with the neural events rather than the processes they support, is to confuse the code with the information".

C O N C L U S I O N

CONCLUSION

We have been arguing that attention consists in the structuring of the field of consciousness into a background and a foreground; the object of attention acting as a centre which organizes consciousness around it. How can we account for the change in consciousness - i.e., different 'objects' 'moving' from foreground to background and/or out of consciousness? One way is to appeal to introspection.

There is a view in psychology asserting that psychological concepts are abstractively derived from inner experience. This inner experience is a sort of quasi-sense related in some way to physical occurrences. It is supposed that we form a concept of judging or desiring by discriminatively attending to, and performing abstraction upon, the retrieval of this 'introspective' quasi-sense. The quasi-sense is compared to seeing - introspection -. There are some peculiar difficulties with the notion of 'inner sense' which make them untanable (see Geach, 1957). At any rate in our case it is asked to make one's mind blank and rely on the memory of such states. As we have been asserting throughout we are dealing with a 'fluid' situation and it is very difficult to tell, in retrospect, which element was in the fore at a particular time.

An explanation of the situation is offered by Ribot (1890) and under similar lines by Wilson (1972): attention is grounded in the emotional nature of the organism. Ribot states his view as follows: "Any animal so organized that the impressions of the external world were all of equal significance to it, in whose consciousness all impressions stood upon the same level, without any single one predominating or inducing any appropriate motory adaptation - were exceedingly ill-equipped for its own preservation. I shall overlook

the extreme case, in which predominance and adaptation would favour detrimental impressions; for an animal thus constituted must perish, being an illogical organism - a kind of incorporate contradiction. The usual case remains, viz., the predominance of useful sensations, that is, of those connected with nutrition, self-defence, and the propagation of the species. The impressions of prey to be caught, of an enemy to be avoided, and from time to time, of a female to be fecundated, become settled in the consciousness of the animal with their adepted movements. Attention, thus, is at the service of and dependent upon necessities; always connected with the sense most perfectly developed, the sense of touch, of sight, of hearing, of smelling, according to the species. Here attention is seen in all its simplicity, and here it affords the most instruction. It was necessary to descend to those rudimentary forms, in order to grasp the reason of its power: - attention is a condition of life; and it will preserve this identical character in its higher forms, where, ceasing to be a factor of adaptation in a purely physical environment it becomes, as we shall see, a factor of adaptation in the social environment. In all the forms of attention, from the lowest to the highest, there is a unity of composition."

Wilson (1972, p 185) states, in a related context: "(3) The machine's behaviour has some coherence, for it can act at different types in pursuit of the same goal. But the various ends that the machine pursues do not in themselves form a coherent system. If they relate to one another, it is only through their common external imposition. The totality of a person's behaviour and of his ends of action does have a kind of coherence. There are two distinct ways in which different things that a person does can form a coherent

whole. As with the machine, different actions can add up to a single complex of behaviour because they are all directed to the same end. But different actions can also be part of a unified whole because they all arise from the same feeling or attitude. This is a distinct type of principle of unity of behaviour. In general, a person's actions, and the different ends he tries to achieve, are brought into relation one with another, mainly through the feelings and emotions he has in particular situations, and through his longer term attitudes towards the things and people and institutions around him, and towards himself in relation to these."

We agree with Ribot that a subject cannot be absolutely indifferent to his environment, otherwise there is no reason for him to pay attention to changes taking place in the environment to which he is aware. Even more, if the environment ceases to matter to the subject any more we hesitate to say that the subject is conscious of his environment. We are not saying that every event, person, etc., that catch the subject's attention has an emotional significance for the subject. If attention is grounded on emotional states, not every instance of attention is caused by an emotional state. As far as the environment is of interest to the subject, every perceptible change in the environment taken by the subject to be novel produces an alert reaction in him (the 'arousal reaction' in physiological terms). That novel stimuli can arrest the sense-organs of the subject quite involuntarily. We are all familiar with the fact that many startling stimuli do not arrest the relevant sense-organ. It happens when the subject is exposed to a number of repetitions of the stimuli, (the 'habituation response') and we can talk properly of an inhibition. But the inhibition at issue is not a 'physiological inhibition': the

stimulus is still 'picked-up'. What the subject inhibits is any further reaction to the stimulus.

