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S U M M A R Y

This dissertation consists of a number of papers on dialogical logic. The dialogical approach in logic is characterized by the way logical constants are defined: not by means of semantic rules, rules of inference, or axioms, but by means of rules that determine when and how sentences with a given logical constant as their principal operator are attacked and defended. A further, allied, characteristic concerns the way one goes about refining the concept of 'logical validity'. In the case of the dialogical approach, this is done in terms of the availability of a winning strategy for the party that wants to uphold some thesis in discussion. The hope is that some of the dialectic systems (i.e., systems of rules for conducting a critical discussion) created in this branch of logic, including those set forth in this dissertation, can in the future be extended to a comprehensive theory of argumentation, of which they will form the "logical skeleton".

In Part 1 of this dissertation, the pragmatic and intuitive foundations are laid for a number of dialectic systems. These foundations are independent from what goes on in other branches of logic, such as the theory of models and proof theory.

Paper 1 (written jointly with E.M.Barth) starts with a definition of the fundamental notion of a 'conflict of avowed opinions'. The paper focuses on 'simple' conflicts, i.e., those conflicts in which exactly one thesis is at issue. The thesis is upheld by a "Proponent" (P) and opposed by an "Opponent" (O). Thereupon, the foundations are laid for (formal) dialectic systems that serve as instruments for the resolution of conflicts by verbal means. These dialectic systems consist of norms and rules for conducting an orderly debate between two parties, P and O, which generally ends with one party winning the discussion. The norms and rules are hierarchically ordered, starting with a number of primary, or fundamental, norms that (the authors assume) most if not all potential debaters will consent to and accept, provided they are explicitly confronted with them. In this sense, these fundamental norms and rules may be called "natural". Two examples of such norms are: the fundamental norm of a systematic dialectics (FD S1; Section 6) and the fundamental norm of dynamic dialectics (FD D1; Section 15). The first of these stipulates that P should be given the opportunity to attempt to defend one

of its own statements that has been attacked, by making another statement (provided that P is willing to uphold this new statement). The second norm requires that a dialectic system be designed in such a way as to promote the revision and flux of opinions.

In order to implement these primary norms, secondary norms or rules are proposed, and so on, up to the rules that regulate the actual courses of discussions. Thus the above-mentioned fundamental norm FD S1 leads to an analysis of discussions into chains of arguments, local discussions, and stages, whereas the norm FD D1 leads to various measures intended to prevent discussions from running on indefinitely. With the exception of Lorenzen's "strip rules", included as $F_2D\ 1$ (Section 16), all the rules are language-invariant. (The examples, however, always employ some specific propositional language.)

In Paper 2 (also written jointly with E.M.Barth) eight definite propositional dialectic systems are defined, in which the norms and rules of the preceding paper are included. Anticipating the results of Part 2, these systems are called "minimal", "constructive" or "classical". The constructive (i.e., intuitionistic) and classical systems are equivalent to the dialogue games known from the works of P.Lorenzen and K.Lorenz. The constructive systems are, in fact, virtually identical with Lorenzen's dialogue games that go by the same name. Clearly then, the system of norms and rules of Paper 1 provides a foundation for these traditional dialogue games.

Paper 3 treats of the way in which the dialectic systems, defined earlier, can be enriched by the introduction of "material moves". A move is to be called "material" if the truth value of an elementary sentence is at issue, it being assumed that the parties agree upon the use of one or more "material procedures" by which to establish the truth or falsity of such a sentence. The paper is concerned with the rules that regulate the way one can, in the course of a discussion, invoke material procedures, and the effects this has on the rights and duties of the parties. The particular rules of the material procedures lie themselves outside the scope of this dissertation. The second part of the paper describes a material dialectic (formal) system (MatDial; Section 5.2) that is independent of the nonmaterial systems of the preceding paper, and that is suitable for the resolution of one type of "mixed" conflict, viz., conflicts in which both parties explicitly reject each other's statements.

The foundations for dialectic systems given in the first paper are not unique. In the short Paper 4, another motivation is offered for what are in practice the same dialectic rules. On the one hand this motivation is simpler than that given in Paper 1, but on the other, it applies only to one type of (simple) conflict, viz., those involving a situation in which a system of opinions is immanently criticized. The proponent of that system is assigned a role in the discussion equal to the role of Opponent defined in Section 3 of Paper 1, and vice versa: the opponent of the system of opinions is, within the discussion, the Proponent (of a provocative thesis).

In Part 2 the dialectic systems, already defined and justified, become the objects of further study, and are related to logical systems of other types.

