IS PRAGMATICS OR PRAXEOLOGY THE FOUNDATION OF LOGIC ?

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I. Introduction : pedagogical requirements and foundational demands

The motivation for this paper arises in part from the teaching experience of its author. This does not suggest that it will be of a pedagogical nature. Quite to the contrary : we shall have to go back to first principles. But its rather unorthodox proposals will -- so we hope -- appear less astonishing when they are seen against this background.

Our pedagogical task was to teach logic to several hundreds of undergraduates in the social sciences, psychology and the humanities. Accepting such a task means believing logic to be relevant for this heterogeneous audience.

We began offering a classical course in logic (exemplified for instance by Copi's "Symbolic Logic"). We tried to show -- as Copi does -- that symbolic logic can and should be used for the evaluation of arguments in everyday language. The problem of translating natural into formal language proved our basic obstacle. This problem is not solved scientifically (translation as such remaining an open question) and practically, simple concrete examples were felt not to need the help of logical instruments, while complex examples proved either artificial or uncertain as to their solution.

This negative result brought us to our second attempt. We tried to use the methodology of the specific sciences our audience were confronted with, showing logic to be the "organon" by means of which the theorems of these sciences were deduced from their principles. As before we always insisted that logic was more than an

interesting algebra, and that mastering it could contribute to understanding and practicing other disciplines. Again we failed, and this time because of the lack of logical analysis in depth, applied to our sciences. Moreover, our audience was not basically interested in them : in later years they would not be scientists but work as professional teachers, lawyers, administrators or clinical psychologists. And for these applied fields, logical analysis was still largely a hope for the future.

It became thus necessary to try now approaches. We realised that we could not hope to bring logic to life for this audience, if we could not persuade the students to cooperate as active participants in the course. We then tried a method "of last resort". We threw the course wide open : anybody could present an analysis of the thought processes involved in any action processes he or she were interested in. It was striking to see how the course became alive. It was also remarkable to observe that most students decided not to analyse thought in science, but to the contrary to dissect the thought processes of well known professions (f.i. : farmers, industrial workers, artisans, or physicians, engineers and pharmacists) and of well known social groups (adolescents, students, political parties, priests, artists). Interest was intense. But the danger existed that amateur descriptive psychology or sociology of thought processes would take the place of logic as such. We really moved in new and unexplored territory.

To bring some order into chaos, we introduced the following questions to be analysed by all students

1) What are the central difficulties met by the practitioners of the occupation or group they analyse ? Enumerate and classify the main problems !

2) Are different and conflicting solutions offered for these problems ? Try to find and to summarize controversies in your field !

3) How are, according to the members of the groups you analyse, good or bad professionals to be differentiated ? Try to give a systematic list of their distinguishing characteristics !

4) What strategies are used in these professions or groups to overcome the obstacles encountered ? What problem solving strategies are typical for "good" or "bad" agents ?

5) Try to compare on the first four dimensions the profession or group you analyse to very similar professions on one side, and to some very distant activity on the other side ! As the result of this comparison try to discover how standards of excellence in problem solving depend on the type of occupation !

6) Try to describe the different problem solving strategies met in as general a language as possible and do the same for the problem situations !

We realised that the students were asked to discover, by methods of observation they were not used to, in domains of activity they were not familiar with, general problem solving strategies, they moreover had to try to formalise. Even more than in our earlier attempts the field was not mature. And still they tried this time with enthusiasm to do the impossible while their predecessors had refused to be interested in the feasible yet difficult tasks they were confronted with. We tried to help as much as possible by teaching a course on problem solving theory, expressed in an elementary logical language.

The results of this formula were definitely better than the earlier ones. This experience brought us to the following conclusions:

1. We are at present confronted with interesting and important inquiries, developed in mathematical logic, leading a life of their own

2. These inquiries are however presented as being of interest for all scientists, because the claim is made that they study part or whole of scientific method as such

3. To go even further, they are claimed to be of interest to all thinking men, because the rules of procedure for valid thought are believed to be expressed by them

4. Only lip service is paid to this universal character of logic. The rules of inference in fact applied in the practical work of the different disciplines are rarely — if ever — studied. If such an *empirical* undertaking was started at all it was not brought in connection with the general proof patterns that constitute the content of logic proper.

5. And yet, if logic is to become what it claims to be, it should be the empirical and formal study of correct and valid thinking in all systematic action, demanding skill.

6. We have to *discover* the universal "organon" by looking at all possible types of skillfull work (scientific work being only part of this vast field), abstracting the "universal" organon from regional standards of validity. We have to teach this "organon" once discovered, by making our students inductively *rediscover* it, analysing types of work (either manual work, or engineering, or applied science, or science) they are personally and vitally interested in.

To summarise : either logic is a specialised subscience of mathematics, and lacks general interest or it aims at being the canon of

clear and correct thinking (problem solving) and must thus be developed on the basis of the study of the heuristics employed by the various types of skilled action. Logic has traditionally been called a deductive science, in opposition to the empirical sciences. If we accept our six theses however, how could we be able to discover the rules of correct inference, valid in all contexts, when we neglected so systematically context as such ?

Logic being the science of correct inference, in discovery and systematisation, in search and proof, has certainly to remain a deductive science, but is must also become an empirical one. This empirical logic will have to investigate how *proof* and *discovery* condition each other.

By descriptive study of actual search and systematisation processes, we must find the norms these processes impose on themselves.

Only by following this road, could we finally reach a discipline that has the universal appeal it claims to deserve, and that can be re-discovered in pedagogical situations, by using the method we finally used with the most success.

Once arrived at these convictions, we could not abstain from looking back. What possible chance could we have to convince the members of our profession that, without abandoning their past, they should direct in the future their work in this startingly new direction? In fact we had come to the conclusion that logic and the theory of work, logic and (sic) ergonomy were fundamentally connnected !

Our conclusion entailed that the logician, while continuing his research in formal systems, should start to observe (!) skilled action as such in order to derive his norms, from his knowledge about the facts in this field. Not rejecting but committing the naturalistic fallacy would be the basis of our insight in the rules of inference, and not separating but connecting search and proof would be the only road to justify proof. It seemed nearly hopeless to us to defend this point of view.

The more so, because we can not yet offer a system of rules for problem solving, not presupposing but founding logic, and derived from the observation of skilled work. We can, in other words, not yet offer a worked out paradigm for a logic course. We have still to bridge the wide gap between rules of thumb, used in specific contexts and universal rules of search and rules of proof. Between the universal rule and the rule of thumb, a large domain of rules not valid in all contexts but valid in contexts of a certain type had to be explored. Only the mapping of this region "in between" could give

us the pedagogical instrument leading from the particular to the universal and the methodological tool proving that the universal is "really" universal.

We decided that we had to look around in formal logic itself for points of view that, without being identical to ours, at least led to it. Only so would it be possible to be saved from radical isolation.

We found the work of A. N. Kolmogorov[1]. To be sure he did not propose to develop an empirical logic. But, long before the theory of problem solving, inspired by artificial intelligence[2] he introduced the concept of "problem" in logic. Intuitionistic logic was considered by him as a theory of problems. For example, the problem to derive from the solution of a first problem a solution of a second problem would correspond to "implication". The problem to solve two problems would correspond to "conjunction".

However the concept of "problem" used by Komogorov remained vague. This is shown by the fact that when later Paulette Février takes up his idea, she comes to different properties[3]. When Y.T. Medvedev[4] tries to make his concept more precise he identifies an important set of problems (the so called "mass problems") with sets of recursive functions. By so doing he closes again (so we think at least) the road opened by Kolmogorov, escaping into pure formalism. However, Kolmogorov and his followers make it at least plausible that general problem solving theory is not only an application of logic but can be considered as its foundation. We then add — and this addition is evidently a huge one — that if problem solving can be used as a foundation for logic, the theory and practice of skilled work, being the concrete incarnation of human problem solving, is also relevant for the foundation of logic.

Paul Lorenzen[5] describes his work explicitly as a continuation of that of Kolmogorov. Far removed from pedagogical necessities, it urges the logician to seek a philosophical foundation for logic.

Giving a philosophical foundation for logic is, in one sense, impossible and in another sense necessary. A foundation of a discipline is a justification of its methods, showing that they really reach their purpose.

If logic is the canon of inference itself however, no justification for it can be a deduction : the very laws of proof that have to be justified will have to be used in their justification. As long as we look for syntactical or semantical bases for logic, this circularity cannot be avoided. On the other side however, logic stands strongly in need of justification. Looking at the usual logical constants (and, or, not, if-then, all and some) we remain radically unsatisfied as long

as nobody can show us that these terms history has selected are really necessary and sufficient to describe search and proof[6]. The working logician may rest content to use them in their traditional versions (although even he notices that the discussions between intuitionistic and classical logic, and those between the proponents of relevant and material implication produce a multiplicity of alternatives that compells us to give reasons for our choices), but the philosopher of logic has to explain to himself and others in a rational way why it is necessary, when looking for the basic rules of inference, to talk in this way about these constants.

At this point we reach a conclusion that brings together our pedagogical and our philosophical needs.

Any non circular foundation for logic must necessarily step outside the realm of science of language. We must show (let us stress "show" and not "prove") that the basic terms of logic can be taught by introducing "practical" definitions for the fundamental constants and practical justifications for the rules governing their use.

If practice is then to be the foundation for logic, only a philosophical science *using* logic (but not *presupposing* it deductively) is able to convince us that human practice really has the properties founding the logical rules. Only this inductive and deductive study of the varieties and the universality of human practice can guarantee us that this practice has the properties allowing it to play the foundational role attributed to it.

