The notion of 'concept' in cognitive psychology
An overview and critical analysis

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1 Problem

This article has grown out of the difficulties I met when trying to create a clear and unambiguous idea of the meaning of the term 'concept' as an object of psychology. Different authors used it to denote quite distinctly discriminable denotata. Distinctions are rarely made explicitly. Moreover, it is only a few years now (in fact since the article of Haygood and Bourne of 1965) that partial attempts have been made to distinguish between structurally and functionally diverse notions of concept, starting off from experimental experience. The latter made it clear that the lack of relevant distinctions (as translated in the definitions) results in wrong options about the forms and properties of thoughts.[1] I shall try to avoid this fault, by introducing an extensive theoretical frame (based on both theoretical and experimental data) to classify the notions of concept that are used nowadays in cognitive psychology.

The following items will be touched subsequently:

— the *pre-analytic* notion of concept: which problems of psychology are tackled? What are the diverse intuitions of the authors?

— *explanation and comparison* of the theoretical notions of concept in cognitive psychology.

— selection of a *valid notion,,* and conclusions.

2 Analytic frame

The intention of this article is primarily philosophical-scientific: it wants *to clarify the meaning* of the terms used by the psychologists. As an instrument of clarification I use an aprioristic frame of reference, that consists of a set of (in my opinion) necessary discriminations to make the field of research (i.e. psychological theories about concepts, induction conceptual behavior, etc. . .) transparant and analyzable. This frame of reference seems necessary to me, because, as mentioned above, the term 'concept' refers to many different denotata in the theoretical psychological research. The confusion that in fact results from this state of affairs *may*

be the cause of the complete lack of any substantial progress in the field for nearly twenty years.[2] The proposed classification may add some support to a renewal. The following distinctions are introduced:

A Distinction between individual and general stimuli, attributes, etc. — In this analysis a strict distinction is made between individual versus general versus abstract stimuli, attributes, etc. . . .

— the term 'individual stimulus' refers to one specific (or concret) spatiotemporally delineated stimulus. For example, the 'title of this article, presented at moment t1 in place p1 to Prof. X'is an individual stimulus. Similar characterisations should be given to all other concepts, as there are individual attributes, subjects, concepts (but see also the remark!) etc. . . .

— the term 'general stimulus' refers to the (similarity) class of all equivalent individual stimuli. One abstracts from the spatiotemporal peculiarities. In the example given above, the 'title of this article' is a general stimulus, whatever bundle of this issue one takes at hand. It is clear that a general stimulus is not a perceptible phenomenon, but a mere construction of the mind. Once more, the same can be said about general attributes, etc. . . .[3]

— the term 'stimulus' or 'abstract stimulus' is a further abstraction. It refers to the class of all general stimuli. This class (or set of equivalent elements) groups all phenomena that are equivalent in terms of their being-stimulus. For example, in this respect one can speak about The 'conjunctive concept'[4], when referring to the set of all general conjunctive concepts or the common proporties of the set. The same goes - mutatis mutandis - for 'stimulus', 'attribute', etc. . . . .

Remark: It is impossible to characterise an individual concept as temporally finite. Since its length of time depends of that of the thought in which it emerges, and since the latter is impossible to 'mesure' (or segment) otherwise than arbitrarily, it seems meaningful to me to define the 'duration of an individual concept' in terms of memory functions: the temporal delineation of it is equal to the time that passes between the attainment of the concept and its forgetting. Once a concept must be 're-formed', I shall speak of a new individual concept.

B Cognitivism and internal factors — S-R psychologists consider thinking as a set of more or less complex networks of relations between a set of one or several stimuli and a set of one or more responses. This approach bears two fundamental methodological deficiencies:

1 — Asch (1968) points to the total undefiniteness of the term 'concept' in this respect: a concept is a S-R-relation (or -structure), of which

neither the stimulus, nor the respons aspect is in any way defined. 'They identified the latter (-stimulus) with the external conditions, without inquiring how the psychological stimulus is achieved, or how a sequence of events becomes a unit; in this way they avoided reference to perception. By dealing similarly with responses they eliminated the analysis of action'. (p. 224)

This critic is relevant here, because I think it one of the merits (and characteristics) of the 'cognitivists' in psychology to have tried to give rather precise definitions of perceptual and action components when dealing with conceptual phenomena. Thereby they stress the continuity and unity of information processing within man in his interaction with the environment (See also further, sub Bruner).

2 — Bever, Fodor and Garrett (1968) constructed a Meta-Postulate of S-R Psychology', a criterion to test wether a proposition is or is not consistent with the theoretical options of S-R-psychology. It goes: 'Associative principles are rules defined over the 'terminal' vocabulary of a theory, i.e. over the vocabulary in which behavior is described. Any description of a set of elements between which an association can hold must be a possible description of the actual behavior'. (p. 583)

This metapostulate constitutes a formal limit for the validity of S-R propositions. The authors then demonstrated that several phenomena of a certain complexity, for example concepts, can not be described in a consistent way within S-R theory (or in S-R language). They give themselves the example of the mirror image, that can not be understood by reference to actual behavior, since there is not any such thing involved.

Once more this article gives an important hint, proposing a necessary characteristic for 'cognitivistic' theories: in human mind the thinking processes occur following inherent rules and in the form of structures or mechanisms (see further) that:

— are *not reducible* (stricto sensu) to stimuli or responses, or a simple association between them,

— do realize a connection between 'rather well-defined' imputs and outputs. Hereto the cognitivist introduces subsystems of selection and processing that constitute the basis of interactions between individual and outworld.

Summing up, the following requirements are necessary (but maybe not sufficient) to call a theory 'cognitivistic'[5]:

1 — well-defined notions of stimulus ans respons (action) in the analysis of concepts.

2 — structures, processes and mechanisms of thinking are principally irreducible to stimulus and/or respons groups.

3 — the organism (black box) has its own laws, regularities (syntax?)

that are to be found. Moreover the organism is characterised as a totality. It is my intention through this article, to work out a more systematic cognitivistic approach on the field of concepts. In that perspective the existing cognitivistic theories must be reconsidered and divided in subcategories along two discriminating criteria: see sub C and D.

