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# Computerization as a Means of Cultural Change: On the Relations Between Information Theories and the Idea of an Information Society

Niels Ole Finnemann
*Centre for Cultural Research, Aarhus University, Denmark*

**Abstract.** Since World War II the concept of Information has received several new definitions. Information can be understood as knowledge in general, as theoretical, formalized knowledge in general or as knowledge related to specific domains or specific representational forms. Because of these mutually inconsistent concepts the common traits are to be found in a perspective transcendent to those theories. The central cultural changes, it is argued, take place on the level of the societal knowledge infrastructure, evolving from the knowledge infrastructure of the industrial societies as a long-term secularization process, resulting in new forms for representation and manipulation of knowledge. The process is seen as rooted in changes of the primary domains for knowledge extraction and in a change in the human relations to the languages in which we interpret the relations to nature.

**Keywords:** Computerization; Information theory; Information society; Language; Knowledge representation systems; Writing technologies

## 1. Concepts of Information

### 1.1 Good Old-Fashioned Information

In the last thirty years the notions of 'information', 'information technology' and 'information society' have spread in many languages both in public discourse and in a broad range of scientific disciplines. In regard to expanding circulation the word 'information' is probably one of the most successful words in this century.

Although it can be traced back to the 14th century in English, and in Danish, my own native language, at least to the 18th century, it has never before obtained such an attention and widespread usage.

Traditionally the concept of information is closely related to the Enlightenment concept of knowledge, but it has actually been used with a variety of meanings.

The original Latin sense "informatio' meant to give form to either materials or meanings, and the sense of "shaping" was also often transferred into modern national languages, so for instance, in the sense of educating or learning pupils the essence (or the founding principles) of some subject matter. Later a common use of the word was related to a more specific kind of knowledge, namely "news" or knowledge of recent events as opposed to rumours. One could be well-informed without necessarily being intelligent, or one could give or get some information or "facts" about something.

Since World War II the concept has undergone several transformations, closely related to central elements of the scientific-technological revolution. If we want to understand the new success of the word, we have to ask for further information.

It is probably only a coincidence that the origin of the new meanings of the word can be traced back to the notion of lacking or "missing information" used by the German physicist Ludvig Boltzmann in an attempt to solve a problem in the theory of thermodynamics in the late 19th century. But as I will argue, this coincidence happens to be very significant. Today the concept of information is not only used in a variety of different – and often inconsistent – meanings[1], it is also – and almost always – used to fill an empty space in the context (or meaning concerned). It seems that the word is mostly required in contexts where it would be quite correct to speak of a certain lack of information.

In this paper I would only give a few examples, before I outline the relationship between "Information Technologies" and the concepts of an "Information Society" which is often used as the key phrase for the kind of society evolving from the industrial societies, and thus in sociological theories replacing the Marxist prediction of a socialist society as the outcome (or new stage) of capitalism.

## 1.2 Information in Mathematical-Physical Theory

The modern – or "postmodern" – concept of Information can be traced back to Ludwig Boltzmann's idea of missing information in closed thermodynamic microphysical systems. According to the English physicist James Clerk Maxwell (1871) there seemed to be a conflict between the behavior of such systems and the second law of thermodynamics, the law of still increasing entropy, since a "demon" who could observe every single molecule in the system would also be able to manipulate the system in a way, which produced more energy without doing any work. But it was, in fact, not possible to observe every single molecule and Boltzmann tried to overcome the problem by linking the idea of missing information to the concept of entropy as an expression of the disorder in the system, which he attempted to describe through a statistical analysis of the probabilities.

Later, the Hungarian physicist Leo Szilard (1929) tried to solve the mystery on a phenomenological and deterministic basis using Boltzmann's idea of missing information explaining that the energy necessary for the "demon" to obtain information about the system would compensate for the energy produced, which meant that the second law was not contradicted.