We had experienced (as explained earlier) that logic only becomes alive in the intellectual development of the general public when presented as rules for problem solving. Now we see that only general human practice can furnish a philosophical foundation of logic. And common practice is precisely that concrete problem solving activity that is the core of all skilled action.

It thus became unavoidable both for pedagogical and for philosophical reasons to *seek the foundations of logic in general human practice and to use these same foundations in the teaching of logic.*

Within logic we had at least found a group (even if the "Erlanger Schule" composed of the pupils of Lorenzen is only a minority) that would not consider our conclusions as nonsensical (even if this group would not follow us in the empirical study of work, it would at least consider human practice as basic).

It became soon evident however that the "Erlanger Schule" refers to general practice in two different ways

a. In its first period, exemplified by Lorenzen's "Einfuhrung in

die Operative Logik und Mathematik" the starting point was the general constructive activity of the builder (ref. 5, p. 9). Action was a relation between the *agent* and the *world of objects*. In his "Protologik" Lorenzen presented general construction procedures deriving from this starting point and necessary as well as sufficient for the foundation of logic.

b. In its second period Lorenzen, by now accompanied by many others, abandoning his first point of view, develops no longer a "monological" but a "dialogical" protologic. Agents engage in discussion and the basic features of these discussions, *social inter-actions between agents*, now serve the purpose earlier attributed to the relations between agent and object.

We can neither agree with the exclusively monological emphasis of the first Lorenzen nor with the exclusively dialogical emphasis of the second. If we did, we would, as teachers, loose contact with the concrete problem situations in which both solitary search and cooperative group problem solving are needed to overcome the difficulties. As philosophers of logic, trying to justify the selection and properties of the logical constants, we can neither reduce know-ledge to the correspondence between the models of different persons (eliminating the reality to be known), nor can we reduce knowledge to the correspondence of the individual model with the external world (adopting naive realism). Object-subject correspondence is mediated by subject-subject correspondence and (!) inversely.

It became also evident that in its first period the "Erlanger Schule", making explicit the properties of constructivism, never saw constructivism as dependent on a general theory of action, and using as introductory examples a procedure of general action, never became interested in action theory as such. Analogously in its second period, using as dialog games special forms of social interaction, this group never became interested in the theory of collective action as such

We can not continue to adopt this attitude because it narrows down the basis on which we build.

A last observation is to be made. We hoped, realising how far fetched our own proposal stressing the relation between the theory of skilled work and general logic would sound (both in teaching and in foundations) that the operational approach of Lorenzen and his students would make these ideas more plausible. However Lorenzen, as a philosopher of logic, never shows any interest in concrete forms of action and production. His approach remains strongly a priori : he uses general human abilities in his foundation of logic and he uses

them by letting them work, never worrying about their properties. They are manifestly for him so universal and clear that they can be exercized and described with perfect ease. We cannot share this unproblematic attitude. As teachers we are of the opinion that these universal and fundamental abilities have to be exercized in specific contexts before one can become aware of their proper nature. As philosophers of logic, we repeat that, between abilities only usefull in one context, and universal abilities a large field of intermediary skills must be described and used as the only possible gateway to the universal skills. These intermediaries have to be ascertained by means of actual production — and problem-solving situations, as much as by a rational theory of action.

In virtue of these three observations, we see that our plans can only be realised if we convince ourselves, other logicians and the members of the "Erlanger Schule" that a joined operational and dialogical foundation for logic needs both exercice in and observation of a multiplicity of production and communication situations.

To prepare the realisation of this plan, we are going to establish
a. that Lorenzen's first "operative Logic" is still needed and can be considered as part of a more general and fundamental science : theory of action or praxeology[7].
b. that, as F. Kambartel and C.F. Gethmann have shown[8], the introduction of logical constants by rules of attack and defense in streamlined dialogues leads back to conventionalism and relativism
c. that to the contrary speech acts like asserting, doubting, consenting and rejecting can be studied as such, so as to establish "natural" dialog logics as a part of speech act theory
d. that both in case a and in case b the multiplicity of pragmatical and praxeological situations leads to a multiplicity of rules.

The inductive and empirical study of these contexts will in the future, so we hope, show that our practical foundation of logic, using pragmatics and praxeology, overcomes Lorenzen's a priorism, allowing to reach our pedagogical and philosophical aim.

II. Lorenzen's "Protologik" is a chapter of the theory of action (praxeology)

"Operating" according to schemes with configurations is known to everyone. For example when constructing a wall stones are superimposed on each other according to a certain rule. When knitting, threads are connected with each other following a given scheme.

Addition and multiplication of natural numbers are nothing else than schematic operations" (p. 9, ref. 5).

This initial paragraph of the "Operative Logik" deserves analysis.

- On the one side our intuition according to which the empirical study of skilled work is related to logic, is confirmed. Constructing walls or knitting fabrics are skilled operations following rules.

- On the other side however, the author jumps immediately from two concrete examples to calculation with natural numbers. He does not feel the need to justify the jump and never comes back in his study of logic to his starting point in practice. Different types of schematic action are nowhere differentiated. We, human agents, his readers, are supposed to grasp immediately with perfect clarity, by means of these examples, the essence of practical action according to schematic rules.

Yet in the chapter introduced by these lines, not logic, but only a preparatory effort "protologic" is studied. Protologic analyses (p. 12-13) the construction of end products from initial materials by means of discrete operations. We don't mention here assertions, propositions or numbers. We simply start with a finite number of distinct configurations and apply to these distinct configurations a finite number of rules (defining operations). "To learn the derivation of configurations according to a calculus only means to learn the execution of operations" (p. 13, ref. 5).

This happens by the showing of the operation and its imitation. Language is not needed. The initial configurations are chosen so as to be present in common practice : they may be rows of colored pebbles. The rules (describing in fact action types) are in this example of the following form (f.i.) :"If one encounters a black pebble, preceding a white one, it is allowed to put a white one in front of the first".

If we are able to recognize types of concrete objects (white or black pebbles, f.i.) and to understand and apply rules we are able to produce the activities studied in this "Protologik".

Deviating now from Lorenzen, we propose to talk simply about action systems instead about "calculi". All skilled actions procede according to rules and we can distinguish as many "action types" as we can define rules. We can also, in everyday practice, easily distinguish between action tokens (concrete spatio-temporally localised actions) and action types (classes of action tokens). In action theory, developed years after Lorenzen wrote his "Operative Logik", Von Wright and Goldman regularly use this distinction[7].

Our action systems (Lorenzen's "calculi"), sets of action types connected with each other, are given as follows : 1. we show the elementary building blocks, allowed to appear in initial or constructed configurations, 2. we show the initial configurations from which every action type has to start, 3. we show the action types, that may be applied to initial or already constructed configurations.

Sometimes an action only depends on part of a configuration. To indicate that the other parts are "free", we add objects indicating this "freedom". These objects are the so-called "variables over segments of configurations" (p. 14, 5).

Any agent, capable of acting on kinds of concrete objects and able to apply action types is capable of creating new and using old action systems.

We notice that only discrete objects are used and that all sequences are discrete sequences. Continuity and indefiniteness of frontiers are absent. This restriction may be understood if we consider these actions sytems as production systems working on solid bodies by means of mechanical instruments. Reasons borrowed from the history of technology speak in favor of this starting point.

The construction of a configuration (called far too early, in this domain so far removed from logic and language, a "statement" by Lorenzen), by means of a sequence of actions (again far too early called (p. 17, 5) a "derivation"), is concretely described by a list starting with an initial situation and enumerating the types of actions and their intermediary results, to lead finally to the last configuration produced.

Already in protologic, Lorenzen speaks about "propositions derivable by rules", we mention only "configurations realisable in action systems by means of actions belonging to action types, using certain building blocks and starting from given initial configurations." The difference seems only terminological. But a difference in terminology has far reaching consequences. For us the typology of action systems in various parts of human production will be a natural continuation of protologic, while Lorenzen leaves non linguistic action immediately behind. And yet, our way of expressing ourselves comes closer to his intentions — so we believe — than his own.

For us it is easy to show that nobody can be an agent if he can not create and work with action systems; for Lorenzen we see no way to show that one can not be an agent if one has no "calculi" at one's disposal.

The study of action systems will to be sure contain a chapter

analysing what happens to a system if one adds or subtracts action types. The extreme cases will be those where the subtraction of one action type reduces all constructible configurations to zero (or to the initial configurations), or where the addition of one action type allows the production of all configurations producible by another action system. Another extreme case is that in which the addition of an action type neither increases nor decreases the number of the constructible configurations.

Among the properties discovered for action types some will be local ones (they characterise this action type in its relation to only a few action systems) and some will be universal (characterizing the action type in its relations with all action systems).

Lorenzen in his desire to leave "Protologik" behind and to reach logic is interested in only one part of the discipline he helped to define : a. in universal characteristics and in b. action types that do not affect the constructible configurations of the action systems one adds them to.

We can, from our point of view, explain why for action systems in general, Lorenzen's interest can be understood.

If, in the economical meaning of that word, an agent is a "rational" agent (trying to use minimal means for maximal results), he will try to "simplify" his action systems. In other words : if it is at all possible to replace n action types of an action system S by one other action type having the same results (a macro-action) the agent will try to use action systems including these macro-actions. (each replacing n micro-actions). In order to define a macro-action, we must consider all those actions Ai that, added to given action systems, neither increase nor decrease the set of reachable goals. A macro action simplifying a system S will a. not affect the set of reachable positions, b. but allow to replace a number, small or large, of other action types.

Lorenzen, to be sure, does not introduce these considerations referring to economical rationality. He introduces simply the concept of an "admissible action type" (rule, operation). such that for all action systems (calculi), it may be added to them without enriching or empowering the set of reachable positions. Such action type he calls admissible.