Any subject or animal devotes most of his waking life to any sort of activity: looking about, listening and so on. These activities are natural and occur spontaneously at certain stages of normal growth. As we said above, the activities in question involves the movement of sense-organs. It is natural to think that to engage in some attentional activities we must suspend some movements. If we engage in looking at a picture attentively, we must suspend the movement of looking around. Thus, in some cases in order to pay attention to an object we must 'fixate' the movement of the sense-organ concerned in order to be successful. In other instances we must use our sense-organs movements in order to pay attention to the 'object of attention' as when we watch a tennis match for example.

We must not loose the thread of the argument because if we can account for a unity of behaviour in different terms of efficient goal-directedness, it can partially explain why a machine is seen as inadequate as an analogue of man. Thus, human activity not only is goal directed (most of the time those activities are loosely related to the ends) but the goal in itself has some meaning, which may or may not be justified, but is comprehensible and that comprehension springs from feelings and attitudes (Wilson, 1972, p 186). When we try to explain behaviour we can, and very often do, use the notion of end or goal and that end can be given sense by reference to more distant and/or general goals. But it can also be given sense by reference to an emotion or attitude. Quoting Wilson once more:

"The many feelings and attitudes that a person has themselves form a coherent whole, though not an entirely consistent one. A

person may have many contradictory and conflicting attitudes and beliefs, and even in particular situations ambivalence and inconsistency of feeling is common. But such inconsistency exists within a larger coherence. A person's total outlook, the whole collection of his feelings and attitudes and beliefs and opinions and views as to what is and ought to be the case, his expectations of others and conception of himself, his notion of what life is all about and of what is worth striving for, makes sense as a network of interconnected items loosely strung together, not as a logically ordered, hierarchical, self-consistent system."

If we base a subject's activity and its ends as rooted in feeling and attitudes we are explicitly stating that the view of rationality of man which is based only in terms of mean-ends is, to say the least, incomplete. We must account for feelings and attitudes as not opposed to reason. The view already stated according to which consciousness consists of a foreground and a background allow us to see how an emotional state can be jointly present with a state of awareness. The current criticism of emotional states as feelings is ill-founded. It is based in the presupposition according to which feelings and experiences belong to the same subject. As Johnson (1978) in a similar context has put it: "Wherever there are experiences there is the (logical) prerequisite of experience. Kant took for granted that the experience and the prerequisites 'belong' to the same person; hence the person must 'know' the prerequisites. There is a view which says that we must divide here: experiences belong to the learner, the prerequisites to the reflective observer"..."If we mean by 'experiencing' being the person whose physiology (or hardware) is buzzing with activity, then the experience is without a doubt that person's. But if by possessing

these experiences we mean being in the best position to name, recount and appraise them, then it is an illusion (created by the Cartesian inheritance) that the one to whom these 'experiences' happen is in the best position to tell what these events are. To have the experience, in the sense of being able to tell what they are, is a function of the relective observer and no other."

Most of the criticisms advanced against the 'feeling theory' of emotional states point in the direction of a lack of evaluation. We do distinguish between shame and embarrassment, for example, by reference to how the subject perceives the object of emotion. Even with subtle differences in bodily patterns associated with the two, it seems that the basis of the distinction is that it is necessary for shame but not for embarrassment that the subject take the object to be something which is his fault. The presence of such evaluations seems to be what makes bodily states and sensations emotional. It has been claimed that no perceptual evaluation of the appropriate sort can be completely unemotional but it still remains true that two persons can see a situation as equally dangerous, yet one be much more frightened than the other. Thus, being frightened cannot consist only in seeing something as dangerous, since the degree of fright can vary without a variation in the perceptual evaluation. As we have pointed out above, that evaluation belongs to the reflective observer. It could mean that we are heading for some sort of objectivity, but the objectivity at issue cannot be the objectivity of the 'reversible'. (Piaget and Inhelder, 1958, Piaget, 1968). Reversibility is a certain concept of objectivity which naturally goes with a picture of the real as a system which can undergo a coherent set of transformations, that is, something which would ideally be manipulable in a coherent way, and connected with