Although the concept of information – and even the concept of memory, "Erinnerung", in the physical system – was also used by Szilard, he used these concepts in a rather traditional and broad sense as quantifiable knowledge. The missing information was found as an amount of energy. Boltzmann was right, in a way he probably couldn't imagine. The notion of information had only importance in the designation of something lacking. The point was that it was necessary to measure the energy used in the process of observation. This also seems to explain why the word "information" didn't become an important concept in physics, although the problem of observation did, both in the theories of relativity and in quantum mechanics.

Boltzmann and Szilard differ in regard to the question whether physical microsystems are to be described in a statistical and non-phenomenological way (Boltzmann) or in a deterministic and phenomenological way (Szilard). The question remains unsettled. But both of them use the traditional concept of information in a way which brings this concept to some interesting borderlines. The one is the understanding of information as a psychical phenomenon (an energy process); the other is that the physical dimension of information implies that it is necessary to include the process of observation in the description of certain physical systems.

### 1.3 The Mathematical Concept of Information

The modern use of the concept of information does not come directly from the theories of thermodynamics, but according to Warren Weawer and others, these theories played an important role in the development of Claude Shannon's mathematical theory of information shortly after World War II (Shannon and Weawer, 1949, 1961).

In this theory information is obviously not seen as merely a function of energy. Shannon proved that it was possible to formulate a theory of information to which you can treat information independently on the one hand of the physical implementation, and on the other hand of the content or message contained.

Besides the technological perspectives, this was a new notion of the concept, since it included a separation between the formal representational system and the meaning represented. It indicates very clearly that it is reasonable to say that a system can be informed without being intelligent. A similar separation was developing in other areas too, for example, in linguistics the attempt to describe natural languages *sui generis* as formal representational systems[2], but nowhere else with the same striking success.

However, there is still a demon of a kind in this mathematical notion of information. Although the idea was to treat information independently of the physical implementation it was also to enable the most rational communication in a physical system in order to solve the problems of physical noise. So the concept of information is still related to a certain concept of energy, not as a mere function, but as a description of rules for organizing certain (communicative) kinds of energy processing. Hence the mathematical notion of information can be understood as a mathematical substitution (or representation) of some physical forms of information.

The theory has often been seen as a mathematical generalization of the theory of physical information, but it should then be added that this kind of theory doesn't say anything about (for instance, biological) information processing systems in so far as these are based on the use of several levels of "physical expressions" interacting upon each other during the communicative process.

The mathematical theory is based on and is limited by the assumption that the communicative process can be sequenced in a linear order or into a number of distinct channels with no interference between the channels during the process. So the most valuable technological acquisition of the theory at the same time inherits a fundamental restriction and limitation in terms of generality.

Yet the theory had another point of relevance since it was a method to calculate not only the limits necessary to separate noise from information, but through statistical treatment, also to separate information from redundant signs in linguistic and other formally expressed messages. This gave the concept of information another and certainly very specific aspect. It meant that "information" on the one hand was defined as a notation of certain physical signals) and on the other hand as a notation of those formal expressions which could not be omitted (i.e. the formal expressions which are open for free selection, and are not determined by the formal representational system itself) if the message was to be understood, given of course that the receiver has the necessary knowledge of the same representational system.

Here "information" is not only separated from any relation to meaning, but somehow surprisingly also from the representational system in which it is expressed. That is the second reason why it is seen as a general theory of communication, but it may be argued that this separation inherits another important and strong limitation of such communication systems, namely the condition of identity and invariability in the relations between the representational systems of the sender and those of the receiver. Such an identity and invariability cannot be taken for granted as a general fact.

Let us take a brief look at a message expressed in written English accepting the idea that the message is contained in the literal form. How much can be omitted from the representation? "*NIwasie*" is obviously incomprehensible; "*No I wr sent in engl*". is also; but what about: "*Now I writ a sent.ce in engl?*" Some might be able to guess the right message: "Now I write a sentence in English". But the point is that others might not.