C Stimulists and action-psychologists — This distinction is theoretical in nature. It is not based on experimental facts, but on the finding that in psychological theory construction two factually not-constituted sets of individual scientists submerge. The proposed distinction unites each set as an 'approach'. The *stimulists* are the psychologists who try *to describe thinking* (conceptual behavior) *completely in terms of stimuli, stimulus organization,* etc. in their relation to action. *The action-psychologists* try *to describe thinking in terms of actions, movements, etc. . . habits.* It is rather peculiar that not one author in the literature on concepts started a systematic confrontation of[6] both views.[7]

D Structure, process, mechanism —
(a) The term 'structure' will be used in this article in the sense of *'cognitive structure'*[8]. Structure is then defined as follows: *the network of relations that consists of the relationships between its elements.* The genesis of this network, the inducing of the structure out of individual set(s) of mutually discriminated attributes (units of perception) is called 'grouping'. The principle that controls this grouping is the *rule.* In a formal notation, the rule can be circumscribed *as the set of properties of the relations that exist between the elements of the structure.* Hence the rule is not the relation itself. This distinction will turn ou to be very useful.
(b) The term 'process' refers always to *'cognitive process'* (same note 8). An individual process is a clearly distinguishable *factual operation which is set at work on information inputs.* For example, with information units red, green and blue, the individual cognitive processes could be: select red, etc. . . ., construct the dimension (color), etc. . . .
(c) The term 'mechanism' points to *'cognitive mechanism'*. I define it as follows: *a mechanism is a set of minimum two cognitive processes that are mutually interrelated.* Somewhat intuitively one could speak of 'complex, dynamic structures'. For example, in everyday tasks an individual is demanded to discriminate between colors red, green and blue and to search for a unifying property between the perceived entities (the dimension: color). This whole train of operations forms one mechanism, one functionally or 'semantically' segmented psychological unit. Hence is taken by convention that the distinction between process and mechanism

rests primarily on the fact that the latter consists of more than one single process (or operation).

3 The pre-analytical notion of concept

What intuitive definitions of 'concept' are generally accepted? In what do concepts differ from percepts, from actions? How are these prescientific notions of ('concept' operationalised in the experimental research? First of all: on this level of analysis emerges a rather strict uniformity in the opinions of all authors considered (at least, as far as valid propositions can be made here). This can be concluded from the following facts:
— The explicit definitions of 'concept' (cf. sub. 4) uniformly focus the *reduction of information* in the conceptual behavior: the amount of bits of information in an individual concept is smaller than the number of bits that can be counted in the set of all individual stimuli that are presented. Operations as the *selection* of relevant information (and elimination of irrelevant) out of perceptual data, and the *grouping* of the diverse selected units into new, more englobing psychological entities (individual concepts) are held responsible for this reduction.[9] The intuitive notion of 'concept' that results is the following: a concept is a common answer to diverging stimuli. This notion can be found explicitly in Vinacke (1951) as well as the 'cognitivistic' works of Bruner et al. (1956: the concept of 'category'), Hunt (1962, ch. 2), Gregg (1967), Haber (1969), Posner (1969) and Bourne (1966, ch. 1) .
Still this notion is too general. As Prof. Vermeersch noted, it equally fits to describe 'Gestalt' or 'percept'. Only a few further going attempts to distinguish 'concept' from both percept and action can be mentioned (that is: in a cognitivistic approach):
a — Bruner et al (1956) and Hunt (1962) both discriminate perception from conceptualisation on a supplementary criterion: the process of perception is characterised by the *discrimination* between stimuli (or components), while conceptualisation involves *identification* (or grouping?). The latter can not occur without the former.
b — Piaget (1967) and Miller et al. (1960) make similar distinctions between general programs (schemata or concepts) and the specific operations (actions) they generate.
However imperfect they may be, these attempts are a considerable progress (they enable exact propositions) in comparison to the frequently used 'philosophical' words: percepts and/or actions are termed 'concrete', concepts are entitled 'abstract'.[10] Since these terms are ambiguous and therefor misleading, they will not constitute a useful tool for classification. A more rigid delineation of the concept in relation to both action and perception, is rarely given (cf sub 4). A more thouroughgoing analysis

and reconstruction will be attemped gradually.
All experimental settings encountered start off from the intuitive notion given above. Most probably the roots of this state of affairs are historical: all experiments in cognitive psychology concerning conceptual behavior are based on the basical experiment of Bruner et al (1956)[11]. Further argumentation for this thesis can be found in Bourne (1966)[12] Hence, I will proceed to reformulate the question asked above:
What intuitive notion of 'concept' is to be deduced from the experiment set up by Bruner et al.? In what way is this notion operationalised and really tested via systematic control and/or variation of the experimental variables?
The first question shall be tackled here. The second requires an overview of the experimental data at hand. It was handled with in Bourne (1966) and in Pinxten (1971, ch. V).
The experiment in the cognitivistic researches tries to 'externalise' postulated cognitive (internal) factors of the thinking organism,[13] through a procedure whereby the subjects are put in a problem-solving situation. The tasks are always: try to detect out of the amount of information that is supplied, the concept the experimenter has in his head. By the systematic comparison between the reactions (verbalisations) of each individual on each set of stimuli that is shown, the experimenter draws conclusions as to the cognitive structures, processes and/or mechanisms that must be presupposed as necessary and sufficient to account for the perceived reactions of the subjects.

Experimental situation — The individual is in a problem-solving situation. Before him are (or appear) stimuluscards that vary along four three-valued criteria (dimensions): color, form, number and framing. In total, the cards content 3^4 or 81 instances (stimuli). The subject is informed about his task. The method of experimentation is direct.
Instructions — The subject must observe the instances of the card closely and try to find the relationship between the set of stimuli in such a way that the card is looked at as the set of all examples and non-examples of the concept the experimenter tried to represent through it.
The subject must verbalize subsequently different hypotheses about the concept that is searched for. The experimenter evaluates each trial with 'wrong' or 'right', until the exact concept is formed.[14]

Conclusions — In the first place the discrimination of the different stimuli is required. The amount of information is here the maximum. Further on hypotheses are formed by grouping together different 'discriminated units'. Once the subject groups a sufficient number of data

in the right way, the problem is solved.
In what respect the intuitive notion of concept is hereby operationalised? In my opinion a much more specific, or rather more sophisticated 'concept' is given. The following elements supplement the intuitive notion:
— the reduction aspect in conceptualisation is very *specific* in nature: reducing consists in grouping, that is in constituting a class or a set of elements that have at least one property in common (for example: varying along a specific dimension is such a property).
— the grouping can take place in the most diverse forms, as can be seen from the instructions of different experiments and from the sort of rules of grouping required (see especially Bourne 1967). In this respect the quotation 'common responce' becomes quite superficial, much too general to be of any use as a relevant characterisation.
— moreover, the succession of the different hypotheses is not arbitrary, but proceeds along certain regularities (cf. decisions, predictability). This fact presupposes a much more englobing 'syntax' of thinking (or, more specifically, of induction), the context of which must be represented in the definition (be it intuitive or not) of the notion of 'concept'.
I think this are three differences that emerge while comparing the intuitions and the experimental settings. All three have to do with the relation between perception and conceptualisation -or: the diversity of the stimuli with respect to the uniqueness of the answer (concept). This problem will be central in the elaboration of the classification sub 4.

4 Analysis of the cognitivistic definitions of 'concept'

A The stimulists —

A 1 Definition and role of the stimulus[15]*:*

This section must bring a clear distinction between the S-R and the cognitivistic approach, in consequence of the critic of Asch (1968) cited above. Most cognitivists are inspired by Lashley (1951) as to their vision on perceptual aspects of thinking. Since the nervous system is a continually active system (with constant charge and discharge), and since perception is organised to a high degree in the central nervous system, a new stimulus is *always* integrated'into a system which is already actively excited and organised' (1951, p. 506). Hence a stimulus can only be defined as a neurological unity, once we are able to know the characteristics of the 'background of excitation', and to control it in an experimental situation.