this it implies that we abstract from their significance for us in coming to grips with them. But the objective understanding and explanation of our emotions need to have different characteristics. Above all there is no point in abstracting from the significance for us what we are examining in trying to understand one's own feelings. If we abstract from 'their significance to us" we are shifting our object of study, and in some way failing to come to grips with the original problem. In fact any substantial gain in our understanding of our feelings changes them in ways which are often irreversible, either factually or intellectually. Thus, the objectivity we are pursuing here is different. The conceptualisation of that different sort of objectivity has to bring in notions as tendency that are intrinsically teleological in character. The concept of consciousness will be inextricably bound up with our idea of how it develops. And this fact cannot be thought of in the traditional sense as a 'value free' science, but neither it must proceed with any less regard for empirical fact or care in formulation and testing of theories.

By way of summary it is desirable to stress the following points.

Attention is regarded as an activity of the person. The activity is seen as an inter-relation between the subject of experience and his environment. It means that we must cease to see attention either as a statistical property of the object (the source of attention) or as a specific mechanism inside the subject which allows to enter in some stimulus and reject the others. If at all, those properties belong to the inter-relation between a person and his environment -

his activity - and this activity is at the service of the purposes of the subject.

It is argued that the object of attention produces a structuring of the field of consciousness by means of which the object of attention stand in a foreground constituting the awareness of the subject. In order to sustain that awareness some sort of activity is required. The activity in question is related to the sense organ used in that activity. (see page 90)

The object of attention itself is considered in holistic terms - i.e. a system as considered in General System Theory - and not as something 'constructed out' of sensory stimuli. Hence conflict of attention comes about when the activity of the subject has to deal with 'different systems'. But depending on alot of factors: culture, skill, age, etc. those different systems can be embedded in a larger one which can be comprehended by the subject.

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A P P E N D I X

There has been a lot of work in the area of modelling in order to get a realisation of the description of mental processes.