Even in the case where we use the same language and the same alphabetical way of spelling we do not, as receivers, have the same representational system. Nor do we have the same ability to detect misspellings or to fill in missing letters. Or said in another way; the relationship between letters belonging to the redundant part of written language and letters carrying the actual information is not invariable. It is variable, not only between single individuals, senders and receivers, but also among groups. It is also variable with respect to time.

There are certain linguistic levels which do not change very much, or at all, in a period of say 50, 100 or maybe even 1000 years, but we can never know the changes of tomorrow. At the level of letters such changes are very common. Words often used by a certain group of people are subject to rapid changes in pronunciation and/or spelling, while the need of distinct pronunication decreases because informational elements become redundant in the group. Furthermore we can question the idea of a general clear-cut distinction between letters belonging to the (redundant) representational system and letters carrying information in written alphabetical language. The variability of the relation between redundant and informational signs in "natural languages" might be seen as one of the most valuable features of these languages. The conditions (or rules?) for such changes also seem to be different from the rules allowed in other formal representational systems, such as algorithmic or numerical representational systems.

This does not mean, of course, that it is impossible to make any kind of purposeful and pragmatic evaluation, but it does mean that the mathematical-statistical approach is to be seen as a specific and limiting kind of translation from one system of representation to another. It represents a frozen picture of a changing system, or a translation from a system governed in one way to a system governed in another way using different rules for stabilizing the relations between redundancy and information.[3]

The fact that the relationship between the representational system (the letters of the alphabet for instance) and the message represented (the meaning) is arbitrary, does not imply that a specific representational system such as the alphabet doesn't put constraints to what is possible to express in that system. It certainly does. We can articulate pictorial impressions very well in written language, but we would never say that colored pictures, communicated through black letter-signs printed on white paper were just the same as pictures actually painted in color.

But what is information if it is not understood either as an amount of energy used for communication of messages or as an expression of certain messages inherited in the particular form? Is it an empty structure where the form is without any determination of the possible meanings it carries? The answer is that it is a concept which allows us to operate on representations without regard to any sense of meaning, i.e. to operate with certain formal procedures without regard to the content to which they might be ascribed.

It is in fact possible to operate with this idea of empty containers, although it has no sense if this kind of work was not related to the actual processing of messages and was not governed by one or another kind of meaning.

'If so, it does not seem to make sense to try to derive any conclusions about the character of "Information Technologies" or "Information Societies" from the physical or mathematical concepts of information. The impact of these concepts is based on the interpretations and implementations of the results in the world of meanings. But no. If nothing is put "in form" why then the notion of "in-formation"?

Despite the claim of the existence of a theory of communication totally independent of meaning, the theory itself is a contribution to the development of a formal representational system, possessing certain attributes which distinguish this system from other representational systems such as pictorial or alphabetical.

The formal representational system itself is actually put into form. And not only into form but into a formal system with its own semantic structures. Hence the mathematical theory of communication can be seen as a set of (numeric-algorithmic) forms which may contain certain messages, but it is itself also informed and carries as a formal system a meaning or sense of its own. To describe how a certain form has a content of its own, one could compare the numerical or algorithmic forms with other formal representational systems.

Perhaps the most closely related kind of human communication is that of writing using the alphabet. It is a formal, arbitrary (or conventional) system for representation of meaning, where it is not possible to designate any message to any specific letter used in the system. But this comparison can also tell us something about the specificity of the mathematical concept of information, namely that it is (or may become) a part of and a contribution to the development of a numerical equivalent to the alphabet.

Such an equivalency, it should be noted, is not to be understood as simple parallelism, but only as a designation of an outset for further analysis.[4]

### 1.4 When Information in One Case is Not Information in Another

Since the mathematical-physical concept of information is related to the level of formal representational systems (the level of the alphabet rather than the grammatical, syntactical or semantic level of language) with special regard to a certain kind of physical implementation, this concept cannot be seen as a general concept of information. One could instead compare this specific use with other specific uses of the concept, for example, in law, where "information" has been used about the material on which an accusation could be built. It is like a container with a certain content, which can only be defined and later judged in a specific case.