We have spoken about economic rationality, because a simplifying action type that would be universally simplifying would also be admissible (even if it has also another property : to be a substitute for n other action types). To be sure, universal admissibility does not necessarily entail economical simplification.

For us, the relation between economical efficiency and admissibility offers a possibility of justifying our interest in this concept. Moreover, our version of "Protologik" makes natural the study of locally admissible action types (non enriching nor empoverishing only for certain classes of action systems), whose properties will enable the logician to study the unexplored field between the particular and the universal,

Maria Nowakowska[9], working in praxeology and not bearing the foundations of logic in mind, does introduce a theory of equivalence relations over action systems that comes close to "admissibility". If A is the set of actions and A' the monoid of sequences of actions taken from A, let then r be the function taking its arguments in A' and having as its values the results of its arguments.

If for all v in A', $r(a_i v) = r(v a_i) = r(v)$ (where "=" is not pure identity, but an equivalence relation defined on results) then a_i is non enlarging with reference to A and r (and thus the counterpart of admissibility for action systems is defined).

Without using r, we can still define an equivalence relation on A'. (ref. 9, p. 171). If a and b are in A', a eq_A b means : for all w1 and w2 in A', (w1aw2) is propositionally equivalent to (w1bw2). If a is such that for all w1 and w2 in A', (w1aw2) is propositionally equivalent to (v1v2) (where v1 and v2 also belong to A' and none of them contains a) then a is L-admissible (in the purely praxeological version of this concept).

We see here that our generalisation of "calculi", introducing them as action systems, enables to understand the central importance of admissibility (Lorenzen's key concept) without having to introduce it ad hoc.

Protologic in its first version will be the systematic study of procedures by means of which we can discover if "rules" (for Lorenzen) or "action types (for us) are universally admissible. We have said — and we repeat here — that local admissibility and other properties of the addition and substraction of action types to and from action systems will in the future allow "Protologic" to expand. For now however we concentrate, with Lorenzen, on admissibility. On p. 37 (ref. 5) we read "In the last paragraphs we have obtained five principles for providing admissible rules : 1. The principle of deduction, 2. the principle of induction, 3. the principle of inversion, 4. the principle of equivalence, 5. the principle of underivability". He adds that he can neither prove nor disprove that this set of methods is complete or incomplete. We are going to show that these five types of admissibility proofs can be understood on the basis

of our praxeological admissibility reduction.

We do this for two reasons : a. the completeness problem can be more easily studied with reference to our general admissibility concept, b. the action theoretical admissibility concept leads normally to extensions that help building the necessary bridges from the concrete to the abstract.

III. Methods for proving universal admissibility are praxeological methods

1. In order to show that an action type t is universally admissible we can try to eliminate it at every point in a construction where it occurs. If this elimination neither increases nor decreases the number of constructible configurations, t is admissible. Many different types of elimination can be distinguished. In the simplest case we only replace t by a sequence v, every time when it is used and leave constructions unaltered elsewhere. In more complex cases we have to modify the stretches preceding the occurrences of t, in order to introduce our replacements. The number and type of these anterior modifications can not be defined in a more precise way (5, p. 22).

Lorenzen states (5, p. 23) "an overview of the possible elimination procedures can probably never been obtained" ("dürfte kaum zu gewinnen sein").

As philosophers this non constructive character of the set of elimination procedures (corresponding, we surmise, to the non recursivity of the set of recursive sets) can not satisfy us. As teachers we realise that a typology of elimination procedures in different action contexts will be a sine qua non for this method of simplification to be understood.

Lorenzen's protologic needs action theory to be understood as a description of fundamental human abilities, but it needs even more a typology of action contexts and action systems.

The grasping of the universal needs an organised overview of the specific. The so-called "deduction principle" is (5, p. 26) only an elimination rule adding to the system initial states (the rule has the form "from a1...an we can construct a" and we eliminate it by adding a1...an and by constructing a).

2. A second procedure for proving admissibility consists in showing that a construction t can be obtained starting from every configuration proper to an action system S. To reach this result we first convince ourselves that it can be built on the basis of every

initial configuration of S. Afterwards we indicate how the result can be obtained, on the basis of any product of an action type of S when it can be reached starting from the initial configurations of this action type. If these results are acquired, we can consider the rule "t can be reached from any configuration in S" as admissible.

The principle of complete induction in arithmetic is a very special case of this more general action principle (only one initial state : 0, only one action type : $\div$).

The generalised induction rule differs strongly from the elimination procedure : the former constitute a complex set but can directly be derived from the definition of admissibility. The latter can be expressed in one clear statement but its praxeological meaning is not evident. We conjecture the following : any agent capable of reaching certain results at given moments of his action series, will try to stabilise his action potential, by looking for results that can be obtained at all future points of his constructive action. If the agent remains invariant, such properties must necessarily exist, and thus the induction principle must at least sometimes be applicable.

It acquires in our version of "protologic" a practical significance that it did lack in Lorenzen's.

3. If, in an action system S, a configuration can only be reached by passing through certain intermediary constructions, then once we have obtained the first configuration, we must be able to reach the intermediary ones. By means of an "inversion principle" abstracted from this sittuation, we prove that the addition of the intermediary steps to S is admissible, whenever the final result is obtained.

An agent in position y, following by back tracking his earlier steps, will be able to construct position x, if x is the only position from which he could have obtained y (an extreme case of our principle)

4. Action systems presuppose action types. They are only possible if the agent can recognize different actions, occurring in different places and times as exemplifying the same action type. Action systems also presuppose object types. Equivalence relations on actions and on objects are thus presupposed by the very concept of action system. On the basis of this concept we can state that if the addition to an S of an action a, or of a sequence of objects o_i is admissible, then the addition to S of actions belonging to the same type as a or of objects belonging to the same types as o_i is equally admissible.

The philosopher, as much as the teacher will have to state that

criteria for the classification of actions and of objects are different in different contexts; in consequence, this rule is rather a set of rules, with different content for different contexts.

5. On one point we must disagree with the first "Protologik". Lorenzen claims that if a configuration is not reachable in S, we are allowed to add to S all action types starting from this unreachable configuration (they will neither enrich nor empoverish S, being unapplicable). Such a rule cannot — so we believe — be justified praxeologically. No simplification of action sequences can be obtained by using unapplicable action types.

The first four procedures discussed can be justified in action theory. If we pursue the purpose to obtain for an S, as many as possible non enriching nor empovering action types (enabling to simplify S) then we have to look for a. global and local elimination procedures, b. possible displacements of action procedures in progressive (induction) or regressive (inversion) direction. c. multiple concretisations of the same action and object types.

We have not proved that these four methods are both necessary and sufficient for simplifying action systems. However, it seems at least plausible that progressive and regressive displacement, concretisation and substitution cover the possible ways of simplifying sytems.

Much more research should be done on this topic. We think that our approach, introducing protologic in praxeology, leads more easily to this work that Lorenzen's isolated attempt.

Moreover - as we announced earlier — action systems suggest the relativisation of admissibility. An S may be such that a type t is only admissible for specific aspects, for specific initial states or for specific contexts. Given the fact that the set of all action systems can not be constructed, the study of special cases is a necessity. Their empirical analysis then becomes a normal and rational undertaking and will — so we hope — be admitted as an introduction to logic by those who took the "Operative logik" of 1955 seriously, and regretted that it has been abandoned even by those who created it.

The study of the simplification of action systems will, on the basis of a more thorough understanding of the philosophy of technology, be one of the two *foundations* of logic (and one of the two *introductions* to logic).

However : a human being is not only a solitary agent confronting the world. He is also a social agent, acting in cooperation. This fact leads to a *second* foundation for logic.

IV. Dialogical Foundations for Logic on four Levels

The first proponents of "Protologik" abandoned their effort for two reasons : 1. If one interprets "Protologik" as a theory of sign manipulation it is too small a basis for a foundation of logic -- and this interpretation, although in contradiction with the central inspiration, prevailed even in the mind of those most opposed to pure syntax. 2. Logic, as it had historically grown was in the first place a theory of rational discussion and argumentation.

A "dialogical logic" was then proposed[10] by Lorenzen and Lorenz in their effort to leave pure formalism behind and find a natural base for the theory of valid argumentation.

We stated already in our introduction that logic has at least to contain a theory of argumentation. In this respect one can only agree with the dialogical logicians. In that same introduction we did also stress however that logic needs something more than a theory of argumentation : it needs a theory of search and of proof. In this respect then we disagree with the dialogical logicians and remain close to "operational logic" (generalised in action theory).

The problem arises how to coordinate the monological and the dialogical version of natural logic.

In order to find the elements of an answer we need to analyse more deeply dialogical logic itself. It presents the rules governing the classical logical constants by means of dialog games.

To take an example, we consider conjunction

O   P

p.q

P?   q?   Ded p   Ded q

A proponent puts forward the thesis "p and q". His adversary (the opponent) has the right to ask for a justification of p and for a justification for q. If P can give these justifications (Ded), he has won; if he fails in giving either of them he has lost.

Logic is claimed to be the study of those assertions that can be defended against all opponents. For each logical constant (and for the quantifiers), a dialog game is provided.

If partners engage in a prolonged dispute, many dialogues will be entered, run, won or lost. "Frame rules" must be adopted stipulating how many times a position may be attacked in the course of

an argument, and indicating if the opponent has to attack the last argument of the proponent, or, to the contrary is allowed to attack any earlier position.

Lorenz has shown that for different frame rules, different sets of propositions can be defended against all proponents.

Intuitionistic and classical logic are universally defensible on the basis of different frame rules.

