SOVIETICA

MONOGRAPHS OF THE INSTITUTE OF EAST-EUROPEAN STUDIES

UNIVERSITY OF FRIBOURG / SWITZERLAND

Edited by

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INFORMATION AND REFLECTION

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INFORMATION AND REFLECTION

On some Problems of Cybernetics and how Contemporary Dialectical Materialism Copes with Them

D. REIDEL PUBLISHING COMPANY / DORDRECHT-HOLLAND

HUMANITIES PRESS / NEW YORK

KYBERNETIK, INFORMATION, WIDERSPIEGELUNG:
DARSTELLUNG EINIGER PHILOSOPHISCHER PROBLEME IM
DIALEKTISCHEN MATERIALISMUS

First published by Verlag Anton Pustet, München and Salzburg, 1969
Translated from the German by T. J. Blakeley

SOLE DISTRIBUTORS FOR U.S.A. AND CANADA
HUMANITIES PRESS / NEW YORK

ISBN-13: 978-94-011-6814-4 e-ISBN-13: 978-94-011-6812-0

DOI: 10.1007/978-94-011-6812-0

Library of Congress Catalog Card Number: 70-118127

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Softcover reprint of the hardcover 1st edition 1970

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PREFACE

The occasion for this work was provided by the recent Marxist-Leninist philosophic publications on problems involving the term 'information' and by the extensive discussions of ideas originating in cybernetics. Thus, the issues are quite recent, which explains some peculiarities of our approach. Our main effort has been toward the clarification and systematization of questions on information, which arise in the context of cybernetics. Where basic questions are involved, one is brought back to traditional issues as is often the case when dealing with a novel subject. Stress on questions drawn from physics is due to the author's professional involvement in this field.

This work was written under the direction of Professor J. M. Bocheński, principally in the context of a special program at the Institute of East-European Studies of the University of Fribourg (Switzerland); a program carried out by Professor Bocheński with the collaboration of Dr. S. Müller-Markus. Participation in the special program was made possible by a grant from the West German 'Innenministerium'. Completion of the work was subsidized by the Bundesinstitut für ostwissenschaftliche und internationale Studien in Cologne. Our thanks go to these persons and organisations, who are in no way responsible for the content of the work.

Givisiez, May 1967

TRANSLATOR'S NOTE

Although we have made use of the works of Cherry and MacKay, cited in the bibliography, our translation of many terms may still seem somewhat arbitrary to some readers. The explanation for this is threefold. First, as MacKay himself states, there is as yet no general agreement among cyberneticians on a standard nomenclature. Second, the present work involves many double translations, from Russian to German to English – which could only confuse matters. Finally, the stress in this book is on the philosophical rather than the technological. This last difficulty is compounded by the fact that many different philosophical views are in evidence: the 'scientism' of the cyberneticians; the dialectical materialism of contemporary Soviet philosophy; and, last but not least, the views of the author of this book.

'Information situation' is a term not usually found in works on cybernetics; it is intended here to include the whole context or environment in which information occurs. For '*Informationsträger*' we have used 'information *carrier*', instead of 'information *bearer*', found in some works. For '*Vertretenes*', the best we could find was 'designatum' (Cherry suggests this, but also 'referent'). For euphonic reasons we have used 'information content' and 'information measure', instead of the more usual 'content of information' and 'measure of information'.

'*Soderžatel'nyj* (*inhaltlich*)' has been rendered as 'contentful' or 'informal', depending on the context. '*Zakonomernyj* (*gesetzmässig*)' is usually translated as 'regular', although 'law-bound' was more appropriate in some instances.

Chapter 16 was translated by the author; a modified version was published in *Studies in Soviet Thought* **8**, 2/3, 105–121, under the title 'Problems of Information in Dialectical Materialism'.