Unhappily this use is not in accordance with the usage of the word in other and connected areas. The use of the concept of information technologies includes, in some cases, technologies used for information processing between humans without regard to the functionality of the system. In other cases it includes only technologies which have algorithmic information processing as a constitutive functional element, regardless of whether the technology is used in communication, production or some other kind of process.

In the first case, the computer is linked with television, radio and other medias, especially electronic, which are excluded in the second, where the computer is grouped only with certain cybernetic and biological systems, related to the specific functional organization. So information in the first case is still connected to the notion of information as knowledge, more or less independent of the representational form, while in the latter case it is strictly bound to a certain kind of representational form independent of the represented knowledge.

These two different notions of information are often confused or used as if there were no important distinctions to be made, not only in public language but also in more complicated ways, in other theories of information and in theories of the "Information Society".

## 2. Information in Theories of the Society

Since Daniel Bell (1973) the concept of an "Information Society" has been understood as a new kind of society, derived from but contrary to the "Industrial Society". No one will probably dispute the idea that modern societies since World War Two have been changing in a variety of – and in many aspects also very fundamental – ways. Nor would anyone probably dispute the idea that new technologies in general and computer technologies in particular play important roles in these processes. But it would indeed be reasonable to call into question whether these processes really fit the opposition between an industrial-based and an informational-based society, especially for two reasons.

The most general is that no society can exist without a fundamental informational structure. Hence any society is to be understood as an "Information Society", and different organizations of the informational processes will probably be of great importance in the understanding of the differences between societies.

The second reason is more directly related to the specific understanding of the "Industrial" and the "Informational" society. According to Bell the "Information Society" is based on the use of theoretical knowledge as a "strategic resource". It might be true that the early industrialization was not built on theoretical knowledge as a "strategic resource", but the later industrial development is – at least from the beginning of the 19th century – to a very high degree based on the purposeful use of theoretical (scientific) knowledge which was implemented in the machines as their most significant element.[5] Not only were the machines in the "Industrial Society" built on theoretical knowledge, but also society itself. The ideas of the state, democracy, the concepts of human rights and even the idea of the free market, were formed on the basis of theoretical knowledge and later implemented as the constitutive order for the "bourgeois" or modern society.

On the other hand there seems to be no reason to believe that the changes in contemporary society is a change from "industrial" relations to "informational", since the technological development gives way to the development of industrial relations in many new areas, such as biotechnology, the organization of the social and educational services, the health sector and even the organization of information processing and mass communication. One could actually say that the computerization of text manipulation might lead to a kind of industrialization of the fundamental – everything underlying – knowledge technology in the industrial society (written texts kept and distributed in printed books), which until recently were only industrialized to a very low degree. These changes could be described as an expansion of industrial relationships to new domains,[6] at least as a strong tendency and a potentiality, for it is after all a question of human judgement.

The point is that the character of the changes in the society – more generally to be described as the outcome of the technological-scientific revolutions after World War II – is more complex and less predictable than suggested by the concepts of an "Information Society". The most indisputable changes are the changes in those domains which concern the extraction of knowledge.

In the "Industrial Society" these domains were above all (and especially regarding the technological development) of the inorganic and physical nature as described in physics and chemistry, whereas in the "Information Society" the most important fields for knowledge extraction are of the biological and organic nature, human consciousness and knowledge about knowledge processes and symbolization. Still physical nature remains a central domain, partly because it is a domain underlying everything and partly because modern physics is able to derive new, not yet exploited, knowledge from various corners of physical nature to which man had no access before.[7]

The most general and fundamental feature of these changes seems to be the analysis of human mental capacities (cognitive, linguistic and perceptive as well) as a privileged domain for knowledge extraction. The human mind is not, as in the concept of Englightenment, only the creator of the world, building on knowledge about the surroundings, but also the object for extraction and creation. The human brain and mind, the consciousness, the capacity to think, speak, write and produce symbols (and not theoretical knowledge in general) have now become a central, strategic resources as a subject matter, and that is why the concept of information has acquired a double sense, both including human knowledge in general and those knowledge forms which we are able to formalize and hence implement in machines. The growing number of different definitions of the concept of information reflects the growing number of formalized algorithmic descriptions developed in a broad range of scientific research fields, each with at least one and often several specific definitions.

