Abstract: In order to organise and represent knowledge properly we must know how it is produced. Based on the actor-network theory of Bruno Latour, this paper analyses power structures and processes involved in the production of knowledge in the sciences. The consequences of these structures on the organisation of knowledge is shown. For any unexplained phenomenon there will be several conflicting theories. Which of these that will eventually be accepted by the greater scientific community, thus gaining the status of knowledge, is decided in scientific discourse. The author claims that gaining acceptance of a theory is not a question of being right, but of being powerful. The scientist must summon sufficient resources with which to overwhelm other theories and force them to leave the field of the domain. These resources may be material (position, economy, etc.), but it is those occurring in scientific discourse, the documents, which are of interest to information science. The paper likens the discourse to a conversation in which the documents act as statements and arguments, and as such form a language. The language philosophy of the later Wittgenstein is used to explain the principles and dynamics of scientific discourse. The paper shows that the interpretation of a document, the determination of its subject, is made by the sum of actors in the discourse. The subject of a document cannot be established by analysing it without regard to its context. Rather the subject must be deduced by looking at what other statements (documents) it uses and by how it positions itself and is positioned though use in the discourse of the discipline. In order to establish this position, a thorough understanding of the current state of the discourse and its socio-political and theoretical history is necessary. If we are to represent documents properly, we must study the disciplines and their discourse.

1. Introduction

The purpose of this article is to clarify some aspects of the relationship between the organization and knowledge production in the sciences and Library and Information Science. The article is an attempt to view Bruno Latour's actor network theory in a LIS context in order to examine its consequences for a theory of knowledge organization. I will limit the scope to that part of generated knowledge which is published; the emphasis is on the part of the actor-network theory that deals with how scientists produce, interpret and use documents. In the following, this is referred to as a whole as scientific discourse. The first part of the article is a general presentation of the actor-network theory. In the second part, Latour's concept of discourse is considered in a semiotic and hermeneutic context in order deduce a theory of meaning and the use of knowledges as the basis of a theory of knowledge organization.


The classic, still quite widespread view of science is that it is but a stenographer taking down Nature's dictation; the scientist meticulously takes down every word. The result is infallible and objective, and since Nature does not lie, the truth. One would be hard pressed to find a view further removed from this than Latour's theory of actor-networks. This is a theory about processes, of which the most important is that which leads to the construction of a scientific fact (Elgaard Jensen p.2). This process determines scientific practice which in turn determines how the actors position themselves in relation to each other. This positioning creates the other parts of the theory, nature and society. The properties which are ascribed to these are consequences of a particular practise. The actors constitute their discipline and its truths simultaneously (Høgh Laursen, p.135). Therefore it is essential to study how and why research reaches its findings in order to understand how that discipline is organized.
3. Actors.

A network consists of actors and the relationship among them. According to Latour (1996 p.53), an actor has a semiotic definition and is a meaningful entity which acts or is acted upon within the grid of the network. Whether that entity is human or not is immaterial. Actors can only be distinguished in and for the specific situation, and the definitions are neither static nor final. Latour is of the opinion that they should primarily be divided by their activity or passivity, i.e. whether they actors or entities in the particular situation.

Actors may be human, non-human or combinations of either. Human actors are those persons who participate in a network: scientist, administrative staff, intermediaries, etc. These kinds of actors have the most direct and immediate influence on the processes within the network. The human actors determine the object of the research and its methods, including what is considered an acceptable scientific proof. Latour emphasizes that the interested parties partake in the scientific practice for private reasons, and that the practice is often (mis)guided by the attempts to reach these goals. Schaaning (1997 p.224) talks of a circle of credibility: The goal of the individual is not to seek recognition, money, research time, publication or any other single thing. Rather, the individual seeks to gain all of these by getting his foot in the door in one place and thereby making it easier to gain access to others. Often the actor is not conscious of these goals, but sees her work as an aspiration to a nobler and more objective goal, such as the cure for a particular disease. The common denominator for these articulated goals is that they represent a search for the Truth.

The non-human actors are nature, apparatus and literature. The latter will be discussed later. The purpose of scientific apparatus is to help the researcher study nature where his own senses fall short. Latour calls these inscription devices because they transform the properties of the matter under investigation into texts. Schaaning points out (1997 p.210) that this concept extends beyond technical, human operated entities such as the Geiger counter. A laboratory or other organization may also be considered inscription devices to the extent that they function as a single, text producing entity. Nature is the matter the inscription devices write about. However, such instruments are not objective but are text producers with their own world view, interests, etc. This is obvious in cases where human actors are part of the instrument. Latour argues as follows: Firstly, an entity is defined by its relationships in the network; neither the scientist nor the Geiger counter is the same on its own as when they are coupled. The scientist acquires an extra sense, allowing him to observe previously unattainable phenomena. The apparatus is supplied with a will, intents and interests to guide its efforts. Secondly, the device is in itself a reflection of scientific efforts. They are material results of the theories, practices and literature of a discipline (Schaaning p.210). As I will demonstrate below, Latour's metatheory of theories and literature rejects the notion that these reflect a value-free, objective truth. It follows that instruments created on such a basis cannot be considered objective observers of and reporters on nature. Often scientists do not take the value-laden nature of the instrument into consideration, and therefore accept its writings at face value. On such occasions the inscription device may be considered an autonomous actor which pursues its own interests.