This is in itself an important and fruitfull result. However, as philosophers of logic, we cannot be satisfied with dialogical logic as such, giving us a foundation for our subject.

Hans Lenk[6] has asked why precisely these dialogues were chosen to define precisely these constants ? As long as we cannot give a material justification for the selection of the constants and for the selection of the dialogue types, we do not leave formalism behind us. We just get it back under a new disguise. We agree with this objection.

Hans Hermes[11] pointing at different "frame rules" states that as long as no material justification for these rules is given, our choice between them (and thus the eminent position acquired either by intuitionistic or classical logic) is a purely conventional decision. We agree with this objection also.

Friedrich Kambartel, arriving independently at these same critical conclusions, gives some constructive proposals aiming to overcome them[12].

He considers the Lorenzen-Lorenz dialog games as belonging to a first level of dialogue logic. This level presents ad hoc specific dialog games without adding their justification.

It becomes thus necessary to introduce a second level. Here the partners discussing with each other are not necessarily only opponents. Instead of selecting one set of frame rules all possible frame rules are taken into consideration.

Logic as such is however neither defined nor founded here because all possible dialog games are taken into consideration. This second level has until now only be described but not been studied. Its importance is due to its generality on the one side, and to the possibility to find formal models for empirical argumentative situations of a strongly non classical nature.

On a third level we abandon the wide extension of the second in order to concentrate on the argumentative features and their intensional meaning. Argumentation is here an interaction between agents performing argumentative speech acts with specific illocutionary forces. The participants commit themselves to the realisa-

tion of obligations (they assert, doubt, consent, justify asf.). The study of this third level presupposes the theory of speech acts, of illocutionary forces (and of deontic logic needed to define them), and the categorisation of a series of speech acts as "argumentative".

Again this third level has mainly been described but begins only to be studied.

Finally we come to a fourth level. Here speech acts are considered as special cases of action in general. The justification of the logical constants is now looked for in the basic combinations of actions, applied to a. speech acts and b. argumentative speech acts.

These four levels are clearly distinct. In Kambartel's thought they constantly interfere with each other, however. He begins by justifying the properties of the logical constants on the fourth level; then he proceeds to summarise his results in a language belonging to the third level, and he ends by simply defending the legitimacy of the second level on the basis of statements belonging to the fourth and the third. (against Lorenzen-Lorenz who tend to remain on the first level).

We stress so much the distinction between the four levels because on level 4 the synthesis between the operational and the dialogical approach becomes possible, while on level 3 (revealing *the essentially performative character of the logical constants*) dialog games may be connected with social actions performed by means of argumentative speech acts.

These general remarks can best be clarified by returning to the logical constant "conjunction". We now analyse it on levels 3 and 4. If an agent performs the speech act of *asserting* "p and q" (we must know, to understand this sentence what a speech act and what an assertion are), he *commits* himself (a deontological expression) to perform the speech act of *"justifying* both p and q" if *asked* to do so (the agent assumes a conditional obligation, and the action to which he obliges himself is again a speech act, though of another type).

The reader will have noticed that the meaning of "and" is explained by a commitment to execute two actions, a commitment once more expressed by using the particle "and". Is such an explanation circular or not ? To this first doubt a second must be added : do we have some reason, either in the general theory of speech acts or in the general theory of actions, to consider the action of doing two things together as important ? In other terms, even if we can show this explanation not to be circular, does it explain why precisely *these* constants are called "logical" constants ?

F. Kambartel states correctly that only if the ability to do two actions simultaneously or in immediate succession (order being irrelevant) is an ability proper to general human practice, and if this practical (non verbal) ability is used to define "asserting p and q" circularity can be avoided.

He states (p. 218, 8a) "we are concerned here not with complex statements but with complex actions". The first "and" is the name of a logical conjunction, the second one (used in the explanation) is the name of a practical conjunction. We would add that according to Kambartel's explanations, the and is not of a pragmatical but of a praxeological nature. It is not introduced by referring to the execution of two speech acts, but to the executions of two arbitrary actions.

In praxeology we can now try to justify the importance of practical conjunction. If I act I must necessarily try to realise my ends by realising suitable transformations of my materials and instruments. Doing two things together is — so we see — entailed by doing as such. Conjunction is no longer a constant that has to be justified because classical logic needs it; it is a sign the use of which is determined by an ability entailed by the existence itself of action.

The other classical constants are discussed in an analogous way by Kambartel. (who never clarifies however, as we try to do, the relation between his practical counterparts of logical constants and theory of action). In each case it is claimed that the ad hocness of the dialog games used to introduce them must be overcome by referring to the general pragmatics of argumentation. But in each case the argument does not use the typical characteristics of speech acts in general or of argumentative speech acts but to the contrary the properties of action itself.

Disjunction is introduced by referring to our capacity to choose among several actions.

Implication is introduced by our capacity to perform actions only under certain conditions.

Negation is introduced by referring to the failure of actions and our ability to react to these failures.

We (in opposition to Kambartel who uses praxeology but also claims to remain within pragmatics) can justify the importance of the ideas introduced
- without choice, no action is possible
- without conditional actions, we cannot regulate our behavior in function of the existent states of affairs and of the consequences of

earlier actions
- without action failures and the possibility to react to these failures we are either all powerful or impotent (and so we are no agents).

The praxeological counterparts of the constants of propositional logic are necessary conditions for the possibility of action.

This deduction, evidently using logic, is not the latter's foundation. It only shows that the claim according to which general human practice indeed contains the counterparts of the basic constants is indeed true (but the "foundation" is to be sought in these active capacities themselves). This statement seems to give a conclusive answer to the question mentioned in the title of this paper.

It also seems to be a complete rejection of the dialogical approach to logic, bringing us back to our praxeological interpretation of the "operative logik". The contribution of interaction, communication and argumentation to the foundations of logic seems to be zero; only the structure of action has been used.

Finally, our pedagogical intuition according to which logic should be taught on the basis of comparative problem solving seems to be false because the logical constants are derived from the structure of action itself without owing anything to the nature of specific action types.

We cannot accept this conclusion. As strongly as we tried to prove the present actuality and usefullness of the monological constructivism, abandoned by the pragmatical philosophers of logic, as strongly do we believe that a genuine and independent contribution to the foundations of logic is to be expected from communication and interaction.

But how can we avoid the conclusions, that our modified versions of Kambartel's proposal compells us to accept ?

In the first place we shall show that on a general praxeological basis, constants other than the classical ones are as important (and thus the foundation of the classical constants on praxeological basis is not complete). In the second place we shall show that the properties of the praxeologically introduced classical constants are non classical. In the third place we shall show that the properties of the logical constants introduced by argumentative speech acts are also non classical.

These three conclusions taken together either — refute classical logic as such – or, in order to save it, compell us to join pragmatics to praxeology in order to find its foundation.

This last step we shall not carry out here. It suffices for our

purpose to indicate that, if classical logic is to be founded in a non-syntactical or semantical way, neither pragmatics nor praxeology alone can execute do the task.

Moreover, the non classical constants, the non classical properties of the classical constants, and both classical and non classical constants defined in argumentative situations will have different properties in different problem solving situations. It will thus be necessary to learn about these properties inductively and to introduce them to students on the basis of their varied engagement in different types of problem solving.

V. Praxeological Foundations lead with Necessity to non-classical Constants.

Any agent, in the pursuit of his ends, must be able simultaneously to execute an action and to refrain intentionally from executing another one. Acting with precision demands this exact delimitation. To do AI and intentionally to refrain from doing A2 is as natural and necessary an action combination as intentionally doing A1 and A2.

Refraining intentionally from doing an action, while doing a second one is also a related necessary action combination. In the first case to the performance of A1, an intentional refraining from A2 is added and in the second case to the intentionally refraining from A1 the performing of A2 is joined. In the first case the principal aim is to perform (and refraining is a means towards that end); in the second case the principal purpose is refraining and the performing is this time the means.

If these action combinations have the importance we attribute to them, we should expect symbols to be introduced by means of these combinations.

They indeed exist
1. p, but q
2. p, and nevertheless q
3. Although p, q
4. Nothwithstanding p, q

To understand these four constants on the praxeological level, we must add to the distinctions made untill now, some others.

The two interfering actions may each entail some results that constitute the partial performance of the other; or to the contrary, no such results are present but the means of each action must be controlled with precision (if left free, they could co-execute the

other action). In the first case compensatory action must be taken, in the second case control suffices.

The four cases of interference so described suffice to distinguish our four symbols. We leave to the reader the task of coordination.

We are not claiming that these combinations are the only ones that will give practical introductions for our four particles. The distinction between partial success (although p, q) and partial failure (p, but q) can also be used.

The non classical connectives we just showed to be necessary on praxeological bases, can also be justified by argumentative reasons. When arguing, we need means to delimit with precision the premises and conclusions, separating them from analogous ones with whom they might be confused. We also need means to make concessions, while still continuing to defend our main theses. The hierarchical ordering of the aims of our argumentative praxis needs tools at its disposal; the non classical connectives mentioned are those tools. Moreover

5. p, and even q

is introduced by the following action combination "I do A1 and A2 where A2 comes closer to the goals of A1 than A1 itself". In the field of argumentation, it is defined as follows "I prove p and q, where q is stronger than p". Analogous expressions like "however" and "to the contrary" may be analysed in analogous ways.

6. "p, as if q"

7. as p, so q"

correspond to the praxeological situation of performing one action, taking another as its model. They constitute the basis for learning new action types and as such, are essential for action as such.

If however non classical constants are as fundamental for a praxeological foundation as classical ones, why should the ones be called "logical constants" and the others be denied this status ?