Both human knowledge in general and the specific forms of knowledge which we are able to formalize and hence externalize in machines are due to changes discussed above, but these changes are not identical. Changes of the latter will always change the former, but changes in the former does not necessarily imply changes in the latter.

This creates a problem especially when the concept of information is used both in an attempt to characterize a certain historical period and as a general concept closely related to knowledge. In the former case the concept is bound to be limited to denote specific forms of knowledge and knowledge organizations, in the latter case it is bound to include every kind of knowledge and every organizational form for production, storing and distribution.

## 3. Information as a Component of Paradigmatic Changes

If we deny the existence of a genuine definition connecting the many different concepts of information a question still remains. How can we explain the widespread – and undeniably fruitful – usage of these concepts? If the answer cannot be found in a well defined content, it might instead be found in the possibility that the concept does allow or enable some important new questions. This seems to be the case.

The concept of information is almost always introduced as part of a new perspective or paradigm, as one of the conceptual means to transcend epistemological barriers, often some of the barriers laid down in the definition of the established research fields. If so the concept signifies that the discipline has reached one or more of its own borderlines.

But the concept of information does not only point out the borders, it also opens up for the introduction of new aspects in the understanding of the research field. In many cases the concept is used as one of the ways to introduce the human consciousness as an integral component of the subject matter studied. The way it is done, and the reason why, it might be different in different areas. But there are, on a general level, certain common traits which are typical for the scientific development in the 20th century.

One is a change in the concept of the relationship between the observer and the observed. There is growing awareness of the conceptual conditions for speaking of "observed phenomenona", a growing awareness of the importance of the observational process not only for the definition of the "phenomenona" but for their production as well. It also includes an awareness of a change from the description of systems based on few variables to the description of complex changing systems including our own cognitive system(s).

So the concept of information seems to be part of a bridge for understanding the interchanges between the observer and the observed, including the process of observation and understanding as aspects of the domains studied. Since the human cognitive system is also a biological system, and all biological systems are also physical systems, this process includes an attempt to transcend the borders between physics, biology, psychology and the humanities.

If so, one can say that the concept of information is used in a change of paradigms pointing at the connections between domains which have been separated in the previous scientific traditions, i.e. the relations between matter, energy and information, living processes and not living processes, biological processes and psychological processes, relations between cognitive biology, psychology and the creative cognitive potentials and artefacts of the humans, studied in the humanities.

No wonder this process has also given life to the old attempt to establish a unified science such as James Grier Miller's theory of "Living Systems" based on a biological founded concept of information, Humberto Maturana's "cosmology" based on the idea of "autopoietic systems", or the revival of the mathematical semiotics of Charles S. Peirce.

Unification is a central mode of science, but so is separation. And there is at least one good reason to argue that it is not wise to give the effort of unification any kind of privilege; namely that the reason to do science is not to be found in the corpus of the existing (accepted) knowledge, but in the corpus of what we don't know. Some would say yet, but let's just wait and see.

## 4. The Problem of Understanding New Theoretical Knowledge when Implemented in Machines, Organizations and Society

In so far as information theories are implied in the technological development and hence in some way implemented in society, there is another kind of problem to face. How do we obtain knowledge about the effects of the implemented knowledge?

There are probably several strategies to be followed. One is the analysis of the outcome of the implementations on different levels ranging from the local level of single implementations to the infrastructural levels in a regional, national and even global scale. The strong limitation of this strategy is its character of "post festum" strategy. Another is the technology assessment strategy guided by the intention to predict the potential outcome before it comes out. Or even better to integrate the process of the assessment in the process of innovation. This is obviously a better strategy in so far as it allows the detection of problems before they really come up. But the strategy also has severe limitations since it is only possible to predict foreseen problems.