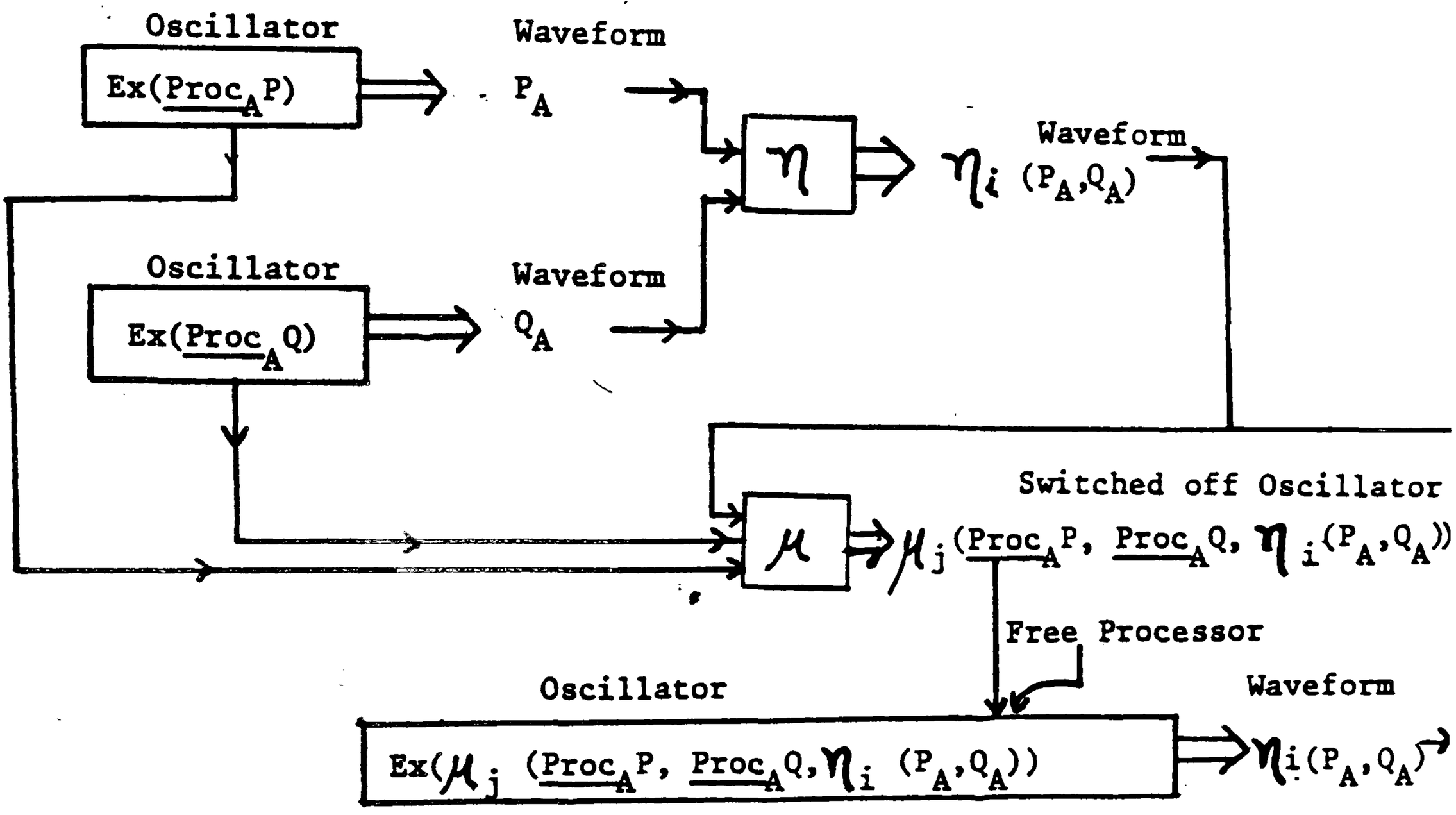
Beurle (1954, 1959) used activity in mass cell arranged in such a way as to produce regenerating impulses storaging and manipulating information in such cells.

One of the most inclusive models is the one of Pask (1975). His model was devised as a realisation of the description of a concept and concept learning.

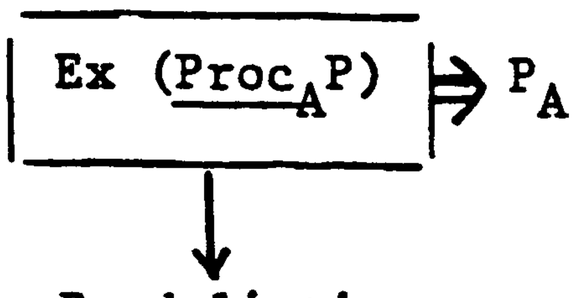
Essentially, the same ideas can be used to represent a description of the attentional phenomena. The following particularisation, appropriate to this study, has been constructed to provide an interpretation in the field of attention and its occasional specificity. The elements of the specialised model may all be units as described by Beurle (above) although, in fact, non linear oscillators were employed for this implementation.

The implementation is one realisation of a free production scheme described in Pask (1977, 1978) for a derivation (see Pask above) of a "topic" T from a topic P and a topic Q (this author alludes to the generators of topics as stable concepts, that are derivable from others; A, B, stand for "participants" (for example, organisms), which have DB (or Description Building) and PB (or Procedure Building) operations, in their cognitive equipment.

Ex, stands for execution of a process; T, P, and Q are different topics of which a participant, A, has a stable concept for P and Q to begin with and derives a stable concept for T.