If no supplementary reason for the distinction can be found in argumentation or in the interaction between action and argumentation, then the reasons for the differentiation must be searched for in the properties of the problem contexts and problem types. In different problem solving domains different connectives would have different eminence. The distinction attributed to our classical constants would correspond to the eminence attributed to certain problems.

Whatever may be the answer to these questions, the empirical study of problem solving becomes relevant for logic as such.

V. Praxeological Foundations introduce non classical properties of classical constants

Let us return to the action combinations, needed to introduce in a non circular fashion the classical logical constants :
- disjunction corresponds to choice
- conjunction corresponds to doing two actions simultaneously or in immediate succession (order being irrelevant)
- implication corresponds to conditional action
- negation corresponds to the action responding to the failure of another action.

This correspondence should entail similar properties for the praxeological and the logical concepts corresponding to each other. However it does not !
- If I execute two actions together, either they are connected (as when driving, I simultaneously observe the road and regulate my speed) or unconnected (as when driving I talk to my neighbour); In the first case the meanings of both actions are connected, in the second case they are completely irrelevant to each other. In a praxeological conjunction, either the two actions are relevant to each other (f.i. one of the two is a necessary condition for the success of the other) or don't interfere at all (none of the consequences of the one has any positive or negative influence on the success of the other). In both cases the terms of a praxeological conjunction are not arbitrary (as may be the case for a logical conjunction).

If I choose between two actions, either the two are different means in the pursuit of the same end or they correspond to the selection of two incompatible ends. In the first case they are related to the same purpose; in the second case they must be related to a metapurpose for the choice to be rational but they are anyway strongly incompatible. In both cases the actions may be executed by the same agent. The praxeological disjunction can not bring arbitrary terms together.

Taking these two short remarks into account, we realise a. that for arbitrary q, "p entails p or q" can not hold, b. that "p entails p or p" is false for a selection disjunction, c. that if p is proved and q is proved, "p and q" is not in general proved (if our conjunction corresponds to praxeological conjunction).

This remark shows that the justification given by C. F. Gethmann[13] (p. 143–146) for conjunction and disjunction cannot be accepted. It attributes to the praxeological basis unreal formal properties introduced only with the purpose to give to the constants

introduced their classical properties. An apparently non circular foundation becomes circular in this way.

Relevant disjunction and relevant conjunction[14] are closer to praxeological disjunction and conjunction. If relevant disjunction means that non p would entail q (and that non q would entail p), this combination of entailment and subjunctive conditional expresses at least part of the selection situation. Analogously if relevant conjunction means that it is not the case that if p would occur then non q would occur (and inversely) at least the second meaning of praxeological conjunction would be expressed. But we still lack complete correspondence between the logical and the praxeological concepts.

Let us now examine the implication operator. He has been introduced on the basis of conditional action. Let us compare the four sentences that follow :

1. "If the state of affairs p is realised, the agent intends to realise q"
2. "The agent intends, if p is realised, to realise q"
3. "The agent intends to execute the action A2, using as instruments the results of action A1"
4. "If action A1 is executed, the agent intends to execute A2, using as instruments the results of A1"

In 1 and 4 the intention exists only if the condition is realised. In 2 and 3 the intention preexists the realisation of the condition of its realisation. In 1 and 2 no relation is presupposed between p and q (or if one exists, it is left free). In 3 and 4 a specific relation is presupposed between A1 and A2. Some — but not all — of these differences have been noticed by Gethmann (8b, p. 122—130 : Zur Rechtfertigung des Subjunktors in der Konstruktiven Logik).

The first type of conditional action (1) is only conditional for the observer; it is not conditional for the agent himself. In sentence 2 the conditionality is present to the agent himself. Only 2, 3 and 4 can be used to teach the meaning of implication to an agent. In 2 however the relation between p and q (that will have to exist) is not explicit. We conclude that only cases 3 and 4 realise the meaning of the term "conditional action".

Sentence 4 (as stated before) shows a praxeological condition as only existent for an observer and not for the agent himself. We should then concentrate on case 3. This is clearly not classical however, because it depends on the relation "using the results of an action in executing another one".

In relevance logic an attempt has been made to state clearly when a proposition is used in the proof of another one. The problem

arises if and how we can use conditional actions of type 3 to teach non linguistically the meaning of relevant implications.

The dialog rules used to introduce implication (called "subjunction" by the "Erlanger Schule"), conjunction and disjunction are far removed from actual practice and don't take into account the non classical properties of the praxeological counterparts of our classical constants.

If conditional action takes the following form "I commit myself to justify q, if you (the opponent) assert p" (this being the definition of "p implies q") this weak conditional commitment cannot yield the foundation of implication because we have to know implication already to make such a commitment ("if p, then q !" or "if p, then it is obligatory that q" both use the implication theory are supposed to introduce). Moreover, if you (opponent) don't assert p, then I am not committed to anything and win. This is far removed from the realistic case 3 in which the agent should have a meta-plan at his disposal, transforming any result of the action A1 into an instrument for the action A2.

We repeat that if a praxeological or pragmatical foundation is sought (as should be) care should be taken not to falsify the starting point !

Negation was introduced by means of two concepts : a. actions may fail (as they may achieve success), b. if an action fails we may have at our disposal positive actions always used when failures occur.

It is necessary to stress that the second concept is as essential as the first. If a symbol called "negation" were to be introduced simply as a symbol of failure, it would – contrary to the other logical constants – this time correspond to a state and not to an action. In the language of pragmatics : to transform the rejection or refutation of an assertion into the assertion of another assertion (the so-called "negation" of the assertion rejected), an essential qualitative transformation is needed. Praxeological negation has non classical properties for three reasons : a. every action may fail in many different and incompatible ways, b. many different and incompatible reactions to a failure may occur, c. no concrete event can be a "minimal" failure (present in all failures) or a "minimal" compensation (present in all reactions to failures).

Moreover if an action fails, it is not for that reason condemned never to succeed. Not being proved is not being unprovable. We can only introduce strong negation by introducing (using this time practical modalities) the impossibility of success of a certain action (and how should these practical modalities be defined operationally ?)

Factual negation is (as we saw) strongly non classical because one proposition will in general have a multiplicity of non equivalent negations and because this negation is not stable (any new action may have as its result the possibility of success where before we met only failure).

Strong negation is non classical because it can only be introduced by a modality applied to actions (non p signifies now "the impossibility to perform an action, not only its factual failure).

The different quantifiers introduced praxeologically are also a. in part non classical and b. if classical they don't have all classical properties. We show first the second fact.

The concept of randomness, in general only used in probability theory, is in fact the foundation of the universal quantifier. If "All A are B" (where I cannot enumerate the A, the only case in which this quantifier cannot be reduced to a conjunction), I can only, *in practice* come to know this by verifying that any arbitrary object I select in the class A also belongs to the class B. I thus need the concept of "arbitrary" object. This arbitrary object can only be an object selected at random in the class A. Teaching quantifiers thus needs teaching randomness.

Already this intervention of randomness gives this classical universal quantifier non classical properties.

The praxeological universal quantifiers don't reduce to the universal one we just commented upon. A list of others, non classical but well known, necessarily accompanies it. Let us compare

1. All men are mortal
2. Man is mortal
3. Any man is mortal
4. Each man is mortal
5. Every man is mortal.

1 expresses that the type of action necessary and sufficient to classify something as mortal can be applied to every object to which the type of action procedure necessary to classify it as human can be applied; moreover we are told that for every other object of that type the "mortality" procedure can be applied in identical fashion.

2 expresses that all procedures that can be applied to the application of the predicate mortal can also be applied to the predication human (2 refers to a meta-procedure).

3 expresses the same fact as 1 but demands that the procedures are adapted to the properties of each individual case.

4. signifies that an ordering for the set of humans is at our disposal, allowing to verify the applicability of the "mortality" proce-

dure, following this ordering, under the condition that we adapt our-selves to the specific properties of each case.

5 expresses the same as 4, but allows the applicability of the "mortality" procedure without individual adaptation.

We present these assertions rather dogmatically, without entering into their defense. We hope the reader will try, using his insight in his own thinking, to verify or falsify these assertions.

We end here our attempted demonstration. We cannot at the present moment offer a system for the non classical properties of these praxeological logical constants. We can however come to our conclusion : either our praxeological foundation for logic leads us to new logics (and then it cannot offer us a foundation for classical logic, that, by the same token, as long as we refuse to be formalists, stands refuted) or this praxeological foundation must be modified in order to understand the relative validity of classical logic.

Some hope to find such a modification is given by the fact that until now we used essentially properties of our fourth level. We might suppose that if we move to our third level (where not complexes of actions but of speech acts and of argumentative speech acts in particular are considered) the conjunctions, disjunctions, implications and negations of speech acts and of argumentative speech acts have properties coming closer to those of our classical constants.

This is only a hope however. We shall see to the contrary that if pragmatics as it now stands is taken seriously we deviate there as much from classical logic as we did until now (but not always in the same way).

VII. From praxeology to pragmatics : logical constants introduced by argumentative speech acts

C. F. Gethmann (17, p. 87) mentions that Kuno Lorenz and Friedrich Kambartel have tried to view the theory of speech acts as a chapter of action theory.

Relevant articles are Kuno Lorenz's "Sprachtheorie als Teil einer Handlungstheorie. Ein Beitrag zur Einführung linguistischer Grundbegriffe" (in D. Wunderlich (editor), Wissenschaftstheorie der Linguistik, Kronberg 1976, pp. 250- 266) and F. Kambartel, "Symbolische Handlungen. Ueberlegungen zu den Grundlagen einer prag-matischen Theorie der Sprache in J. Mittelstrass — M. Riedel (eds.), Vernünftiges Denken, Berlin 1978, pp. 3- 22.