Some might say that this is what can at most be done, and they are to some extent right. We never get a complete understanding of what we are doing in nature, but we might get better strategies. In some respects, not only for economical reasons but also for social and ecological reasons, do we really need better strategies, since we are not able to simply withdraw the effects of our inventions. On the contrary, the technological development is in many aspects irreversible. It is just as important to recognize that the effects of technological innovations always go far beyond the horizon of the knowledge necessary to make the innovation and its implementation in society. The knowledge necessary to build a car doesn't help us very much in the understanding of the effects of this product when implemented in society.

That is where sociology comes to the aid, or ecology or whatever. Some would say, but why didn't they then come just in time to prevent the ecological problems we are facing today? At one level, the reason is provided by the "post festum" problem of scientific description, which is not solved in terms of the scientific-based forecasting of the future. But on another level one could say that the reason, to some extent at least, is the lack of our understanding of the limitations of the theoretical knowledge implemented.[8] This is certainly a theoretical problem, but of increasing social importance because of the increasing use of many kinds of newly developed theoretical knowledge in the daily life of society. The question is how do we describe and understand new theories which we only know as hypothetical constructions before they are implemented in one way or another in social life?

There are probably no general answers to this question, but there are some general risks to be taken into consideration; first and foremost the risks of unification strategies (whether initiated by state policy or within the scientific communities) in the development of the scientific knowledge.

As a rule of thumb one could say that it would be most valuable if the development of new theories was accompanied by the development of research founded on opposite assumptions and directed towards the analysis of the assumptions and conclusions drawn in the first concept. This happens of course, but very seldom as an integrated element in the official – whether public, scientific or corporate – research policies.

But the development of scientific knowledge does not only depend on research policies, it also depends on the scientific work and on the scientists working in specific areas with specific problems. I shall now return to the questions concerning the understanding of information in the area of computer technologies and society.

## 5. Computerization as a Writing Technology

In the area of computers the most relevant concept of information is as algorithmic representations. Although these representations can be broken down into binary representations, the algorithmic level seems to be the most fundamental or essential. The condition of binarity is of technical relevance while the algorithmic condition also represents the more wide potentialities. What can be expressed in finite algorithms can be computed and what cannot be expressed in algorithms cannot be computed. Hence the understanding of algorithms plays a key role for the understanding of computers. But as in other cases such an understanding cannot itself be expressed in the same language i.e. in algorithms. We are forced to use another language to describe this. The one reason is that algorithms are very difficult to comprehend for human beings, (thinking about the teaching algorithms involve non-algorithmic representations, the teacher has to explain the content in ordinary language), but another is that the description of algorithms includes the description of the demarcation lines and the representation of the concept of non-algorithmic representation for which there cannot exist an algorithmic expression. One could maybe say, that algorithms, because of these limitations, do not represent a language at all and that might be right. But at least it can be said that the algorithmic "language" today is only one of the elements in the language of computer communication. It is an element which gives this language a character different from human – spoken as well as written – language. The character of this difference is still under debate, but differences will exist even in the case of the development of algorithmic representations of "natural languages". This is because of the differences between the physical systems wherein the languages are implemented (similarities are not identities) and because of the explicit formalization of the relations between the "natural" language and the algorithmic representations which are necessary for the computer to operate while humans do not need to know or see the algorithms the brain might be said to be using when speaking.[9]

Anyway, there seem to be good reasons to conceive the computer as a communicative medium, as suggested in Andersen (1986); and as a medium which on a fundamental level is a linguistic medium, based on a representational system close to – but still also different from – other linguistic systems.