A. 1.1 Perception:

Bruner (1957) started the 'information theoretical' approach to perception. In his attempt he distinguishes two important properties in the reception of information:

— veridicality: (p. 228) the things that are perceived are in some way a representation of the external situation.
— categorical aspect (p. 229): the received imputs are restructured, interrelated out of a chaos.
When the information is still further processed, different *categories* are formed[16], in terms of which further information imputs are selected as relevant, are interconnected, etc. . . .
A 1.2 The role of the stimulus:
Few things are known here (cf. Bruner's philosophical term 'veridicality'). Haber (1969) and Posner (1969) point to the importance of memory in this question: it would form an actively structuring device. I shall suffice to report some data about memory that are relevant is this respect.
Neisser (1967) states that stimuli can be hold in the 'iconic memory'[17] from 0 to 50 msec. after the ending of the stimulation. During the interval the role of the stimulus can be pointed at. The generation of a reaction (for example verbal expression in the experiments) endures *100 msec. for each digit* that is emitted (ch. 2, resp. a and f) These facts suggest a strong influence of coding of information in a memory and of (re)structuring of the data -for reason of economy?- in this memory device. Further analysis of the role of memory seems necessary to be able to delimit the role of the stimulus.
A.1.3 Definition of stimulus:
The following definitions are regarded as definitive for this article. They are mostly based on the notions of Bruner et al. (1956) and Bourne (1966). They were put in a systematic and suitable interrelationship.
— an *'event'* is a spatiotemporally delimited *presentation* of perceptible material.
— an *attribute* is the unit of information that can be discriminated during such event. It varies from event to event. Moreover it is the *smallest* distinguishable unit of information in the event.[18] Bourne tried to express the meaning of this term in a physicalistic sense: it is 'a range or category of physical variation' (p. 12).
— 'an attribute represents a dimension' (Bruner et al. 1956, p. 26): the attribute is a member of a set of elements with at least one common property. Such a set is called a *dimension.* Each dimension (e.g. color, form, etc.) has a range of possible *values,* i.e. te different forms of extention of the property. Once an individual dimension is characterised by one specific value, an attribute is constituted. Hence follows that each dimension can only be discriminated on one attribute at a time. (An object can not be blue and red at the same time, or round and triangle, etc.).
— an individual *stimulus* then is *the set of all individual attributes in a*

single event. A few consequences of this terminology can help clarify some vague concepts. Since each individual stimulus can only contain one attribute of a specific dimension at a time, stimuli can be mutually distinguished if in two of them the *same dimension* is relevant and has a *mutually different value*. Moreover, stimuli can be considered as distinct if the *number of dimensions* or the *variation of dimensions* differs in both. These are the only three possibilities to distinguish between stimuli (and hence, also to try to define stimulus similarity).
— an individual *instance* is a stimulus with a specific function: a stimulus can be an instance with regard to an individual concept *iff it contains the information that is necessary* (but not always sufficient) *to detect or recognize the concept*.

A.2 Definitions of 'concept':
The discriminated attributes are interrelated by a rule, a principle to form a concept. Generally the stimulists characterise this sequence as follows:
a — the interrelating of the attributes is called *categorisation* or *grouping*. Conceptual categorisation is often termed psychological induction (Hunt, Marin and Stone, 1966): it consists of the inductive inference of an *identity class* out of the set of mutually distinguishable stimuli.[19] Out of the amount of information in the perception a part is selected as relevant, part is eliminated. The relevant information is then replaced by a common, binding principle, that is itself an information unit. It is often called the *code*.
b — All definitions have these aspects (above) in common. Yet they vary in the stress that is laid on one or more component structures and/or processes.
A.2.1 'Concept' as cognitive structure:
This is a static approach. The elements of the structure are the representations of the attributes. The grouping is realised in the network of relations. The concept is viewed as a mental image that is isomorphous with the instance, from which it has been induced. Consequently, the concept is het *result* of the thinking process. This structure can be stored in memory.
This vision on concepts can be found in Thompson (1969), Fisher (1969); also in Kuhn (1966) and Hebb (1949). The definition of Kruithof (1968) seems to correspond with these: a concept is 'een algemeen, relatief konstant ordeningsschema, waarmee het denken opereert' (p. 102 and p. 563).
(a) The group of Bourne — In Bourne's book (1966) the structural approach is very clear. His definition goes: 'A concept exists whenever

two or more distinguishable objects or events have been grouped or classified together and set apart from other objects on the basis of some common feature or property characteristic of each'. (p. 1) The quotation 'it exists whenever. . .' is rather vague and prohibits every strict delineation of 'concept' as structure.
The same goes for Bourne's article of 1968. Archer (1966) has a much more clear notion: he identifies the structure (concept) with the verbal signs that refer to it.
In a polemical article of 1969 Bourne tries to give a fully extensive account of the theory that is basical to the work of the whole group (Bourne, Archer, Guy, Dodd, Haygood, etc. . .). He pleads for a psychology of behavior Since *'any particular behavior* (response or response sequence) committed by the organism *is recognizably consistent with and instantiates a rule'* (p. 177), psychology must be seen as the search for *behavioral rules.*[20]
Newell (1969) argues in a quite inconsistent way that Bourne's statement is reductionistic and therefore necessarily incomplete. This follows from the researches on simulations (especially by Simon and Newell). Even a simple computer, with the capacity to multiply two multi-digit-numbers is equiped with 'an internal structure and internal processes that accomplish this total behavior' of considerable complexity. (p. 202) This critic is unsatisfactory, because it presupposes the 'faith' in the validity of simulations and even of the analogies between human and mechanical mind. Since outstanding proofs are still lacking on this subject, the point can not bear any value in an argumentation on psychology.[21]
(b) Hunt — Hunt creates a logical metalanguage to be able to express his ideas in an axact way. He starts from proposition logic, supplemented with some notions of set theory. He applies all the concepts hitherto defined, but translates and integrates them into his 'system of denotation!' In order to simplify matters, I shall content myself by resuming his ideas in everyday language. Otherwise an extensive exposition of the formal system would be necessary.
He characterizes a concept as a simple *rule of categorisation* (cf. Bourne). The factual categorising is quite congenial with the normal deductive (logical) reasoning, since categorising consists in the filling in of an argument (value on dimension) in a non fulfilled propositional function on the criterion of extentional correspondence (as in formal logic!).
(c) Overview — The following items are characteristic for the structural approach to 'concept':
— a concept is a static entity.
— the structure is the network of relations between the (informational) elements, or the rule that governs it.

— the concept is the endproduct of the tinking activity.