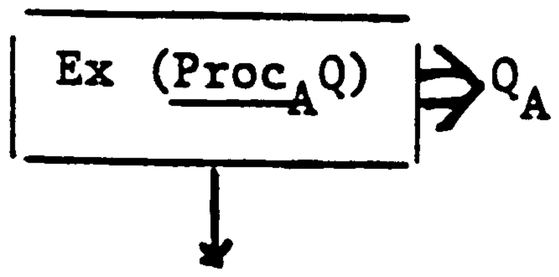
it is assumed, initially, that oscillators (corresponding to the indefinite iteration of "procedures" $\underline{\text{Proc}}_A P$ and $\underline{\text{Proc}}_A Q$ in distinct processors) exist and are turned on, to emit waveforms P_A and Q_A (the descriptions computed by $\underline{\text{Proc}}_A P$ and $\underline{\text{Proc}}_A Q$). If used as input to the device, η, with parameter i, the waveforms are combined and form, for some value of i, the waveform $\eta_i\ (P_A, Q_A)$. A further device μ, with parameter j accepts as input $\underline{\text{Proc}}_A P$, $\underline{\text{Proc}}_A Q$ and the combined waveform $\eta_i\ (P_A, Q_A)$, such that for some value of j, there is created or programmed in a free independent processor, an independent oscillator emitting the waveform $\eta_i\ (P_A, Q_A)$. To clarify the matter one serial or sequential approximation to the (actually parallel) process, so described, is as follows.



1. Read listing

$\underline{\text{Prog}}_A$P in

$\underline{\text{Proc}}_A P = \langle \underline{\text{Prog}}_A P, \underline{\text{Inter}}_A \rangle$



Read listing

$\underline{\text{Prog}}_A$Q in

$\underline{\text{Proc}}_A Q = \langle \underline{\text{Prog}}_A Q, \underline{\text{Inter}}_A \rangle$

2. Read $\eta_i(P_A, Q_A)$

3. Combine $\underline{\text{Prog}}_A$P and $\underline{\text{Prog}}_A$Q (some value of j in μ_j) to form

$$\mu_j (\langle \underline{\text{Prog}}_A P, \longrightarrow \rangle , \langle \underline{\text{Prog}}_A Q, \longrightarrow \rangle, \eta_i(P_A, Q_A))$$

4. Interpret program in free processor (fresh $\underline{\text{Inter}}_A$) to give

μ_j ($\underline{\text{Proc}}_A$P, $\underline{\text{Proc}}_A$Q, η_i (P_A,Q_A)).

5. Trial execute the combination interpreted, and ascertain if results in η_i (P_A,Q_A).

6. If, and only if, this is so, for at least some value of i (the parameter of η_i), instate the combination

μ_j ($\underline{\text{Proc}}_A$P, $\underline{\text{Proc}}_A$Q, η, (P_A,Q_A)) and call the combination, tentatively, $\underline{\text{Proc}}_A$T.