A more detailed analysis and description of the computer language is beyond the scope of any short paper, but it seems necessary to include the relationships between alphabetical, pictorial and numeric-algorithmic representations both in the descriptions of how the computer works and how humans can communicate with and through computers.[10] Anyway, one new feature is striking, i.e. the capacity to give a linguistic representation of pictures. It is striking because this capacity builds a bridge of a new kind between written alphabetic representation and pictorial representation. The bridge itself is linguistic. The pictures contained in computers are stored and manipulated through written algorithmic instructions. Of course one could say that this is only what has been done with algebraic representations of geometric forms for hundreds of years. But the capacity has not only been further developed, it has also got new dimensions both because of the electronic computation of the translations, and because of the capacity (which is still under development) to manage the relationships through instructions themselves written in alphabetic – or pictorial – languages.

This is one of the reasons for conceiving computer technology as the main medium for the development of a new language in society. And this again might be a good point of departure for further reflections on the character of cultural changes since it points out that these changes might be on the more basic, but also more indeterministic, level of the language in which we produce and express human knowledge, rather than on the level of production or service functions in society.

If we are going to compare the "Information Society" with the "Industrial Society" we are forced to compare the central mediums for knowledge production, knowledge storing and knowledge distribution, i.e., the written text (including both alphabetic and algorithmic representational systems as well as the non-linguistic pictorial illustrations and the printed book) and the computer.

The change is not a simple substitution of written texts and books with electronic and numerical based devices. The alphabetic representation will still play an important role, but the relationships between different representational systems are changing. This change occurs in the areas of knowledge extraction, in the theoretical foundations of knowledge, in the relation between different formal representational systems, and in the technological means to produce, store and distribute knowledge. The main agent of change is the rapid developing capacity to formulate algorithmic representations. This process reveals even more the significance and importance of the differences between different representational systems – in spite of the idea that the numerical representation could be seen as the new general form for knowledge representation.

If so, one could say that we are rapidly moving away from the possibility to talk about unity in science, towards a situation in which scientific descriptions of the different forms of knowledge representation become a central theme.

It is not new that we have alphabetically as well as numerically expressed knowledge. The new thing is that it is no longer possible to say that there can be no discrepancies between knowledge represented in these two different forms. This process might be described as a new kind of secularization since the concept of formal representation is now divided into concepts of different representational systems transforming their compatibility from a question of axiomatic beliefs to a question of research, discussion and interpretation. If the classical process of secularization is described as an emancipation in man's relation to surrounding nature, based on the establishment of the written theoretical knowledge as the primary medium of truth, the new secularization might be described as a secularization of the relations to languages and hence to the classic idea of scientific truth. This takes place as a secularization of the relation to the medium through which the classic secularization was performed and in which the truth could be represented as an indisputable possibility.

This is of course, not to be understood as a description of the changes in the world from World War II until these days. After all the differences between society in the sixties and today is not so great in spite of the rapid theoretical and technological development. That is actually one of the reasons why we need a new perspective in the understanding of the cultural changes, since the theories of the "Information Society" in most cases implies that farreaching transformations have already taken place.

The classic secularization developed through a period of at least 300 years and most of the technological fruits were developed late. The perspective of a process of secularization is a long-term perspective and it points out a level of change which is difficult to articulate, since it cannot be articulated from within the concepts from which it evolves. The new secularization also has this kind of unpredictability, since it is based on a change of the whole knowledge system. But we are no longer at the very beginning. The computer, which probably will be a central technological instrument in the process, is already 50 years old, and the theoretical roots of the process are 100 years old, and both the theoretical and technological processes continue.

A main reason to formulate this perspective is to be found in the theoretical development in the 20th century. In spite of the increasing specialization one theme has still been a more central and common theme in all areas, i.e. the discussion of the representational capacities of languages. The problem arose in the late 19th century as the problem of observation in thermodynamic theory, in the theories of relativity and in quantum mechanics in the physical sciences. At the same time Freud and Jung introduced the psychoanalytic concepts of the unconscious, contributing to a weakened confidence in the truth of explicit knowledge, while Ferdinand de Saussure introduced the structuralist concept of language as a formal representational system. Since then the theme has spread and given rise to a number of new theories, methods and technologies.