A.2.2 'Concept' as cognitive process:

This vision was only found in the work of Gagné (1966): 'A concept is an inferred mental process'. (p. 83) The process meant is probably the inductive process, spoken of above (cf. Bruner). Yet, it is not at all clear on what basis Gagné decides to identify this process with the concept itself. Nowhere else did I find supporting facts or theories. Moreover the experiments of Gagné and his collaborator[22] seem important only in so far as they handle about distinct, individual processes of inference, rather than about concepts. For example, the recognition of different colors is a series of cognitive processes, as well as the inference of the dimension 'color' out the discriminated colors, as well as the storing of this category in the memory, etc. . I think it ridiculous to call each of these cognitive processes concepts. The characterisation is thus superficial.

A.2.3 'Concept' as cognitive mechanism:

This is the most widespread vision in the cognitivistic literature on concepts. I shall entitle this vision as 'mechanismic'.

The group of Bruner:

A most eminent work in cognitive psychology is without any doubt the book *'A Study of Thinking'* by *Bruner, Goodnow and Austin* (1956). At the end of this work the authors agree on this definition of 'concept': 'a network of significant inferences by which one goes beyond a set of *observed* criterial properties exhibited by an object or event to the class identity of the object or event in question, and thence to additional inferences about other *unobserved* properties of the object or event'. (p. 244).

When analysing this definition, 'concept' emerges as a mechanism, in the sense explained above: it is a network of processes (inferences), with the further specification that these 'are or may be set into play by an act of categorization' (p. 245). Therefore, it does not have the status of 'endproduct of thinking', but rather of 'unit of thinking'. Two supplementary properties:

— *identification:*

This factor is denoted by the fragment '. . inferences by which one goes beyond . .'[23] The identification of the discriminated units is the first link (after the perceptual operations of course) in the process of constitution or conceptualisation. It is the concrete transscription of Bruner's 'to go beyond the information given' (1957). In still other terms and starting from a functional standpoint, one speaks about the 'process of grouping'[24]. The principle that governs this grouping is the conceptual rule or, in Bruner's terms the 'category'.

The postulating of such rule as autonomous with regard to the presented

stimuli and/or the overt behavior (though there may well be connections between them, the principal mutual irreducibility is respected) is quite typical for an cognitivistic approach. Bruner et al (1956) and Bruner et Olver (1965) choose explicitly this frame: thinking is dominated by a mental organisation of mechanisms with a number of rules that are interrelated into a psychological (cognitive) 'syntax'.
Since the essence of this grouping or identification is already handled above, I can be short here. It consists of the transformation of the set of attributes (in perception) into a class of 'identical' elements, in such a way that the 'grouping is less complex than te sum of all the distinguishable features of all the elements of the collection'. (Bruner and Olver 1965; p. 417) This class is 'named' and encoded in memory.
The grouping itself can show different regularities. The most common are the following: subordinal grouping (to group all attributes in respect to one single) or superordinal (equally grouping of the attributes along a common feature). Furthermore, a few logical rules are revealed as nearly universal: conjunctive, disjunctive or conditional groupings. (cf. especially Bourne 1966).
— *generalisation:*
The second property of concepts (as mechanisms) is ' . . . thence additional inferences about other *unobserved* properties of the object or event . .' This sort of 'extrapolating' shall be termed generalisation here. In this aspect also a 'syntax' is suggested to be at work, rather than the fortuitousness that governs in S-R theories: Bruner and Olver state (1965): 'when people associate things with each other, they most often do it by extension or combination of groupings previously formed' (p. 148). The grouping thus has the status that *it is more than the sum of the parts.*
One can now test the fruitfulness of this classification (hitherto) by comparing each of the definitions mutually and by comparing them with the experimental setting (for example in the basical experiment described above).

A.3 Stress is placed on other mental factors:
(a) Theory of memory — The authors of this theory start from the assumption that *memory* orders and constructs the informational units that enter the organism in terms of the memory's own *structuring.* In the study of psychological (and especially cognitive) processes, stress is placed on memory in its relation to perception, action and information processing. A modern assimilation of these ideas can be found in the work of Neisser. Neisser (1960) introduces rather complicated cell-systems as units (structural and functional) of perception, thinking and actions, called *recognizers.* They are the units that select and group the incoming information

via relatively constant, preorganised sets of memory processes.[25] The recognizers are hierarchically interrelated in a *schema.* A particular recognizer and a schema are resp. an individual and a general *concept.* (Cfr. also Neisser and Weene 1962 about this hierarchical structuring of concepts).

Consequently to these presuppositions Neisser claims conceptualisation to be dependent on memory capacities. The following citation is typical in this respect and should be translated to conceptual behavior in particular: 'The proposal is therefore, that we store traces of earlier cognitive acts, not of products of those acts. The traces are not simply 'revived' or 'reactivated' in recall, instead, the stored fragments are used as information to support a new construction'. (p. 285-286).

The long-term memory is then proposed as a sufficient explication of the transformations on the incoming information. Probably because of the lack of evidences concerning this memory, this point looks quite unsatisfactorily worked out. On purely speculative grounds a few structures and operators are introduced to account for[26] the sufficient distinctions between conceptual behavior, goal-directed thinking, problem-solving. . . . The model is sometimes completely aprioristic. An attempt to support a similar 'memory-model' of conceptual behavior with experimental data, has been made more extensively elsewhere (Pinxten, 1971).

(b) Symbols as representations of concepts — Some authors start from the identity or interchangeability of language and thinking. Concepts are then seen as 'Nouns that name shared characteristics of objects and events'. (Gregg, p. 107) Similar (but more elaborated) notions are to be found in Jenkins (1966) and Feigenbaum (1963). Rather than dwelling upon these attempts, I shall turn to a short critic on them.

The critic is twofold:

aa) the extensive work of Furth on deaf children (e.g. 1966) rejects the identification of conceptual and linguistic (capacity of) symbolisation. In his experiments Furth proved that deaf children (without verbal symbols!) are equally capable of abstract conceptual behavior, and concept formation. Still his data can not be fully used here, since he does not clearly distinguish between verbal symbolisation and symbolisation in general (or signification?).

bb) A second critic is more general. Gregg and Jenkins agree that thinking occurs within the frame of linguistic rules, structures (syntax). Put in other terms, this is pointing to the primacy of linguistic upon cognitive structure.[27] This problem can not be met here in full extent; a single, specific project of research will be mentioned. Nevertheless, it may suggest the extent of the problems the authors just mentioned mixed up in their model of 'concept', by just choosing this approach.

Greenfield, Olver and Reich (1966) try to discriminate a level of psychological (or semantical) grouping in their cross-cultural study of categorisation. This grouping is primary in regard to the syntactical (linguistic) one. For example, color categories are universal, but the differentiation within each constant category varies corresponding to the linguistic peculiarities of the subject.
Both these citics seem sufficient to me to reject the theories of both Gregg and Jenkins as unfruitful, that is in as far as they wanted to give an enlargement of Bruner's attempt. Of course, this does not solve the problem of the relationship between language and thinking. It only suggests that the identity between both is unlikely.