TABLE OF CONTENTS

PREFACE v

TRANSLATOR'S NOTE VII

INTRODUCTION 1

1. CYBERNETICS AND INFORMATION 2
1.1. On Cybernetics 2
1.2. The General Debate about Cybernetics 3
1.3. On the Question: What is Information? 4
1.4. Two Philosophic Views on Information 6
1.4.1. The Ontic Mode of Aristotelian Forms as the Ontic Mode of Information 6
1.4.2. Information as Third Ontic Element 7

2. MARXISM-LENINISM AND CYBERNETICS 9
2.1. On the Relationship between Dialectical Materialism and the Sciences 9
2.2. Rejection and Acceptance of Cybernetics 11
2.3. On the Philosophic Problems of Cybernetics 12

PART I / INFORMATION

3. PRELIMINARIES 18
3.1. On the Origin of the Word 'Information' 18
3.2. 'Information' in Ordinary Language 19
3.3. Formal Analysis of Statements on 'Information'; the Information Situation 20
3.3.1. Preliminaries on the Information Situation 20
3.3.2. Statements about the Communication Partners 20

3.3.3. Statements about the Means of Communication (Information Carrier) 22
3.3.4. Some Remarks 23

4. LANGUAGE AND INFORMATION 24
4.1. Language 24
4.2. Sign and Sign Situation 24
4.2.1. Semiotic Disciplines 25
4.2.2. Classification of Signs 26
4.3. On the Analysis of the Sign Situation and on Terminology 27
4.3.1. Pragmatic Considerations 27
4.3.2. On the Analysis of the Designatum 28
4.3.3. Sign as Sign Function 29
4.4. Linguistic Signs 30
4.5. The Functions of Language 31
4.5.1. The Communication Situation 31
4.5.2. The Primary Communicative Functions of Language 32
4.5.3. Further Linguistic Functions 33
4.5.4. The Supra-Linguistic Character of Linguistic Functions 33
4.6. Definitions of (the Concept of) Information 34
4.6.1. Two Basic Definitions 34
4.6.2. Communication Situation and Information Situation 35
4.6.3. On Other Meanings of 'Information' 36
4.6.4. Some Other Definitions of Information 36
4.7. Different Interpretations of the Definitional Elements 38
4.7.1. On 'Meaning' 38
4.7.1.1. The Meaningful Parts of Language 38
4.7.1.2. Linguistic Meaning and Information 40
4.7.1.3. The Illusion of 'Carrying' 40
4.7.2. On 'Communicating a Report' 41
4.7.2.1. Reporting as Transmitting: Communication as Connection 42
4.8. The Physical Aspect of Language and Signs 43
4.9. Perception and Information 44
4.9.1. Information as Knowledge 44
4.9.2. Information as Correlation 45

4.9.3. Perception, Sign-Like and Pure 45
4.9.4. Semiotic Stages in Perceptual Processes 46

5. INFORMATION THEORY 47
5.1. Nomenclature 48
5.2. Extended Communication Processes 49
5.3. On Statistical Information Theory 50
5.3.1. The Hartley Model for Message Source 50
5.3.2. The Bit 50
5.3.3. Shannon's Problem 51
5.3.4. Message Production as a Stochastic Process 51
5.3.5. Entropy and Information Content 52
5.3.6. Encoding 54
5.3.7. Shannon's Fundamental Theorem; Channel Capacity 55
5.3.8. Further Statistical Information Measures 55
5.3.8.1. Conditional Probabilities 56
5.3.8.2. Transinformation 56
5.4. On the Theory of Signal Structure 57
5.4.1. Structural, Metric and Statistical Information Content 57
5.4.2. Modulation 58
5.5. Observation Processes and Signal Reception 59
5.5.1. Disturbances in Communication Processes 59
5.6. Storage 60
5.7. Data-Processing 60
5.7.1. A Special Boolean Algebra 61
5.7.2. Interpretations as Propositional Calculus and as Switching Algebra 62
5.7.3. The Operation of Data-Processing Machines 63
5.7.4. Binary Representation 63
5.8. Control; Feedback; the Complex Dynamic System 64

6. THE INTERPRETATION OF INFORMATION MEASURES; ISOMORPHY 67
6.1. Some Fundamentals 68
6.2. General Interpretations 70
6.2.1. Variety 70

6.2.2. Variability 71
6.2.3. Specificity 71
6.2.4. Complexity 72
6.3. Special Interpretations 72
6.3.1. Indeterminacy, Uncertainty and Their Resolution 72
6.3.2. Novelty Value of a Report 73
6.3.3. Information Gain 74
6.3.4. Selection 74
6.4. Order Measures for Objects and Systems 75
6.5. Correspondence and Correlation 76
6.6. Mapping, Isomorphy and Homeomorphy 77
6.7. Model 79