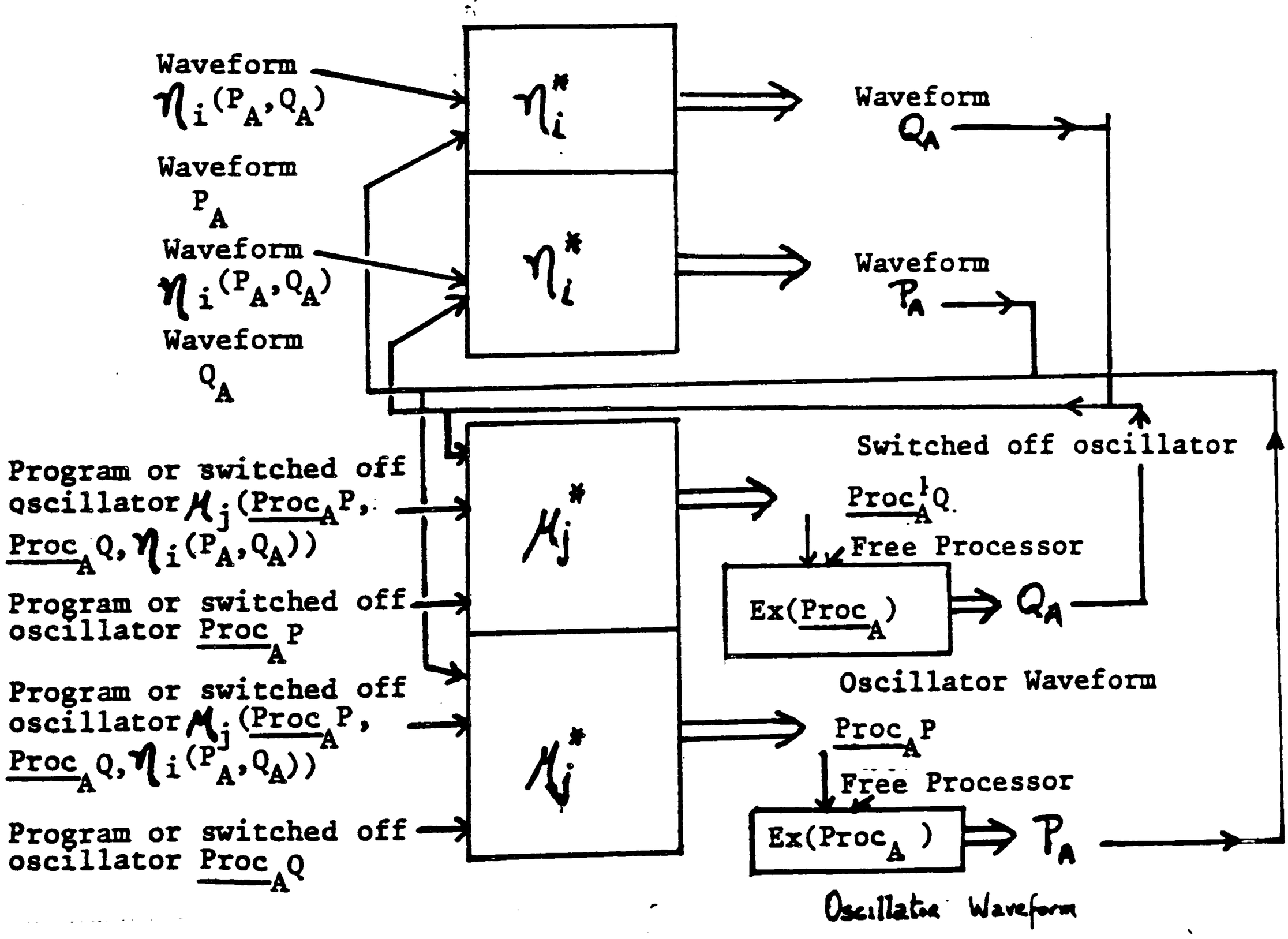
7. If not, then change the value of j (in μ_j) and thus the combination of $\underline{\text{Prog}}_A$P and $\underline{\text{Prog}}_A$Q. Return to step 4 in process.

8. Execute (tentative) $\underline{\text{Proc}}_A$T so that Ex($\underline{\text{Proc}}_A$T)$\Rightarrow$ T_A (tentative).