The fact that these secularizing processes in relation to the knowledge representation take place in the sciences and in the humanities as well, does not directly imply that they will also transform society. However, they are certainly a contribution, which supported by the computer – itself a fruit of these new epistemologies – can be transferred from the mental implementations to implementation in the societal and ecological surroundings. It would be more difficult to tell how it could be avoided and even more difficult to argue against.

If there is any candidate to take the empty place as the creating force of human history today, these theories and technologies are surely a strong one. Or they have the position already. Not only because of their own credits, but also because of the political use of science and innovation as the central means of economical growth and social development.

Fundamentally it is a human centred process, since human competences are a central domain for the knowledge extraction. But we now have even stronger reasons to insist on a difference that makes a difference, for example, the difference between nature or culture and the limited representations of nature or culture in any knowledge system.

## Notes

1. As documented in Machlup and Mansfield (1983).
2. An idea put forward by the Danish linguist Louis Hjelmslev (1943). (*Prolegomena to a theory of language*, 1953) which – himself inspired by Ferdinand de Saussure – among others, influenced French structuralists.
3. It has been argued that natural language as well as human cognition in general – at least at the bottom – is to be seen as the algorithmically governed procedure. But even if the biophysical mental system is actually processed in an algorithmic way, we are able to talk without knowledge of these algorithms, which means that we are able to govern them in another way, probably using grammatical and semantic principles including rules, multiple determination and the possibilities of rule suspensions without explicit use of algorithms.
4. Here it may briefly be stated that both systems are built on the arbitrariness of the symbols used to carry (and in a computer, transform) certain kinds of messages, which are organized in (and governed by) another symbolic system(s). But there is an important distinction between a numerical and an alphabetical representation – although the same signs can be used – since numerical representational systems are based on a more strictly defined set of rules determining the legitimate relationships between the arbitrary forms by which the messages are carried. Maybe this can be seen as the basis for a distinction between the alphabet understood as an indeterministic formal system, and the numerical representational systems as a deterministic one. But a deterministic system is of course, also an indeterministic (arbitrary) system in regard to the relationship between representational form and represented meanings.
5. As stated in J. R. Beniger (1986) the efforts to control and regulate the transportation and distribution processes played a central role in the industrialization of the United States in the 19th century. Beniger stresses the continuity between the industrial society and the contemporary development of information technologies as means of the same control revolutionary process.
6. As was the case in the first scientific analysis of the modern organization of knowledge production, Frits Machlup (1962), who introduced the concept "knowledge industry" including education, research and development work, communication medias, information machines and information services.
7. Specifying the primary domains for knowledge extraction as a distinction between different kinds of societies is not enough. The character of knowledge plays quite as important a role, as is illustrated in the difference between the knowledge forms used in traditional household farming, modern machine farming and biotechnical manipulation of biological nature. On the other hand there are also some important connections between the domain and the knowledge forms to be analyzed, as for instance, the relation between the physical paradigms used in classical physics for the description of physical phenomena on a "macro" level and the paradigms used in microphysics (thermodynamic field theories, theories of relativity and quantum mechanics) or the relation between the Darwinian concept of biological nature based on the cell, organism and species as the "founding" entities and the microbiological analysis of (some of) the inner cellular processes. It is however not to be done in this paper.
8. Some illustrative examples are given in L. Qvortrup (1990).
9. Connectionism is another case where a central difference is the difference between (human) systems who can operate while they learn and (machine) systems which cannot.
10. This is supportive of the argument given in P. Ehn (1988) – to conceive the system development both as a work-oriented design process and as a language game across the borders between the arts and sciences. Since the capacity to write in alphabetic language is also based on both forms of language practice it might be an idea to cross the institutionalized borders in this area as well. But there are still distinctions to be made. Not only between different genres in a language, but also between the languages in which the game is played.

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*Correspondence and offprint requests to*: Niels Ole Finnemann, Centre for Cultural Research, University of Aarhus, Finlandsgade 26, DK 8200 Aarhus, Denmark. Tel. (45) 86 16 36 11. Fax: (45) 86 10 82 28. E mail: AUCKNOF@VMS2.UNI-C.DK.