7. SIGNAL DETERMINATION 81
7.1. 'Signal' 81
7.2. Definition of Signal Determination 82
7.2.1. Signal Situation 83
7.2.2. Signal Structure 83
7.2.3. Structural Dependence 84
7.2.4. The Irrelevance of 'Energy-Relations' 84
7.2.5. The Determinant Character of the Signal System; Class Formation 85
7.3. An Objection 86
7.4. Processes with Signal Determination 87
7.5. 'Information' 89

PART II / THE DIALECTICAL-MATERIALIST DOCTRINE OF REFLECTION

8. SOURCES AND FOUNDATIONS OF THE DOCTRINE OF REFLECTION 94
8.1. The Basic Question of Philosophy 94
8.2. Matter 95
8.3. Consciousness 95
8.4. The Primacy of Matter over Consciousness 96
8.5. Lenin's Influence on the Doctrine of Reflection 97
8.5.1. Reflection Theory 97

8.5.2. Rejection of Empirio-Symbolism 98
8.5.3. Hypothesis on the General Sensitivity of Matter 99

9. REFLECTION THEORY 100
9.1. Ontology 100
9.1.1. The Objective Dialectic 101
9.1.2. The Philosophic Categories 101
9.2. Epistemology 102
9.3. On the Dialectical Traits of the Reflection Theory 103
9.4. The Meanings of 'Psychic Reflection' 104

10. REFLECTION AS GENERAL PROPERTY OF ALL MATTER 106
10.1. The Stages of Reflection 106
10.2. Properties of Reflection 108
10.2.1. External and Internal 109
10.2.2. Reaction, Adaptation and Practice; Adequacy 109
10.2.3. Passive and Active; Objective and Subjective 110
10.2.4. Abstraction and Generalization 110
10.2.5. Irreducibility of All the Various Forms of Reflection 111
10.3. Reflection and Motion 111
10.4. On the Ambiguity of 'Reflection'; Shifting the Problem 112

PART III / DIALECTICAL-MATERIALIST CONTRIBUTIONS TO THE 'INFORMATION' THEME

11. SURVEY 118
11.1. On the Notion of a Connection between Reflection and Information 118
11.2. The Nature of Information 119
11.3. The Objectivity of Information 120
11.4. The Universality of Information 122
11.5. Contentful Information Theory 124

12. INFORMATION AS CONNECTION 126
12.1. A Cybernetic Notion of Information 126
12.2. Views on the Relationship between Reflection and Information 128

12.2.1. Information as Contentful Connection 128
12.2.2. Information as an Aspect of Reflection in Control Systems 129
12.3. The Universality of Information as a Matter of Viewpoint 130
12.4. Causal Dependence and Information 131
12.5. Material and Ideal Information 133
12.5.1. The Ambiguity of 'Meaning' 134
12.5.2. Specification of the Problem 135
12.5.3. Information as Semantic Relation 137

13. ENTROPY AND STRUCTURAL INFORMATION 139
13.1. Information and Entropy 139
13.1.1. A Principle of Negentropy of Information (a Digression) 140
13.1.2. Information as Ordered Reflection; 'Heat Death' 141
13.1.3. On the 'Anti-Entropic Effect' of Information Processes 143
13.2. Structure, System, Organisation 145
13.2.1. Information as a Structural Property 145
13.2.2. System and Information 147
13.3. Developmental Processes of Systems 149
13.4. The Generality of the Concept of Information; Potential and Actual Information 152

14. ELABORATION OF THE DOCTRINE OF REFLECTION 156
14.1. A Cybernetic Theory of Perception 156
14.1.1. Analysis of the Signal 157
14.1.2. The Operation of Comparing 158
14.1.3. The Image (Psychic Reflection) 159
14.1.4. The Ideal as a Functional Property 160
14.2. Signal and Isomorphy 162
14.2.1. Differing Descriptions of Perception 163
14.2.2. On the Problem of Perception 164
14.3. Universal Reflection 165
14.3.1. Interaction and Reflection 167
14.3.2. Inorganic Reflection and Technology 170

15. INFORMATION IN A DIALECTICAL-MATERIALIST THEORY OF SIGNS 172
15.1. General Remarks 172
15.2. The Meaning of Signs 174
15.3. Meaning and Information Relative to Non-Linguistic Signs 176