A.4 General conclusions concerning the stimulists' definition of 'concept':
The importance of the distinction between three standpoints now seems clearer: *the conceptions of 'concept' as resp. structure, (or rule) and process are in fact studies of components of 'concept' in the mechanismic approach.* This thesis can easily be proved with the help of experimental facts. I shall make an attempt in that direction.
The experiments by Bourne (1967) -based on those by Haygood and Bourne 1965- are quite revealing. In order to be able to study the acquisition of the conceptual rule (independently of the learning of the attributes) all other variables are under control: they are eliminated as interfering variables by integrating them into the instructions.
Bourne says: 'Before each problem was begun the experimenter named the relevant attributes; and indicated wether the rule was the same as or different from that of the preceding problem'. (p. 20) Hence, the task is narrowed to the finding or application of the rule. In this way the author analyses the structural aspects of thinking (which he names concept or rule). This can be compared with the 'network'-components in Bruner's vision. In the latter case, the structural aspect is only part of the concept. Therefore, he will not talk as readily of 'conjunctive or disjunctive concepts' as Bourne would, but rather of dito conceptual rules.
If 'concept' is taken as a process (Gagné 1965), it must refer to an inductive process: 'a process which enables the individual to classify objects'. (idem, p. 83). The identity with the 'inference processes' of Bruner is apparant. Further evidence for this identification can be found in supplementary remarks of Gagné: discrimination of stimuli is required in concept attainment. And: a concept is attained if the subject is capable to locate an object in his specific class.
Hence I can conclude that the notions of 'concept' can both be well described as components of Bruner's mechanismic conception. The final choice between the three approaches is theoretical, because all three are

experimentally demonstrable. Since it is my opinion -intuitively- that thinking is not describable but via complex and dynamic units, i.e. mechanisms and since I think concepts are units of thought (following in this respect Reitman 1964 and many other simulation psychologists) and not just endproducts of it, I choose the mechanismic conception of 'concept' to be the most fruitful to explore.

B The action-psychologists — The action-psychologists can be delineated as the group of psychologists who *describe thinking* (or conceptual behavior) *in relation to actions, behaviors, habits of the individual.*
Action, etc. . can be seen as the gathering word to denote all 'overt behavior' from concrete movements unto language, *bound at* the structural and processing components that constitute the link between thinking and perceptible behavior. In this sense these psychologists are also 'cognitivistic': not only the perceivable effect of the stimuli, but also the multitude of internal structures and processes that occur between simulation and reaction (overtly), and which are in principal not describable in terms of 'overt behavior', are integrated in the theory. (cf. the critics of Asch and of Bever, Fodor and Garrett above).[28]
This cognitivistic conception, with stress on action, is still very young in Anglo-Saxon countries, but it has a solid tradition of now more than fifty years on the continent.[29]
A systematisation that would be comparable with the one given on the occasion of the stimulists, is impossible for me. At first sight, such work would also be superfluous, since all authors encountered hold on to the mechanismic conception of 'concept'. I shall distinguish two main groups:
— the group of Piaget
— the group of information theorists (Miller etal. 1960).

B1 Piaget:
It will be understood that I did not devour ALL the books by Piaget. I had to content myself with a few works, and different articles of his collaborators.[30]
B.1.1 Schema:
(A) Structural — Not perception, but action, movement[31] is central in the theory of Piaget. The importance of action is primarily genetic: the child learns to know his outworld by moving in it, grasping, etc. After many attempts and selections the mental (internal) representations of these actions emerge, called *operations,* with following peculiarities:
— they are anticipations of the individual actions (they are more 'abstract')
— they are reversible

— they are necessarily coordinated in an englobing structure (a 'lattice') called a *schema.*[32]

(B) Functional — A schema is a relatively constant *equilibrium* (De Mey, 1964, p. 43-44), 'équilibre' (Piagte, 1967, 2, IV) between two constant movements[33]: accomodation and assimilation:

— Il y a assimilation chaque fois que l'individu incorpore à ses cadres personnels le donné de l'expérience. Assimiler un objet (ou une situation), c'est agir sur lui pour le transformer en ses proprietés ou ses relation — (Hattwell, 1966, p. 128)

— 'L'accomodation consiste en une différentiation de plus en plus fine des actions, ou plus exactement des schèmes d'action pour mieux les adapter aux caractères particuliers des objets. — (idem, p. 128)

Cognitive processes are simply 'manifestations' of both these movements (De Mey, 1970b, p. 211). The schema's become ever more coordinated and integrated during the individual's development, making way to 'higher-order'-schemata. In this way different schemata emerge that constitute a new equilibrium between individual and outworld. During the first years the schemata 'objects', 'space', 'causality' and 'time' are thus formed.[34]

(C) Grouping — All structures generate along one and the same 'groupe'. This 'groupe' has its definitive form around 11-12 years of age. It is put in a symbolic notation in order to make the communication easier, i.e. the *4-group of Klein,* in terms of the logic of propositions.[35]:

I = identity transformation set to work on a function of two propositions (p and q) results in this same function:

$$f\,pq \xrightarrow{\quad I \quad} f\,pq$$ (Frey, CNRS, p. 336)

Identity is yet a complex operator, composed out of two others (cf biconditional in logic): 'l'opération directe et l'opération inverse' (Piaget, CNRS, p. 341).

N = negation-transformation set to work on a function of two propositions results in the inverse function:

$$f\,pq \xrightarrow{\quad N \quad} n(f\,pq)$$

R = reciprocity transformation on a function of two propositions (p and q) is a form of reversibility of the negation and results in the function of the negations of both p and q:

$$f\,pq \xrightarrow{\quad R \quad} f(np)(nq)$$

C = correlative transformation set to work on a function of two propositions (p and q) is the transformation that results in the inverse of the functions on the negations of p and q:

$$f\,pq \xrightarrow{\quad C \quad} n(f(np)(nq))$$

By combining several of the transformations, another can be deduced: NR = C; NC = R; CR = N; and NCR = I. This is the grouping of all schemata of man.

(D) The verbal factor — In the experiments of Piaget, the schemata are often linked to verbal units (words, utterances)[36], in the way that 'l'enfant .... emploie en effet le laguage pour affirmer un concept dans sa réponse'. (Wohlwill, 1966 p. 219). From there one comes too easily to the conclusion that the child with verbal competence 'est clairement avantagé pour grouper systématiquement un ensemble d'objets, spécialement quand il a affaire à plus qu'un seul critère de classification, soit simultanément, soit successivement'. (idem).

Furth repeated some of these conservation experiments of Piaget with deaf children. The instructions were, evidently, non-verbal. The results point to an agreement with Wohlwill's remark[37]; the 'avantagé' must yet be understood as 'being ahead' to the deaf and is thus bound to certain genetic stage, at most five years of difference. After 16 all deaf succeded 100 % in all conceptualisations. There is no more diffrerence with the other children. Hence, the role of the verbal factor must not be seen as decisive.

B.2 The informationist psychology:

Here I shall content myself to summarize the revoltionary work of Miller, Galanter and Pribram. Most applications and differentiations of it lie in other fields, such as psycholinguistics, simulations, etc.