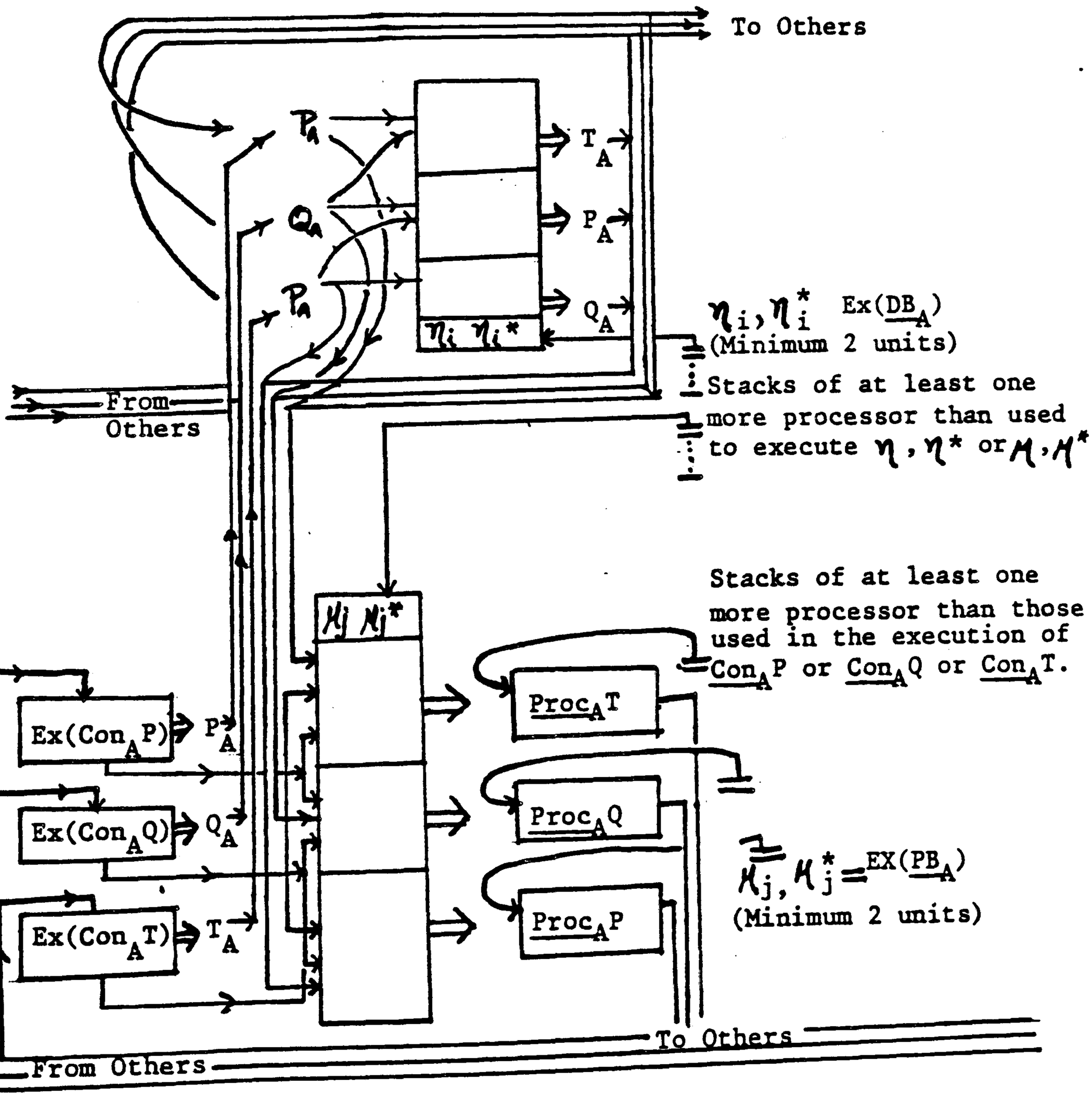
This serial approximation of the coupling process involving device η and device μ which may, otherwise be regarded as a complex form of resonance involving, for μ, combinations of descriptions of oscillators (their structures) and, for η, combinations of the descriptions generated by these oscillators (their waveforms). using the notation of Pask (1977, 1978) a procedure, for example, $\underline{\text{Proc}}_A P$ or $\underline{\text{Proc}}_B P$ (another participant, B) is specified as

$$\underline{\text{Proc}}_A P \triangleq \langle \underline{\text{Prog}}_A P, \underline{\text{Inter}}_A \rangle$$
$$\underline{\text{Proc}}_B P \triangleq \langle \underline{\text{Prog}}_B P, \underline{\text{Inter}}_B \rangle$$

where Prog is a program or algorithm and Inter is an interpretation open to execution by participant A (or B).



If, for some values of parameters i and j, the conjugate and converse transformations (together with the further pair of free processors) are able to satisfy the stipulated conditions η_i (P_A, Q_A) is known at T_A, and μ_j ($\underline{Proc_A}P$, $\underline{Proc_A}Q$, η_i (P_A, Q_A) is known at $\underline{Proc_A}T$. If these requirements are satisfied, then the originally $\underline{assumed}$ $\underline{Proc_A}P$ and $\underline{Proc_A}Q$ have been $\underline{constructed}$ as $\underline{Proc_A}P$ and $\underline{Proc_A}Q$. Further, there are conjugate and converse transformations which yields a $\underline{Proc_A}T$, such that $Ex(\underline{Proc_A}T) \Rightarrow T_A$. Under these circumstances the device pair η, η^* forms a $\underline{DB_A}$ operator and the device pair μ, μ^* forms a $\underline{PB_A}$ operator; also η, η^* is an oscillator and μ, μ^* is, in $\underline{this}$ context, an oscillator.