16. CONCLUDING REMARKS 179
16.1. General Remarks on the Interpretation of Information 179
16.2. Materialist Monism and Information 182
16.3. On the Objectivity of 'Ideal' Information 186
16.4. Information and the Doctrine of Reflection 189

REFERENCES 195

BIBLIOGRAPHY 211

INDEX OF NAMES 223

INTRODUCTION

Questions about information have arisen in the context of cybernetics and what is called information theory. But they have also come up in the most diverse contexts. One often hears information theory mentioned in reference to the natural and social sciences, and in technology. As a result, there are many meanings – some technical, some from ordinary language – for the term 'information'. And this ambiguity brings with it a whole series of problems.

Information is a widely discussed theme among Marxist-Leninists. The discussion is explicitly philosophical, information being interpreted in function of a central theme of Marxism-Leninism, namely the doctrine of reflection. The answers given to questions on information and other cybernetic notions evidence a refreshing variety.

Therefore, our first part deals with the various meanings of the term 'information'. This requires a discussion of the relationship between language and information and of various other aspects of information theory. The second part provides an account of the dialectical-materialist doctrine of reflection, the context for the Marxist-Leninist discussion on information. The third part discusses the problems about information as posed and treated by Marxist-Leninist philosophers.

But first we will deal with some preliminary considerations. These involve a description of cybernetics and some answers to the question "What is information?" (Chapter 1). They also provide the general background (Chapter 2) for the Marxist-Leninist discussion of 'information'.

CHAPTER 1

CYBERNETICS AND INFORMATION

Since most of the recent questions having to do with information arise in the context of cybernetics, we will begin with a description of this domain which is both scientific and technological. We will also deal with the reasons why cybernetic ideas and procedures have given rise to controversies. Finally, we shall mention some views on information itself, thereby indicating the variety of possible opinions on the subject.

1.1. ON CYBERNETICS

Cybernetics was christened in 1948 with the publication of Norbert Wiener's *Cybernetics, or Control and Communication in the Animal and the Machine.*[1] Of course, many of the procedures and theories which are today considered part of cybernetics (e.g., data transmission, control theory) had been developed prior to this time. Among other things, Wiener pointed out that certain neural processes and automatic control processes (as well as the breakdowns of the former and the latter) can be mathematically and structurally represented by the same formulae. He later included social processes in comparisons of this kind, although with some reservations.[2] Such are the domains in which cybernetic notions have come to play an ever greater role.

What cybernetics is cannot be expressed in a few words simply because it is not clear what is to be included in the field and what justifies collecting the theories and processes that might be included under a common title. Here it will be enough to indicate that cybernetics deals mainly with control processes and with the reception, transmission and processing of messages in complex, dynamic systems, whether they be technological systems, animals or social systems; and this is done with the help of exact scientific methods. Accordingly, 'messages' has to be taken in its

most general sense, viz. as processes or things with particular structures which play a role in these systems.

Technologically cybernetics involves the development of automatic devices which take over repetitive functions or those which exceed the normal capacities of man. At the same time cybernetic machines model the functional aspects of organic (especially neural) processes and the comportment of living systems (including man's intelligent activity).[3]

This means that the simultaneous consideration of problems from very different domains is characteristic of cybernetics. In dealing with them one abstracts from the qualitative differences between these domains and the physical conditions are only marginally considered. Cybernetics is interested not so much in what kind of system is involved as in the functional, operational and behavioristic points of view. Cybernetic theories deal not only with existing devices and their properties but also with possible machines and their potentialities. Attention is centered mainly on the stability of the processes involved in such systems, on the constancy and limits of their functions, in short, on the optimal variants of these systems.[4]

In order to find exact and especially mathematical answers to these questions, the systems have to be submitted to a suitable analysis. For this purpose theoretical cybernetics develops and studies abstract models in simplified form. Often the models thus developed are not directly realisable from a technical point of view. This is because technical realisation involves a series of factors (e.g., safety measures or reliability) which depend on the current state of technology. We find the same to be true of all theoretical branches of cybernetics, and of information theory. It is the technical-economic point of view rather than the theoretical one which is decisive for all the devices actually used.