B.2.1 Miller, Galanter and Pribram:

The analogy between structure and function of the mechanical and the human brain is essential in their work.

The TOTE is the behavioral unit of man and automaton. This is a serial event with the following phases:

— *Test:* the organism compares his own internal state with the information of a similar segment of the world he is viewing in his perception. If there is 'incongruity' (p. 26) between the two sets of information, the organism passes to the second phase.

— *Operate:* with regard to the revealed difference of information between internal and external situation, the organism acts upon one of them, in order to change the information of one of them.

— *Test:* a second test, similar to the first one. If the result now is 'congruity', the sequence comes to

— *Exit.*

In computerterminology, one has to do with 'een beslissingsblok gekop-

peld aan een operatieblok waarvan de output wordt 'teruggekoppeld' aan de input van het beslissingsblok'. (De Mey, 1970, p. 198).
Each Tote is built up hierarchically itself (can contend several sub-Totes) and is a member of a hierarchy. Each hierarchy is composed out of a network of Testblocks. The activity of building up is called a Plan, 'any hierarchical process in the organism that can control the order in which a sequence of operations is to be performed'. (p. 16).
Consequently, the Plan is functionally similar to the 'groupe' of Piaget (it is the transformation or structure of transformations) that is set to work on the action-informations.
Besides the Plan, another mental phenomenon is conceived, i.c. the *Image*. It is: 'all the accumulated, organized knowledge that the organism has about itself and its world'. (p. 18).
There is only one Image, whereby the authors want to refer to the cognitive map of an organism. It englobes all information data about the mental structures and operations and about the known parts of the outworld. Moreover, it has stocked the names of the Plans, since the latter constitute the relation with the outer world. Image resembles the 'datastructure' or 'liststructures' (Feigenbaum's EPAM) of computers.
B.2.2 Analogy between Piaget and Miller et al.:
The behavioral unit of Miller et al. remains too general, especially because of the lack of extensive simulation programs that can support the initial analogy. Since Piaget bases his theories on abundant empirical evidence, it may be useful to try and compare the concepts of the two theories.
In my opinion *Plan* can be substituted to a high degree by *schema* or *concept*. Most of the properties of 'concept' (or schema) in Piagetian theory can be detected:
— it is a *decision mechanism* that realizes transformations upon actions (test — operate)
— a Plan contains all information necessary to generate an action.
— the grouping-component is rather vague, but since Tests determine the Plan, together with the impact of a part of the Image, and since both components thank their content to the *information* they conatain, the grouping-aspect of Plans should be studied with regard to the *variables that determine the information*. Therefore one can make use of data out of concept-experiments.[38]
— finally, it must be mentioned that Plans are general mechanisms that can be found -just like schemata- in perception, thinking, etc. (see Galanter who worked them out for perception).
The analogy between Piaget and Miller et al. is still quite elementary. Nevertheless, I think I managed to express my intuition that the Plan-

theory must be principally reducible to the Piagetian theory, although the former is still unsatisfactorily worked out, especially with respect to the fundamental notions of 'hierarchy' and 'grouping'. Moreover the comparison has to be made in a much larger theoretical frame.[39]

C Three attempts to bridge the gap between stimulists and action-psychologists — Only recently[40] a few attempts were made to construct what I shall call *'bridge-mechanisms'* between stimulus- and actionside. In matters of method and general options the authors here must be termed 'cognitivistic' Moreover, the following starting-points are common to all three:
— *memory* (especially long-term memory) plays a very important part in conceptual behavior. Both are explicitly and necessarily linked.
— more stress is put on the aspect of *representation* of the concept. The formation and the use of concepts are characterized by a similar (identical, isomorphous or equivalent?) structure of representation.

C.1 Bruner (1966a) starts explicitly from a communication model of thinking[41]: two sets of mechanisms are in interaction with each other, i.e. individual and culture. The culture serves 'amplifiers' (Bruner 1966c) to the individual[42] that enable him to develop his capacities. These amplifiers (typically informational) are available in three forms: the individual develops three *systems of representation* that emerge subsequently, but last after their genesis in interaction with the former and/or forthcoming one:
— the enactive representation is the 'background of representational processes' (p. 18) that is responsible for the first connections between perception and action. It generates the organisation of motory behavior. It could best be compared to Piaget's 'sensori-motor schemata' (1967).
— the iconic representation exists 'when a child finally is able to represent the world to himself by an image or spatial schema that is relatively independent of action'. Itcould be called 'stimulistic'.
— the symbolic representation is based on the use and development of symbols. It presupposes: categorising, hierarchical, structuring of the conception of the world, precise anticipation, causality, all of them lacking in the previous forms. The role of memory is here (because of the stress on structuring) predominant. *The central problem then to me is how the two poles* (stimulus and action) *are related concretely i.e. interms* of (memory) *structures and/or operators?*
A possible answer on this question could lie in the interrelation of the three systems. Here, Bruner (1966a) proposes -in abstracto- three possibilities: the systems can be *independent* to one another, they can be *'matching'* (2 systems corresponds along a criterion), or *'mismatching'*

(one system suppresses the other by generating a schema that coordinated both).
Potter (1966) tried to concretize such interaction in his experiment. The result is the perceptual *recognition*.[43] In fact, the model of Bruner is not tested, but is 'validated' (or rather justified) by pointing to a foreign, but still unknown (experimentally not controllable) factor in the memory. The same goes for Olson (1966), who refers to the same 'recognition' in trying to detect strategies of conceptualisation. The problem stated above, is thus not solved.

C.2 Neisser:
Neisser (1967) identifies conceptual behavior and functioning of the 'long-term memory'. His model resembles the 'symbolic representation' of Bruner (1966):
— on the one hand this memory functions as a filter, with an elaborate 'mental organization', by which all discrimination becomes an 'elaborate process of recognition' (p. 285).
— in the other way, not the concrete, individual attributes are stored in memory, but 'traces of *prior processes of construction*' (idem).
— the synthesis of both results in a conceptmodel that is in fact a 'memory-functioning-model'; stimuli and responses are mutually linked by the memory.
Neisser commits the same fault Bruner did: an unknown mechanism 'explains' the regularities of thinking.[44]