To the contrary, C.F. Gethmann (8b) asserts (p. 73) "Handeln

lässt sich methodisch als Befolgen einer Aufforderung einführen; demgegenüber lässt sich "auffordern" methodisch nicht als spezies oder Exemplar für Handeln einführen" (Action can be introduced in a methodical manner as "obeying a command". To the contrary "to command" cannot be introduced methodically as a species of action").

If the first theory is correct we need to define symbolic actions, asking how they can be synthesized and decomposed. These methods of synthesis and decomposition will yield a new approach to the logical constants. If the second theory is correct, we should to the contrary start with a logic of commands and introduce the logical constants on its basis.

Allthough we adopt the first view, we cannot, in the scope of this article decide which of the two approaches is correct. We only take notice of the fact that until now neither a theory of symbolic actions nor a theory of commands have been presented as foundations for logic.

Let us start with a brief description of communication as a preparation for action in cooperation.

If cooperative action is to occur, an agent must be able to *demand* action from other agents.

The actions asked for have to appear at suitable moments : they should happen when adequate *conditions* are realised. An agent engaged in cooperation thus needs not only commands, but primarily *conditional commands*.

It must also be possible to indicate to one's partners that the conditions under which their action is expected are indeed realised. Symbolic actions to that effect are called *"assertions"*.

All symbolic actions must be such that other symbolic actions can be performed in order to *strengthen or reinforce* their impact (this follows from the inevitable occurrence of complete or partial failure, represented in this context by *misunderstanding* and *disagreement*).

The strenghtening of demands leads to a logic of imperatives and the strengthening of assertions leads to a logic of assertions. We shall call *"doubts"* demands to strengthen symbolic actions.

We must also be able, if our communication is to prepare cooperation, to indicate that one pursues the same aims as other partners or that one uses the same means. We call *"consent"* an action by means of which we indicate that we accepts either the demands or the assertions of another agent as our own. If we want to indicate that we pursue other ends or the same ends by other means, we

"*reject*" certain demands or/and assertions.

Two remarks are now in order !

1. It is possible to describe an interaction between an agent and himself in the course of which all kinds of speech acts we just mentioned do occur. Even if asserting, demanding, doubting and consenting are argumentative symbolic actions unthinkable without social interaction, an agent uses them also in this reflections about himself. A foundation for logic on the basis of these speech acts is thus not yet necessarily a social foundation (even if this limiting case is unimportant in comparison to the social functions, just described, of these speech acts types).

2. Discussion is only a preparation for collective action. Collective action is a succession of cooperative and discursive episodes. We are of the opinion that the praxeology of interaction (even of non discursive interaction) yields other logical properties than the discussion of action in isolation. These properties do not necessarily depend on the properties of speech acts.

These two remarks don't have the intention to diminish the merits of a pragmatical foundation for dialogical logic. (historical arguments plead strongly in the favor of such an undertaking). They only intend to make clear our strategy : a. either we have to look for the logical consequences of non linguistic social interaction, b. or we have to derive these consequences from the theory of speech acts, c. or we have to combine speech act theory with the theory of collective action.

The first strategy-deriving logic from the theory of collective action — is, as far as we know — completely new and has never been used. The second strategy has been tried[8]. However — and for this reason we have to start over again — the basic operations of asserting, consenting asf. are just given ad hoc in these attempts and not deduced from general speech act theory. Their properties are neither observed nor are they brought into contact with the analytical theory of performative speech acts.

In this article we shall not tackle the theory of collective action in its function as a partial foundation for logic. The problem is not unimportant — far from that — but it is brand new and moreover leads us away from pragmatics.

We ask the following questions :

1. Can the basic argumentative speech acts be defined in general pragmatics ?

2. Can the operation of "strengthening" be defined there ?

3. Can this strengthening operation be used to define "entailment" ?

(resp. "subjunction") ?

4. If so, are the properties of this entailment classical or not ?

5. Can this pragmatical entailment be used as a foundation for logic ?

VIII. General Pragmatics and Pragmatical Consequence as a Foundation for Logic

A speech act is an action containing an utterance, by means of which its agent produces an effect using this utterance, as the means to produce the result. A performative speech act describes the very action performed by means of this utterance.

The different argumentative speech acts are performative speech acts. It is thus normal to ask if the logic of assertions can be derived from the logic of speech acts.

To find an answer to this question, we need a general description of the logic of performative speech acts. With Searle and Vanderveken, we call this discipline "illocutionary logic"[18].

Generalising and in part modifying this illocutionary logic we shall be able to connect it on the one side with action theory, and on the other side with a pragmatical foundation for logic.

Quoting ref. 18, we shall indicate its author (D. Vanderveken) as 'VV''. With VV we represent a speech act by an expression "F(p)" where F indicates the illocutionary force and p indicates a proposition (to be asserted, denied, questioned, asf.)

1. A speech act is an action. Every action intends to realise a purpose. Thus : every speech act intends to realise an aim. Specific types of speech acts intend to realise specific types of aims. With VV we call this aim "the illocutionary point of the illocutionary force". It is (18, p. 253) "what the speaker conventionally intends to do when he performs that illocutionary act of that force".

2. Every action uses means. Types of acts are characterised by types of means. A speech act being an action, we call "illocutionary mode "of an illocutionary force the typical means used by an agent performing a speech act of that illocutionary force.

3. Aims are realised to a certain extent. Types of action are characterised by the degree of realisation normally expected. The degree of strength of an illocutionary force indicates for this illocutionary force the degree of intensity of realisation.

VV does not relate his concepts to action theory in general. We, to the contrary, show by our presentation that these ideas become more natural (and less isolated) when their connection with general action theory is shown.

However, action types are not, in general, co-defined by their typical instruments and their typical degree of realisation. Many of them are (but then more often by their normal mode of execution than by their normal degree of success). Here however, studying speech acts, these dimensions (point, mode, extent) are viewed as more rigidly determined than for actions in general.

We call a speech act successful in the first respect (s1) when its typical aim is realised by its typical means to the requisite degree. We could present a more refined analysis by using instead three dimensions of success (s11, s12, s13) but for the time being we collapse the three dimensions into one.

4. A speech act uses, as we have said, an utterance as one of its means. VV takes over from propositional logic the idea that this utterance may contain a proposition. We shall in our context consider a proposition to be a map of a set of events or a plan of a set of actions. Uttering a proposition means then for us (but not far VV) producing and exhibiting maps and plans. Given types of speech acts prescribe specific types of maps and plans but exclude others.

This concretist or nominalistic way of speaking is suggested by general convictions about the nature of propositions. However, it has even advantages for our present purpose : the danger always exists that in the definition of proposition already a definite logic is presupposed (condemning our undertaking to be circular). The analysis by means of maps and plans prevents this collapse.

In general, actions are executed without producing and exhibiting maps and plans. But if we consider collective action, even non speech acts can only be coordinated with other cooperative actions if the intentions and beliefs of their agents are shown to the partners of the cooperation. This allows us to correlate this specific "propositional" feature to action theory in general.

We call a speech act "successfull in the second respect (s2) when the types of maps and plans required for the execution of these types of actions are produced.

5. Actions depart from initial states and act on materials to be transformed by their execution. We call *preparatory condition* for a kind of action the types of materials and states of affairs that must normally be at our disposition if we have to begin this action with a chance of success.

"A preparatory condition for the performance of an illocutionary act in a context of use is a state of affairs that the speaker presupposes to be actual in the world of the utterance when he performs this act in that context" (18, p. 255).

In the definition quoted, its author does not talk about objective preparatory conditions for success but about subjective (believed) preparatory conditions. We prefer to the contrary to introduce our conditions first objectively, and come back to their subjective counterparts later. This eliminates the heterogeneity giving some success conditions for speech acts in the objective, and others in the subjective mood. A speech act is successful in the third sense (s3) if its preparatory conditions are realised.

6. When an agent performs an action, he is normally in a specific state referring to that action, both caused by and causing the action. An agent who actually is in the internal state in which he is normally supposed to be when performing the action shall be called "sincere". A speech act is no exception to that rule : here also we normally presuppose an accompanying psychological state and here also the agent is sincere if this state is realised.

A speech act is successful in the fourth sense if it is sincere (s4).

The four dimensions of the success of actions in general, and of speech acts in particular are logically independent from each other. This fact has been noted in some cases by (18) but not in general. Yet it is important to see that : 1. an action may reach its purpose without starting from its typical preparatory conditions : s1 does not entail s3 (as s3 does not entail s1), 2. an action may reach its purpose without exhibiting its typical plans or maps (s1 does not entail s2 and s2 does not entail s1), 3. an action may reach its purpose without its agents being in the normal psychological state accompanying it (s1 does not entail s4 and s4 does not entail s1)

The systematic independence of the types of success makes it necessary to consider the following cases, all possible, none necessary : s1, s1 + s2; s1 + s3; s1 + s4; s1 + s2 + s3; s1 + s2 + s4; s1 + s3 + s4; s1 + s2 + s2 + s4.

Even the three aspects of s1, s11, s12 and s13 are independent from each other, and from the other dimensions of success. The four dimensions of success, if they have to be measured at all, must be measured on ordinal scales. Each of them is susceptible of degrees. Finally, we mentioned that all our types of success have been defined objectively. But for each ot them subjective counterparts exist. These subjective dimensions are independent from each other and more-over independent from the objective dimensions.

Our analysis of speech acts becomes more complex than that of the first proponents of illocutionary logic[18]. It becomes also more systematical. And the large variety of possible relations left open

allows us to investigate concrete situation with the view to character-ise them by supplementary restrictions imposed on the relations between the subjective and objective ordinal dimensions of success.