1.2. THE GENERAL DEBATE ABOUT CYBERNETICS

The discussion centered around cybernetics has developed mainly along two different lines.[5] On the one hand, decisions have to be made on the far-reaching social effects of the employment of cybernetic devices and on solving the resultant problems. On the other hand, there are extensive discussions on the limits of automation and of the machines themselves, and on the value of cybernetic ideas for the explanation of biological,

mental and social processes. The most frequently mentioned problem in this context has to do with whether or not computers can 'think'.

The terminology used in cybernetics has provided fuel for such discussion in that it leaves room for massive associations. Several gross simplifications in some cybernetic theories have aroused criticism.[6] Such discussions are also caused by general and sometimes speculative statements by cybernetic theoreticians and technicians about the future of cybernetics, its synthesizing character, the applicability of its exact methods in the human and social sciences, etc. Misunderstanding, on the other hand, of the novel ideas and procedures involved has frequently led to a direct rejection of cybernetics.

Before embarking on any speculation one has to have stated what factually happens in computers and what precisely is said in cybernetics. Only then can one examine these statements and their premisses and put them into a context with statements from other domains of science. For example, a question about the 'thinking of the machine' is difficult to answer in this naive form. Cybernetics makes possible an exact description of the activities of the nervous system, which enables one to develop technical models for intelligent comportment and mental expressions. But, if one means by 'thinking' mental activity involving images, concepts, questions, memories, etc., the question has to be answered negatively.

1.3. ON THE QUESTION: WHAT IS INFORMATION?

Information theory (or communication theory) is one of the most important sub-divisions of cybernetics. In speaking of complex dynamic systems one says that they receive information, process it and use it to control their functions, that information is transmitted, etc. 'Information' is the term which indicates the common level on which cybernetics deals with qualitatively distinct processes; but, it is also the cause of the broad associations mentioned above. Our main effort here will be to deal with the question "What is information?". The ambiguity of the term means that there is no simple answer.

By 'information' cybernetics designates a special type of process. This can be seen if one compares it with other branches of technology. There is a technology of energy and of matter. There is a distinct technology of transformation. These serve as preparation for a tool technology which

uses the laws of mechanics. To be sure, cybernetics also produces 'tools'. However, these 'tools' do not take over manual (human) work, but chiefly mental labor. And these devices are mainly made up of electromagnetic and electronic elements. This new domain is often called 'information technology'.

Among the answers to our question we find that of Wiener: "Information is information, not matter or energy. No materialism which does not admit this can survive at the present day."[7] This is a purely negative statement. His other utterances often have a mixed character. For example, he sometimes talks as if one can imagine the world as composed of schemata or patterns which are distinguished simply by the arrangement of their elements. Information in such a case would be the measure of the regularity of a schema (pattern), especially a time series since it is clear that a purely chance pattern can provide no information.[8]

This last point seems to be really plausible. However, Wiener is referring here to measure as defined in statistical information theory and basic to this conception of measure is the notion that only 'random' messages provide information.[9] No clear answer to our question is provided because of inexact use of words like 'regularity', 'order', 'chance', etc.

The fact that one finds so many different meanings for the word 'information' has led some to suggest that it is an irreducible term.[10] For example, H. Stachowiak says: "The difficulties in finding a substantive definition for the concept of information seem to indicate clearly that 'information' is a *basic concept* (*Grundkategorie*)."[11]

D. M. MacKay has noted in a similar vein that "'amount of information', actually in more than one sense, can be given numerical meaning", like the term 'size' has "the quite different but complementary senses of *volume*, *area*, and *length* – if not others."[12] He suggests an 'operational definition' as a way of providing a common denominator of the possible information measures: Information is that which enables the information receiver to form a representation of something which is factually or hypothetically the case, or which expands such a representation. In his view information theory measures changes in knowledge and knowledge can be represented.[13]

'Information' taken as change in knowledge obviously derives from ordinary language and not directly from information theory. It is difficult to describe the mathematically defined measure, 'amount of

information' or 'information content', in ordinary terms. "'Information content' is not a commodity, but rather a potential of the signals" is C. Cherry's way of putting it; one can *grosso modo* compare it with the economist's concept of labor.[14]

Clarification of our question requires as minimum that the ordinary meanings of the word 'information' be separated from those used in information theory. J. R. Pierce notes in this regard that communication theory cannot be applied to all problems which use the words 'communication' and 'information' in their varied, everyday meanings. It deals solely with certain aspects of communication, just as Newton's laws of motion did not deal with all phenomena which were included in Aristotle's use of the word 'motion'.[15]

1.4. TWO PHILOSOPHIC VIEWS ON INFORMATION

The question "What is information?" has also become the object of philosophic consideration. We will limit ourselves here to two works which are frequently treated by Marxist-Leninist philosophers. Both are branded as 'idealistic' accounts of information. Since these philosophers do not go into detail in this matter, we shall only sketch the main points made in these works.