C.3 Kleinmuntz (1967) gathered articles of different authors, most of them dealing with the relation between conceptual behavior and memory. Only Newell and Simon (1967) really try to bring a synthesis. They propose to define concepts with the use of a *'catalogue of mechanisms and structures'*. To clarify the question I will subsequently tackle two topics:
C.3.1 Capacities and boundaries of the information-processing system:
Newell & Simon (1967), Peterson (1967) and Cofer (1967) all agree to describe thinking as a 'hypothesis-testing'-sequence (cf. above, Bruner). Newell and Simon furthermore distinguish between three processes in conceptualisation:
— *generators* that give rise to a set of hypotheses and rules that may, indirectly, determine behavior.
— *tests* that try out the hypotheses.
— *response* processes, that generate overt reactions. Only this one is on the action-side.[45] Still, the problem as to how the transfer from 'discriminated stimuli' into actions takes place is not solved here, even not in a preliminary way. There is once more the analogy between man and

computer, and the authors base their model of memory on the rather simple 'discrimination net mechanisms' of the latter. By doing so they implicitly refer to the model of Feigenbaum (EPAM)[46]. Since this computerprogram is only capable of a few, simple operations, the argumentation of the authors is rather cheap.
The same goes for Peterson (1967) who identifies concepts with structures of the long-term memory, that -on apriori grounds- has the capacity 'of holding programs' (p. 250). The programs are operational wholes that consist of decision processes. Once more, there is a lack of clear predictions as to the concrete functioning of these programs, be it that they occur and work blindly, loosely. But this would be in contradiction with the successful postulate of cognitivism (the 'syntagmatic' approach to reasoning and thinking.).[47]
C.3.2 The representation of individual concepts in the memory:
Gregg (1967) and Bourne (1967) are most concerned with this problem. To Bourne, the memory' owns a certain amount of categories (in his vision be it the rules), complemented with the capacity to order perceptual material per dimension. He presupposes four categories to be given to each individual with respect to an algorythm that is inherent in memory. As Newell and Simon (1967) remarked, the experimental research that ought to support these intuitions is so meagre and ambiguous, it can not be taken into account. This leaves us with a mere speculation.
The articles of Gregg (1967) and Gregg and McNeill (1967) are better worked out. The authors explain the working of memory essentially as a *sequential* device, i.e. via the introduction of *'chunking'*[48] This hypothesis can only be tackled sensefully after a minimal typology of concepts is elaborated. Only then will be undoubtfully clear, wether the proposed functioning of memory is specific (namely, just limited to 'sequential concepts') or general. Until then, we can merely guess.
The general conclusions of Newell and Simon are of even more importance than the authors themselves -with less implications- could claim: 'Rather, what we need to know is the organizations that the subjects do have and when they are evoked, or as we have now said several times, by what clues they make their presence known.' (p. 260)
Finally I shall try to summarize what may be known with a high degree of certainty about the processes of conceptualisation in a cognistivistic, and more specifically mechanismic, outlook.

5 Summary and conclusions

After a short review of the definitions in a systematic ordering, I shall give a few suggestions as to the directions in which -in my opinion- research should be led.

A Summary — Since the exclusively struvtural and dito process-approach have been found easy to integrate in the mechanismic conception, I shall only stress the last one here.

Concepts are regarded as *cognitive mechanisms* that consist of a complex network of mutually interrelated processing operations (inductive inferences) set to work on information that is entering the organism. (Cfr. Bruner and collaborators 1956, 1957, 1964, 1965 and Furth 1966).

Two specifications can occur:

— the mechanism is situated in *memory,* namely in long-term memory (cf. Neisser 1960, 1962).

— the mechanism is a *linguistic* one; language and thinking are parallelled are identified (cf. Gregg 1966 and Jenkins 1966).

The information that is entering the organism can be totally or primarilly perceptual imputs (Bruner) or action imput (Piaget, Miller et al.). The idea of 'concept' that results is dependent of this starting-point.

Finally, a few authors tried to avoid this question of primacy and define concepts as *'bridging mechanisms'* to fill the gap between stimulus and respons (Bruner et al. 1966; Neisser 1967 and Newel & Simon 1967).

B General characteristics of the (individual and general) concept — The following characteristics seem common to all concept-notions of 5.A. This part is an important extension of the 'intuitive' conception.

(1) A concept is a *mechanism:*

— it consists of a bundle of *inference processes* defined on a set of discriminated attributes and/or actions.

— these inferences are *inductive,* i.e.

1) more-one-relation: this presupposes:

1a) reduction of information, selection of 'relevant' information, a reduction mechanism with rules, astrategy.
These are active in each conceptualisation. It can be explained by the theory of discrimination (of relevant versus irrelevant; (cf. Vermeersch 1967)

1b) Induction implies *coding,* storing in memory, because there is always a flow of time between perception and action.

2) the relation is *asymmetrical*[49]; from stimulus (action) unto memory. Via feedback it remains possible for codes to reoccur in a later act of thinking.

— the inferences are mutually interrelated in a *network.* This structure is referred to by the terms 'representation', 'map' etc.)Uhr, 1969). Some authors (see above) identify 'concept' with the network alone.[50]

(2) *Analytical conceptions of 'concept':*

Putting into a schematic frame the ideas that were encountered, be it

with a few extrapolations, the following overview results:

I Stimulistic 'concept' holds:

1. a structure of discriminated stimuli
2. reduction of stimuli and grouping. Memory plays an active role in retention and grouping.
3. storing in memory (long-term) of the result.
4. stages 2-3 in usually called identification; the whole cycle is named induction.

II Action-psychological 'concept' holds:

1. a structure of memory codes
2. procedures of decoding, involving selection of 'relevant' codes.
3. generating of patterns of action and reduction of potential actions
4. editing of a concrets action
5. Levels 2-3 are central for the concept.

It is evident that these schemata should be elaborated far more, complementing them with feedbacks, and should be realised on an automatic device.

Perspectives —

(1) It must be able (at the limit) to define a one-one-relation between sets of stimuli and sets of actions, otherwise information processing is a void term. The memory codes that are the result of induction, must be the same that are basical for the planning.[51] Since so little is known about these memory factors, one can postulate processes, structures, etc. at will. I think this way of completing the model must be avoided. Therefore I think it reasonable to work out the pole of stimulus and that of action *separately,* as if both were not interconnected, by *admitting hypothetically the existing of two forms of concepts,* a stimulistic and an action concept.

(2) *Further suggestions:*

— I think it is made clear that a clear view on perception, action and memory is necessary to give a full characterisation of conceptual behavior.

— the impact of perceptual variables on conceptualisation may be sought in the 'constructive' nature of perception: the organism segments, structures his data in terms of perceptual dimensions. Individual concepts can probably be best described in terms of these very same dimensions.[52]

— the research on conceptual rules is hardly begun. The results should be integrated in the theoretical conceptions of 'concept'.

— intuitively I presume inductive inferences should be described interms of memory operations (cfr. both have parallel processing, discrimination, etc.).

— finally, an attempt should be made to distinguish general and abstract concepts from the individual ones and to try to realize this distinction in experimental research. Some authors tried to go on this path, in a rather unconscious manner.[53] Clear definitions are lacking.

These suggestions can not be worked on all at a time. The importance to notice them is essentially reduced to the joy one experiences, to know one's work is embedded in an englobing, totality that makes sense. Making sense by having joy surely is given only to human mind, especially when exploring human mind.

Notes

1 An overview of these experiments can be found in Pinxten (1971) chapter V.

2 Vinacke (1951) claims that the mening of the term (concept' is very vague in psychology. Newell and Simon (1967) stress that there has not been made any progress since, though they think theoretical unification on this subject of psychology very important.

3 The distinction between individual and general stimuli is the result of a profound discussion I had with Prof Vermeersch.