We are not interested in speech acts for their own sake in this context.

Our analysis affects the definition of the relation of commit-ment between illocutionary acts, and this commitment relation has to be used necessarily by all attempts to give a pragmatical founda-tion for logic itself.

"Illocutionary acts F1(p)....Fn(pn) commit their speaker to the illocutionary act F(p) if in all contexts of use in which the speaker succeeds in performing simultaneously these acts Fi(pi), he also succeeds in performing F(p)"[18].

This basic notion has to be modified in function of our analysis of speech acts. It then becomes : "a sequence of illocutionary acts commits (si...sk, sl) their speaker to another illocutionary act if an only if : s_i (F1(p1)).....sk(Fn(pn)) is always accompanied by s_l (F(j(p)). The si indicate forms of success (i = 1, 2, 3, 4 or any sum of these) and si(Fj(p)) means that p is used in the illocutionary force Fj with dimension of success sl.

Commitment becomes thus a relativised concept, the precise utilisation of which depends on a. The relation between the (si...sk) and sl, b. the relation between the F1...Fn and Fj, c. the relation between the series of F's and the series of s'es.

The commitment relation so defined is a special case of a com-mitment relation defined on actions (when I do something, by my acting I commit myself to do something else also). We must also stress that all dimensions are measured by ordinal variables. (if they are measured or evaluated at all). The concept of degree of success (in any of the four basic or the many combined dimensions) is a gradual concept.

A multidimensional manyvalued relation of commitment lies at the core of illocutionary logic.

The modified "illocutionary commitment" just introduced leads to the consideration of a multiplicity of commitment relations in various contexts. It may indeed be presumed that the relative importance of the "s" dimensions and their mutual interactions are context dependent.

Coming back to the original commitment relation proposed in (18) we understand the differences between our notion and the original one when we look at the axiom system introduced (81, p. 262—263). We abstain from discussing it in detail, but if

illocutionary logic is to be used as a possible foundation for logic, axiom VII cannot be accepted. This axiom arbitrary asserts that a speaker is always committed to propositions following by strict implication from the propositions he is already committed to. We to the contrary — and this is the reason for this critical remark — will in the following pages try to define an implication by using the concept of illocutionary commitment (suitably relativised).

Before proceding to this task we make a last modification. The concept of illocutionary commitment can (and should) be temporalised : 1. all illocutionary acts occur at given moments in time, 2. If one act commits us to another one, our obligation in general only starts from an ulterior moment 3 when commitment has been undertaken, it usually finishes at an ulterior moment. The definition can be modified taking this temporalisation into account.

Once temporalised, one can only assert commitment to be transitive with certain reservations of a temporal nature.

The example of transitivity shows with how much caution the axiomatic method should be used. For us all axioms of illocutionary logic can only have the status of general theorems, acquired on the basis of observation. We remind the reader that their function is only to convince us that the constructive procedures used in the foundation of logic (introduced by actual acting and talking) have indeed the properties allowing them to be warrants for our inference rules.

We now have at our disposal the materials necessary to give non conventionalistic introduction of the logical operators.

The crucial concept of strengthening or reinforcing, (assertions or commands), the basis for any pragmatically founded logic, can be reduced to temporalised illocutionary commitment.

A discourse during which assertions are strengthened by means of others must necessarily have the following form

    F1(p) : p is asserted
    F1(q) : q is asserted
    ....
    F1(s) : s is asserted

under condition that for some p, q and r in the sequence, F1(p) and F1(q) illocutionary commits to F1(r). (we use again the simplified commitment of VV). If the sequence has this simple form, the commitment holds true in fact but the discourse does not show this to be the case in an explicit form. If the sequence shows explicitly

the existence of the commitment, this "awareness" may be retrospective or prospective.

Retrospective awareness supposes that in the discourse the assertions "F1(p) comm F1(r) is present *after* r has been asserted. The symbol "comm" means "commits to". Prospective awareness introduces "F1(p) comm F1(r)" before the assertion of r occurs.

Explicit prospective awareness will necessarily be present in all series the development of which is planned, and the planning of which is shown explicitly. This prospective awareness is exhibited in two different types : either "F1(p) comm F1(r) occurs before F1(p) or after F1(p). In the first case the speaker, aiming at the assertion of r, announces that he will strengthen r by means of p, and afterwards asserts p. If this purposive structure is not present the order would have no sense. It is not yet made explicit however. If we spell it out, we come to the following statement "p strengthens r, and the speaker shall in the future assert p, in order to be able to assert r".

To express this formally we would need a combination of pragmatics and praxeology, a theory of intentional action enabling us to explain" I do x in order to do y".

C.F. Gethmann for instance (8b, p. 113) introduces the logical consequence relation on the basis of the following pragmatical-praxeological expression "I assert p, and I shall in the course of the discourse that follows try to strengthen p by means of q".

This anticipation of the future development of discourse allows economy of thought : the partner will either consent or not consent to q, but if he does proceedings are simplified.

The combination of pragmatics and praxeology (implicit, though non expressed, in Gethmann) introduces new but necessary complexity.

Moreover, if I am to be able to express my planification of my discourse, I must be able to say :

"I assert now that I shall in the future assert p" (1)

"I assert now that I shall in the future assert p on the basis of my commitment to q" (2).

Formally F1(F1(p)(1) and F1(F1(q) comm F1(p)) (neglecting time). The iteration of expressions for illocutionary· commitment is thus necessary. Nothing in our description of them prevents such an iteration. We shall be able to represent a discussion about a proposition p, if to the speech act "asserting" we add two others : "doubting" and "consenting"

Opponent   Proponent

                                 Ass p (F1(p))

Doubts p(F2(p))

                                 Ass q (F1(q))

Doubts q(F2(q))

Cons q (F3(q))

                                 F1(p),F1(q),F1(F1(q)comm F1(p))

F3(p)

The relation between our elaboration of illocutionary logic and pragmatic protologic is confirmed by the fact the two cases distinguished by (8b, p. 112–121) in defining its pre-implication (the commitment relation is asserted before or after its antecedent has been asserted) are cases necessarily to be distinguished in our transcription of discussions by means of illocutionary commitments and types of speech acts.

We now arrive at our final result : the commitment relation, natural basis for implication, does not define a classical operator. The multiple dimensions of each speech act, each of them polyvalent (exhibiting varying intensities) entail that also commitment between speech acts is a multivalent multidimensional relationship. And yet from this relationship all attempts to find a pragmatical foundation for logic have to start.

This gives us the answer to the question formulated at the end of chapter VI. Even if one procedes from a praxeological to a pragmatical foundation of logic, the logical constants remain non classical.

We also have now the answer to the question asked in the title of this paper : in order to procede from the description of inferences as they factually occur to the planification of discourse, using operations having inferences as their object and simplifying and streamlining them, we must introduce means-ends relationships between assertions. If a pragmatical foundation for logic is to be worked out it has to be combined with praxeology[19]. The reader might be of the opinion that we conclude too rashly :

1. Will logical constants, other than the implication, also have non classical features if they are based on pragmatics ?

2. Can we show the pragmatical counterparts of the logical constants as natural and fundamental operations in pragmatics.

3. Can the different types of speech acts necessary in a theory of argumentation be defined in illocutionary logic ?

We try to offer some remarks on these three topics.

1. The logical constants

The incompatibility relation between speech acts has to be multidimensional and polyvalent in the same way and for the same reasons as illocutionary commitments. Two speech acts are illocutionary incompatible if one cannot be simultaneously successfully committed to both. This "impossibility" has to be considered relative to various dimensions and to various degrees or intensity on these dimensions.

The illocutionary denegation of a speech act A, originally defined as a speech act declining to perform the illocutionary act designated by A, should to the contrary, in order to be of the same type and to belong to the same level as the consequence relation with whom it has to be combined in discourse, be defined by means of illocutionary incompatibility.

But many different illocutionary acts are incompatible with a given act, and none of them (simple denegation not excluded) constitue the absolute minimum of this set. As in the praxeological case we meet a multiplicity of negations.

The conjunction of two illocutionary acts may, in some cases, perform simultaneously the two illocutionary acts ("I apologise and promise not to repeat what I did" being a case in point). One may convince himself that this is not the general case by analysing the general formula for a conjunction "I do x by stating that I do x, and I do y by stating that I do y" is to be compared to "I do x and y by stating that I do x and y". The I of each sentence being the name of the speaker of that sentence is a different one in each case. Even if we overcome this obstacle by suitable extensions of the meaning of "I", we still remain aware of the following two facts a. in performing the first two illocutionary acts, we never utter "x and y" and b. the "and" that links two actions is different in nature from the "and" that links two statements.

To overcome these difficulties it will be necessary to define conjunction by means of implication. If we do this ("p and q" being the weakest statement that entails both p and q), we obviously transfer the non classical properties of a consequence relation based on illocutionary commitment to a conjunction based on this consequence relation.

II. The function of the pragmatical counterparts of the logical constants in pragmatics as such

Dieter Wunderlich has already made clear that speech acts are constituted by the fact that they have consequences[20]. A speech act commits us to something. The pragmatic consequence relation is thus an essential feature of the essence of speech acts.

The same remark can be made about illocutionary denegation. If by speech acts I modify my relations with others, I make it impossible for myself to perform speech acts that I could have done in the past. Incompatibility is as essential as consequence in the illocutionary field.

The same holds for conjunction and disjunction. No speech act determines completely my future position. The possibilities, with necessity left open, have to be made explicit by using disjunctions. Finally, no speech act has only one consequence. We saw that all speech acts commit their agents to several attitudes and future actions. Making this fact explicit demands the use of conjunctions. In the service of brevity we neglect speaking about quantifiers, about whom analogous statements could be made.