Paper 5 starts by introducing dialogue sequents in which the crucial elements of dialogue situations are codified. For each dialectic system, an equipollent variant is defined in which the rules of conduct pertaining to P are more lenient. This facilitates the description and study of (winning) strategies. The various situations that can occur in a dialogue are grouped according to type (Section 1). Further, the rules for constructing P-winning strategy diagrams (Lorenzen's dialogical tableaux) are reformulated and classified. Both tree notation and tableau notation are used (Sections 2 and 3). In Section 4 it is shown that the norm FD D1 is implemented to the extent that discussions are guaranteed finite (Theorem 2). Section 5 demonstrates -- within the confines of dialogue theory -- that the dialectic systems incorporating a propositional falsum-constant are equivalent to the corresponding systems without this constant. The larger part is devoted to the proof that this holds for minimal logic.

In Paper 6 it is shown, by graphic description, how closed dialogical (Lorenzen-)tableaux can be transformed into closed deductive (Beth-)tableaux.

Paper 7 is devoted to the step that takes one from closed semantic (also Beth-)tableaux to closed dialogical (Lorenzen-)tableaux. For that purpose, it is first shown that each system is invertible (Lemmas 1 and 2). A dialectic system is called invertible if the existence of a P-winning strategy does not depend on whether the first move consists, as usual, of an attack by O on the thesis, or rather of some move by P, P having the

right to pronounce the thesis.

Papers 6 and 7, together with some other steps that are not included in this dissertation, make it clear how dialogical tableaux can be inserted into a "circle of metatheorems" in which, besides the two kinds of Beth-tableaux already mentioned, natural deduction, axiomatics, and (model-theoretic) semantics find their proper place.

Paper 8 deals abstractly with material dialectic systems. According to the Adequacy Theorem there proved, whosoever is right (from a semantic point of view) will be able to carry his point, provided that the dialectic system satisfies three quite plausible conditions.

In Paper 9 this proof is repeated with respect to a concrete example: the adequacy of the system MatDial (Paper 3).

In Part 3 the exploration is extended to modal operators. Both the foundations of modal dialectic systems and metatheoretic questions are discussed.

Paper 10 originates in the following questions, that were put to the author: What would a noncumulative logic be like (i.e., a logic based on Kripke models for intuitionistic logic, but without the Principle of Cumulation)? and: Can a plausible dialectic system be constructed that corresponds to this noncumulative logic? It was through these questions that modal dialectic systems were reached. In Section 1 various ways of refining the concept of a 'noncumulative logic' are discussed. Section 2 lays the foundations for dialectic systems with two levels (of strictness) at which statements can be made. The following fundamental norm is proposed: a strict thesis is to be defended, ultimately, on the basis of strict concessions. Several ways of implementing this norm by means of further rules are investigated. While none of these implementations is fully satisfactory, one particular set of systems is singled out as preferred and is allotted further metatheoretic study. The noncumulative systems turn out not to be invertible (Section 3). It is nevertheless possible to establish a circle of metatheorems (Section 4).

Paper 11 discusses modal dialogue theory (based upon constructive propositional logic), starting with a review of the current literature. Notably, the contributions of Lorenzen, Murphy (Section 1.1), Hintikka (Section 1.2), Marčinko, and Van Dun (Section 1.3) are discussed. In Section 1.2, moreover, a Modal Adequacy Theorem is formulated that is a corollary to the General Adequacy Theorem of Paper 8. In Section 1.4 the

relationship Paper 11 bears to Paper 10 is expounded. The introduction of a necessity operator is motivated by the way this operator serves to eliminate certain logical operators with a portmanteau character, viz., implication and negation in the way they occur in Paper 10. From now on the necessity operator shall indicate the degree of strictness, whereas implication and negation retain their ordinary dialectical meaning. The normative foundations for modal dialectic systems are then laid. The fundamental norm of Paper 10 returns in a generalized form (Section 2.1): any number of levels shall from now on be a possible choice. Modal dialectical tableaux are dealt with in Section 2.2. The modal dialectic systems are invertible (Theorem 5^L). After, a circle of metatheorems is, once more, established (Section 3). The last section contains, among other things, some remarks about classical modal systems. However, the modal dialectic systems that stand out as the most attractive ones are those that are based on a constructive or minimal propositional logic.

The Appendix contains two papers on dialogical predicate logic. The first (Paper 12) shows how the foundational reflections of Part 1 and the metatheory of Part 2 can be adapted so as to be applicable to predicate logic. In Section 1 there is a brief discussion on how debates can be kept within bounds. Section 2 demonstrates how "infinite" winning strategies (something unheard of in the context of propositional logic) can be depicted by (finite) dialogical tableaux. In Section 3 it is shown that the establishment of a circle of metatheorems in predicate logic is unproblematic. Kripke's semantic tableaux for nonclassical logic, however, are not yet included in the circle.

Paper 13 serves to insert these last-mentioned tableaux into the circle of metatheorems. To that end it is shown that the applications of rules in a closed semantic (Kripke-)tableau can be permuted so as to yield a standard form suitable for transformation into a closed semantic (Beth-)tableau, and thus into a tableau that is more akin to a dialogical or a deductive tableau.