4 Cfr. e.g. Hunt (1967). This concept will be explained later on.

5 These criteria are methodological and epistemological. A fully consequent argumentation should lean upon experimental facts. Since these are still very rare, this target must be postponed.

6 When a confrontation is endeavoured, one is satisfied with vague analogies (cf. De Mey 1969, p. 22: Bruner and Miller are comparable in the light of the more general paradigm of 'skil').

7 Cf. Voss (1969), Anderson and Ausubel (1965), Harper and Rowet al. (1964) and Wason and Johnson-Laird (1968) distinguish between the authors on the rather risky (or gratuit?) basis of the *terms* they use, not on the differences in theoretical standpoint.

8 Cf. Anderson and Ausubel (1965 and 1965 a and b) and Piaget (CNRS and 1967, III) as to the relevance of the term 'cognitive structure' (and -process) in psychology).

9 These assertions are analytical: they are made to explain what is supposed to be necessary to justify the notion of 'concept' that is used. Rather seldom (cf. Bruner et al. 1956, p. 18-20) the term 'reduction' is used explicitly.

10 The book by Pikas (1965) can be given as an example of the fallacij pointed at. He used both as crucial theoretical instruments.

11 The authors got their experimental attributes from Hovland's (1951) theoretical analysis.

12 A 'lonesome' exception in this tradition is the 'problem-construction' experiment by Donaldson (1961). It rests on the inversion of the original problem-solving setting.

13 The following paragraphes are a systematic resumé of Bruner et al. (1956), pp. 40-44.

14 In merely *all* experiments the evaluation follows *each* hypothesis. This could give way to artefacts: Suppes and Ginsburg (in Bourne 1966) proved that this evaluating (versus restricting from it) had important facilitating and accelerating impact on the acquisition of concepts.

15 The term 'imput' is here synonymous to stimulus, or discriminated unit, or 'form' (in the terminology of Prof. Vermeersch).
16 Bruner et al. state: 'by a category we mean a rule for classing objects as equivalent' (p. 234).
17 This can also be seen as a physical property of the retina, called *retention.*
18 I speak of *discriminated* (versus identified) units, forms, each time the individual *reacts differentially* on that unit, with regard to another.
19 Cfr. Kuhn (1966, p. 105), Hunt (1962, ch. 3), Hunt, Marin and Stone (1966, ch. 1).
20 This remark is meant as a critic against the postulating of mechanisms with a 'deus-ex-machina' character, against Bourne detects this trend mostly with authors I shall classify as 'mechanismic' (cfr. sub. A.2.3.), whom he reproaches to be the re-editors of a 'mind-problem'. 'This problem of 'mind' has proved to be a false problem in the history of psychology (cf. Jordan 1968, Gregg, 1967, and Jenkins 1966).
21 Cfr. the divergence of opinions between Newell and Simon (1967), Feigenbaum (1967) who have faith in the analogy and Hunt and Hovland (1963), Hunt (1962 and especially 1968) and Hovland (1960) who reject it.
22 Cf the experiments of Lee and Gagné (1969 and 1970).
23 E.g. Bourne (1966) and Bruner et Olver (1965).
24 In one place the authors identify concept and category; 'the concept or category is, basically, this rule of grouping' (p. 45). This quite syntthetical expression is in contradiction with the definition of concept of p. 244, where the rule is but a part of the total concept.
25 This preorganisation is a relative concept: the organism is preorganised in front of every particular imput of information.
26 E.g. operators as attention, pre-attention, etc... and mechanisms like 'scanning', 'iconic' and 'long-term memory (to be responsible for resp. discrimination, individual concepts and general concepts.
27 This is the so called Sapir-Whorf-hypothesis (1956). Bruner et al. (1966) reformulate the hypothesis as follows: 'If perceptual analysis is necessary, then language is crucial as an analytic tool. Whrere perceptual analysis os not necessary, as in color perception, language is much less important'. (p. 316)
28 The requirement of a clear definition seems unredemptable: maybe the notion us so basical it ought not be defined. One could compare with the notions of energy and mass in natural sciences: they are undifinable Segmentation and measuring are possible, definition not.
29 Cf. De Mey (1967, 1970), and Chomsky (1970).
30 E.g. De Mey (1970), Holloway (1967), Bresson (1966); Wohlwill (1966).
31 Piaget (1967), Part I and Part II, II.
32 This definition of schema corresponds beautifully with that of 'mental structure' (Piaget, 1967, 2, II).
33 'On constate que cell- ci apparaissent comme le terme d'un processus d'équilibration'. (Piaget, CNRS, p. 27[1]).
34 Cf. Piaget 1967, 1, I A and 1965.
35 The information about the INRC-group is mainly from Piaget (1967), Piaget (CNRS), De Mey (1964), Frey (CNRS) and Piaget (CNRS, critc on Frey).
36 This constatations also to be found in De Mey (1964), Wohlwill (1966, p. 219) and Furth (1966, ch. IX and XII).
37 This was realised by spreading the differences progressively over a great

amount of examples (13).

38 The descriptions of TOTE by Galanter (1966) point in the same direction.

39 At the Univ. of Ghent, a workgroup of 'Communication and Cognition' is actually trying a daring project around the theories of Piaget: to simulate the notions of 'assimilation', accomodation, equilibrium'. The TOTE resulted to be useless, much too little of a workable unit.

40 All works date of after 1965, i.e. Bruner et al. (1966), Kleinmuntz (1967) and Neisser (1967).

41 Cfr. Hovland (1952) who is the founder of this approach.

42 The sociological dimension is present (be it minimally): cf. Greenfield (1966) who searched for the relevance of differences like city/rural environment, differences in social environment.

43 Recognition is equated with the identification of an object against its background in this experiment.

44 Cfr. Neisser himself (1967), ch. 6: he states that nearly NOTHING is known about structure and functioning of the memory.

45 It is a computermodel and thence best comparable with Miller et al 'S TOTE.

46 Cfr. Feigenbaum (1963) and Feigenbaum & Simon (1964).

47 Three neobehavioristic authors propose a 'matching' - mechanism as 'conditio sine qua non' for the bridging of the gap: Malton (1967) and Lee and Gagné (1969). In both articles one is only uttering *intuitions:* 'One is left with the implication . . .' (Melton, 1967, p. 218) and: '. . . postulated processes of matching . . .' (Lee and Gagné, p. 472).

48 Cfr. Miller G. A. (1956) who introduced this concept.

49 Asymmetrical means here 'never symmetrical'.

50 Copi (1958) names it the 'logicist' approach of concepts. The same authors (Bourne, Hunt) try to detect conceptual rules that correspond to thoes of mathematical logic.

51 Inductionrefers to identification of stimuli, just as planning refers to the equivalent processes of specification of actions.

52 For a first attempt, see Pinxten (1971, IV and V).

53 The articles of Neisser and Weene (1962), McLean and Gregg (1967) and Posner and Keele (1968) plead for this conception: a hierarchy of concepts that would form a cognitive map.

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