III. The argumentative speech acts

The four speech acts used to introduce the logical constants : assertion, consent, doubt and rejection, can be described in illocutionary logic. We don't have to do this here. We refer the reader to (18), to be used in combination with (22) and (8b).

The application of illocutionary logic in general to typically argumentative speech acts (studying the denegations or illocutionary commitments of asserting, rejecting, consenting and doubting) will once more show (given — for instance – the differentiation between strong and weak consent, and strong and weak rejection) that a pragmatically founded logic will no more be a classical logic than a praxeologically founded one.

We could end here our exposition but we still have to make a critical remark. We saw already that the proponents of illocutionary logic risked to deprive it from its basic originality by embedding a theory of strict implication in it. However their approach remained sufficiently close to observable reality to allow us to accept the valuable parts of their theory, without their attempt to impose by pure convention a logic not justified by the facts of inference. This same tendency, appears even more strongly in two excellent recent

attempts to build a formal pragmatics, making it impossible to use them as a foundation for logic.

Albert M. Sweet[21] introduces for sets S of sentences, the set U of their users, the set T of moments at which these sentences are evaluated, the set C of conditions (or contexts) in which these evaluations occur and the act V of values attributed to these sentences. Pragmatical theory is then a theory about the values attributed by the users to these sentences in different contexts and at different moments. This is indeed the general schema of a pragmatics. However — and here our disappointment sets in — classical logic is conventionally imposed on S (by the equivalence relation defined on it) — S being either a Boolean algebra or a monadic algebra (Halmos) or a polyadic algebra (Halmos) : the aim of the exercice becomes to induce on V or on SxUxTxCxV (the x represents the Cartesian product) the same algebra as on S.

Such a "predetermined" formal pragmatics cannot, by definition, help us to give a foundation for logic. However we can propose for future work the following problem : for what type of natural structure on U, C, T and V will the structure of S be determined ? What will then the structure of S be ? This inversion of Sweet's program is the algebraic counterpart of our own program in this present paper.

Rainer Hegselmann[22] comes closer to illocutionary logic. For him, as for us, pragmatics is the study of speech acts and he develops it sufficiently to reach the definitions of asserting, consenting, doubting and rejecting. He does this in a pragmatical metalanguage expressed in predicate calculus.

To each type of speech act a probability and an utility function (with classical properties) is attached. A speaker is sincere if he attributes to the denotatum of his sentence the probability and utility typical for speech acts of that type. A sequence of n speech acts is valid if whenever the first n-1 members of it are sincere, the nth member of it is also sincere.

However the classical probability and utility calculus presupposed have as consequence that by a definition (and thus by an ad hoc convention) the classical consequences of a proposition can be inferred from it by a pragmatically valid sequence. Presumably the probability and utility functions used should be more naturally defined and otherwise combined. We propose as a program for the future the synthesis of illocutionary logic and Hegselmann's logical pragmatics, in the service of our aim.

IX. Conclusion. Dialectical and genetical pragmatics and praxeology

A theory of action uses in its development always a preexistent logic (see 9, passim). An illocutionary logic does the same (see 18). Yet we claim that we can use these disciplines in order to investigate what a natural logic should be. The result of this investigation being that natural logic is a non classical structure, we have to modify the logic we used in our original illocutionary logic or our original praxeology. We thus have to return to our starting point, formulate it otherwise and begin our work all over again. This being the case (because of the immature state of praxeology, pragmatics and natural logic much work has to be done before the spiral can continue its unfolding) we are of the opinion that we may call our pragmatics and praxeology dialectical disciplines and our foundation of logic a dialectical foundation.

This is our first and startling conclusion. But more is to come ! We see now – so we hope – that looking for the foundation of logic in action (private or collective, manual or verbal) and teaching it on this basis is no longer an extravagant idea but a natural conclusion,

Is it then too speculative to conclude that both in order to understand and in order to teach logic, we have to base it on
- the schematic and formalised history of human action, concretely present in human technology
- the schematic and formal history of human interaction, concretely present in the history of communication and discussion ?

We need – at the end of our exposition — the concept of history because neither action nor interaction can be understood outside of their historical development. Moreover if — as we argued - the study of procedures of medium generality (Gethmann's "topica") is a necessary tool for the understanding of universal and particular methods, we must acknowledge that these contexts of "medium" generality are historical in character.

But before introducing this developmental dimension it is already much to recognise that general praxeology and general pragmatics need the multiplication of regional praxeology and regional pragmatics, these regional sciences being moreover the foundations of regional logics.

The proposal made in this paper, if carried out, would change fundamentally the study of logic. We would not dare to put it forward if we did not consider it to be the direct consequence of our teaching experience and the natural conclusion of the attempts made

to find a praxeological and a pragmatical foundation for logic[23].

NOTES

[1] A. N. Kolmogorov "Zur Deutung der Intuitionistischen Logik", Mathematische Zeitschrift 35 (1932), pp. 58—63.

[2] Nils J. Nilsson, Problem Solving Methods in Artificial Intelligence. McGraw Hill, 1971.

[3] P. Février : "Rapports entre le Calcul des Problèmes et le Calcul des Propositions" (Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences de Paris, 1945, pp. 484—486.

[4] U.T. Medvedev, "Stepeny Trunosti massovyh problem (degree of difficulty of mass problems), Doklady Akademyi Nauk SSSR, vol. 104 (1955), pp. 501—504 - summarized in Journal of Symbolic Logic, 1956, vol. 21, p. 320.

[5] P. Lorenzen : "Einführung in die Operative Logik" und Mathematik, Springer, 1955.

[6] Hans Lenk : Kritik der Logischen Konstanten, Berlin, 1968.

[7]a. G. H. von Wright : An Essay in Deontic Logic and the general Theory of Action. Amsterdam, 1968.

[7]b. A. Goldman : A Theory of Human Action. Englewood Cliffs, 1970.

[8]a. F. Kambartel : "Uberlegungen zum pragmatischen und argumentativen Fundament der Logik. pp. 216- 228 "Konstruktionen versus Positionen", De Gruyter, bd. 1.

[8]b. C.F. Gethmann : Protologik - Untersuchungen zur formalen Pragmatik von Begrundungsdiskursen, 1979, Surhkamp.

[9] Hans Lenk (editor), Handlungstheorien - Interdisziplinar. Bd. I. Fink Verlag, München.

[10] Paul Lorenzen - Kuno Lorenz : "Dialogische Logik", Wissenschaftliche Buchgesellschaft, Darmstadt, 1978.

[11] Hans Hermes : "Some Remarks on Lorenzen's Theory" pp. 253—254 — Proceedings of the 4th international Congress for Logic, methodology and philosophy of science. Bucharest, 1971, vol. IV, North Holland, 1973.

"In my opinion everybody should agree that the rules of a game are mere conventions... It is not possible to give convicting reasons which show that there are rules for a dialogical game leading to intuitionistic logic rules which are in themselves better that any set of rules, leading to classical logic, then the dialogical foundation of Lorenzen is not an appropriate tool for this purpose" (p. 254, op. cit.)

[12] See ref. 8.

[13] See ref. 8.

[14] A.R. Anderson and N.S. Belnap : "Entailment (vol. 1) Princeton University Press. For intensional disjunction see pp. 176—177 and for conjunction see pp. 37—38.

[15] See ref. 8.

[16] See ref. 9.

[17] See ref. 8.

[18] Daniel Vanderveken : "Illocutionary Logic and Self defeating speech acts" (pp. 247– 272) in "Speech Act Theory and Pragmatics (edited by John Searle, Fernec Kiefer, Manfred Bierwisch).

[19] We consider the connection established between the later efforts of the Erlanger Schule and the illocutionary logic of Searle and Vanderveken as one of the two contributions of this paper (the first being the praxeological interpretation of constructivism). Already at present we see some uses of this first connection : a. the general postulates for discussion, proposed by Gethman (pp. 99– 102) will eventually be derivable from a synthesis of illocutionary logic with praxeology. The basic relation of this theory will be "S does F(p) in order to make it possible for H(resp S himself) to execute an action A (of a non linguistic nature)" b. theory of debate should be derived from collective illocutionary logic (still to be constructed).

[20] Dieter Wunderlich "Ueber die Konsequenzen von Sprechhandlungen (pp. 441—462) of "Sprachpragmatik und Philosophie" (edited by K.O. Apel, Suhrkamp, 1976.

[21] L. Chiaraviglio and Albert M. Sweet : The Pragmatics of Truth functions, Notre Dame Journal of Formal Logic, vol. V, no 3, July 1964.

[21]b Albert M. Sweet : "The Pragmatics of Monadic Quantification. Notre Dame Journal of Formal Logic, vol. X, no 1, January 1969.

[21]c. Albert Sweet : The Pragmatics of first Order Languages, 1 (Notre Dame Journal of Formal Logic, vol. XIII, no 2, April 1972.

[22] Rainer Hegselmann : "Logische Pragmatik" (pp. 190–212) and Zur Logik propositionaler Einstellungen (pp. 213- 240) in "Theorie des Wissenschaftlichen Argumentierens (edited by C.F. Gethmann), Surhkamp 1980.

[23] If our proposal is accepted logic itself becomes an interdisciplinary science, combining the services of the mathematician, the sociologist, the historian and the philosopher of technology. The logic course of the future would be basically different from that of the present. The historical genesis of ways of acting and interacting (potentially already stressed by Jean Piaget) will be synthesised with the practical constructivism (monological and dialogical) of Paul Lorenzen.