This is a minimal, or nearly minimal system of oscillators for a stable concept, which is one implementation of a free production scheme as realised by partly synchronised collection of machines such as an array processor with initially asynchronous modules. The system is informationally open as well as organisationally closed, insofar as the lines shown as "from others" and "to others" exist; that P_A, Q_A, T_A: $\underline{Proc_A}P$; $\underline{Proc_A}Q$, $\underline{Proc_A}T$ may be constructed in other organisationally closed systems, and the products of this system be more coherent with other systems. The essential point is the realisation of the "in Con" relation, where "Con" is a semi-coherent cluster of procedures (for example) $\underline{Con_A}T$ is specified as $\underline{Con_A}T \triangleq \underline{Proc_A}T$ or $\lceil \underline{Proc_A}T \rceil$ or $\{\{\underline{Proc_A}T\}, \lceil \underline{Proc_A}T \rceil\}$ where '$\lceil\ \rceil$' signifies a coherent set of processes and '$\{\ \}$' signifies an unordered set.

Evidently, very many physiological mechanisms as well as electronic mimicries will satisfy these conditions and maintain specificity without appeal to a particularTransmitter/Channel/Receiver model

Empirically, the system is stable and correctly images, for example, McCulloch's "Redundancy of Potential Command", though without committment to particular physiological identification.

The arrangement acts as a complex multiple mode oscillator, the stability and unity of which depends upon an information transfer in the sense of Petri. This property obtains because the model is not a computer simulation but an actual process (compare this with the simulation on a serial machine, of

McCulloch's "redundancy of Potential Command" where, regardless of the detailed neuroanatomical image, the transfer of information is also, necessarily, simulated by a probabilistic component and a "random" input) . That is necessary because the prior independence of the unit oscillators, or active filters, is, in turn simulated, and the "random" input is present in order to simulate, independency or incoherence, allowing for the appearance of partial coherence or dependency .

A manifestation of partial coherence, or dependency, is a transient hierarchical organisation, certain modes of non linear oscillation being (transiently) dominant . Here, these modes are the "topics" T, P, Q, or combinations of topics; in that sense a system said to "know T" may "attend to" T, or to P, or to Q, etc. This implementation is interpreted and identified with the more general ideas of my thesis as follows. One topic (at least) will constitute the "foreground" and the remainder the "background" ; for example, if T_A is the "foreground", then P_A and Q_A are the "background". Details of this implementation, using the elements of a Fuzzy Set simulator (see photograph) and its interpretation are given in research Memorandum, (F Hernandez Chevez (1978) System Research, or a paper (Hernandez Chevez (1978) below);

This equipment (the photograph) is intended for studying concurrent processes. It consists in a (programmable) collection of analogue integrators and linear and non linear multiplying and threshold elements; delay, logic, and switching modules;

impulse counting shift registers with location storage for setting up either parameter values or event sequences. Replica hard wired implementations of "relational operators", acting upon small finite sets (such as "join" and "projection"). The implementation was hand simulated only with regard to providing the free processors from "stacks", and this amounted to switching in further oscillatory modules, as required.

As a less trivial exercise (for the implemented oscillator system is only a tool of demonstrative value), it has been possible to use special runs with the team decision system (ARI Grant DAERO 76-G-069) at System Research Ltd. In this system, each participant has multiple display and programmable control of up to 2 x 2 "vehicles" normally employed in a complex command and control task but, in this case, for data gathering.

It was possible in these special runs to confirm the predicted effects with human subjects engaged in human decision making. This work is described in a forth-coming publication (Hernandez Chavez (in press)) .

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