1.4.1. *The Ontic Mode of Aristotelian Forms as the Ontic Mode of Information*

E. Wasmuth has discussed the question on an Aristotelian and Christian basis. He agrees with Wiener that in cybernetics "materialism has found its last victory and turning point".[16] In developing his views he distinguishes various dimensions which he calls 'time-relationships.' Processes in machines happen in the first dimension, i.e., in continuous time-flow, and are themselves members of an endless time-series; they are 'time-forms'.[17] Only the future decides on the value of the results of the mechanical processes. Manifest in this evaluation is, for Wasmuth, a second time-relationship which intervenes to order the first and which is, as it were, information from the future.[18]

Wasmuth therefore sees information as a time-relationship in a dimension other than but added to that of continuous time-flow, or as product of the two time-relationships.[19] Information is not just the effect

of causes; it is more the actualization of 'incipient paradigms' (Goethe's rendering of 'entelechy'), existing ontically as Aristotelian forms.[20] The evaluation – a decision – of computer operations is for Wasmuth comparable with creation – a division – through the divine word.[21] This comparison leads Wasmuth on to the further notion that religious paradigms, which men use to 'inform' themselves and to order their lives, can be seen as a third form of time-relationship – time as eternity.[22]

This outline shows that Wasmuth uses information as an analogical concept, applying it to different realms of being, the components of which may, apart from physical causality, determine concrete operations and processes. He retains Wiener's notion of information as a 'time-form' by viewing the effects of different components as effects in different 'time-relationships'. In reference to the question on the ambiguity of 'information' this means that one characteristic of the processes, which are called 'information processes' in cybernetics, is attributed to other processes which he also calls 'informational' but which do not have this characteristic.

1.4.2. *Information as Third Ontic Element*

Another interpretation of information is provided by G. Günther. This is based on a very speculative, transcendental view but it is not clearly developed.[23] He maintains that information and communication processes are not just not material processes but also not mental phenomena. This is why he expands Wiener's remark by adding: "Information is information and not spirit or subjectivity."[24] For cybernetic purposes one has to do with three metaphysical components of reality: the 'objective, transcendent object', the 'information element', and the 'subjective, introscendent self-consciousness'.[25] Günther's conclusions from this are far-reaching.[26] The assumption of only two components of reality – materiality and spirituality – is based on a simplification since there is always a remnant which cannot be assigned to either and which cybernetics designates with the word 'information'. The very foundations of our thought – classical, two-valued logic as corresponding to a metaphysical dualism – are shaken. We must turn to a logic with at least three values.[27]

This revolution in thought, which began with transcendental idealism and which today finds technical interpretation in cybernetics, does not

destroy what classical thought accomplished in the objective domain.[28] What counted up to now as the subjective sphere, however, now divides into two domains: the 'information-producing reflection-process' and the 'purely subjective, introspective interiority'.[29] Günther calls 'reflection-process' or simply 'process' that third component[30], to which he assigns the third value of a non-Aristotelian logic and which he tries to interpret as a mediation of opposites. He holds that precisely in cybernetics "one takes seriously Hegel's idea that reflection is a *real* process, by systematically trying to transpose processes of consciousness in analogical form onto machines."[31]

We will not go into the details of Günther's views. However, two things should be clear. (1) Whether there are two or three metaphysical principles has nothing to do with the use of a two or three-valued logic. Metaphysical principles are, like any other things, objects (contents) of propositions, while the logical question has to do with the number of possible truth-values for propositions. Whether one is talking about two things or three, one still has to decide if there are truth-values in addition to 'truth' and 'falsity'. (2) Günther's speculations on three metaphysical elements stand only if information processes can be interpreted as autonomous. Otherwise his assertion of the "metaphysical autonomy of the *reflection process*"[32] is without foundation. Technological information processes, however, are always dependent on men.[33]