Some matter probably exists independently of human observation, but nature does not. Nature is defined through observation. According to Elgaard Jensen (1999 p.5) objects are constructed when they are identified and their position in the natural system is established. A plant may for instance equally well be described as a particular species or by the structure of its fibers. Actor-network theory is based on the assumption that no action, and thus no observation, is value-free. Furthermore any examination is conducted from a perspective that reveals only one side of the motive. The sense that scientists, according to Latour, make of their research is close to Brier's theory of meaning (1996. p.33). According to Brier, the sense that is made is a highly simplified representation of the complexities of reality. Simplification
is a prerequisite for understanding the wealth of sensory impressions. Composite actors consisting of both human and non-humans are dualistic by nature. Depending on the situation they may be considered single actors or fairly autonomous networks. Simple forms are, for instance, the aforementioned human-machine couplings. More complex kinds are laboratories, universities or other institutions that may appear to be a single entity from the outside and yet contain a multitude of interests, goals, etc. which are only partly in agreement. Only when such an agreement occurs may the organization act as one. Common to these kinds of actors are that they have their own wills, world views, goal and interests. Furthermore, they are all text producers who are able to participate in networks in order to further their particular interests. That is the subject of the following.

4. Text, Discourse and Network.

Goals are reached through the mobilization of resources; the actor seeks to gain sufficient support for his project that any competitors must retreat. This mobilization has a textual and a non-textual part that interact. A text is a statement in a medium which allows communication. It is, like the other parts of the network, both actor and object. Let us assume that scientist A has reached a theory on some part of nature and wishes to communicate it to her colleagues. So she writes a text. Text and document are used as synonyms in the following. The statement is often written when there is no agreement within the discipline about the answer to that particular question. Why write an article that states the obvious? A's theory is therefore but one of several aspiring to become the chosen one, the truth. Something must be done to make that particular text convincing. The text is the result of a research process, often conducted with various instruments, each with its own theoretical payload as described above. Because these devices are controlled by the subjective scientist, the final text is an extension of the author and of the network she is a part of.

The scientist is convinced that her research results represent the truth, and the aim of the text is to persuade others of that. In order to achieve this the author must use a number of rhetorical moves. Latour refers to this as stacking; a text is stacked in the same way as a deck of cards in order to gain an advantage in the game. Latour describes (1987. p.22-26) a number of ways, called modalities, in which claims can be supported. These leave more or less room for doubt on the part of the reader, thereby controlling how factual a claim appears.

Firstly, the author can omit the research conditions from the text, thereby elevating claims to contextless facts (Elgaard Jensen p.2). By doing so, the statement is released from the conditions and theories of its creation that might question its status as truth. The author may for instance arrogate greater authority to the statement by writing "it is well known..." rather than the perhaps more correct "it is my belief...".

Secondly, one may seek support and supporters for ones view in other texts, thereby outnumbering the solitary reader who will then have to cease his opposition against the claims. It is important that texts used in this way have greater authority than the author. The latter in effect claims that the earlier texts agree with him. There may be varying truths to such a claim. The references therefore must be used in a manner that assures that the reader's attention is only directed to those parts that the text wants him to see. The text uses references in such a manner that a reader must reject them as irrelevant or untrue in order to reject the text. This can of course also be used on competing texts. By making the competitors supporters, its references and citations seem less reliable, ones own position is strengthened. These external texts are both the document's fortifications and the points at which it may be attacked. The document presents external literature (other documents) and internal literature (inscriptions written by instruments) as equally reliable. The author is often the producer of the internal literature, and is therefore interested in ascribing the same credibility to these as to the external texts. Furthermore, inscriptions are good arguments; they usually are not written
in prose but as diagrams, tables, etc. Such forms of presentation produced by devices are ascribed greater credibility because they are thought of as more objective representations of phenomena.

Thirdly, the author may make her text so complicated that the reader loses his grasp of the matter, and thereby the ability to oppose. The most important tool for this job is a highly specialized language, although complicated inscriptions may also prove useful. As a result the document addresses a narrow audience. By excluding the greatest possible audience, the text denies possible opponents many resources that might otherwise be mobilized against it.

The text may ann itself as much as it likes, but its faith is decided by others once it steps into a discourse. Latour likens (1987. p.104) the published document to a ball: Others have to use it if it is to get anywhere, and these players choose the game. If it is not used, it is quietly laid to rest under the ever increasing pile of publications. When the text is used through citations and references its original intent is immaterial; in discourse later generations of texts determine the meaning of their predecessors. A later text will use the earlier to fortify its own statements, and through this use change its meaning, in the manner described above. Over some generations a general agreement about the meaning of a given text is usually negotiated. It is in other words defined on a social level. Since this happens through other texts one might more accurately say that texts constantly position themselves and each other in a network. On this matter Hjørland talks of semantic holism: "the meanings of a symbol or a term are relative to the entire systems representations containing it."

The material part of resource mobilization is actor-networks. These are founded on a number of related problems. "We need others to help us transform a claim into a matter of fact" (Latour, 1987. p.108). Actors find that they are working on different aspects of the same problem. According to Høgh Laursen (1996. p.129) such problems, whether they are theoretical or technological, cannot be defined clearly at the outset. They are white spots on the map of scientific knowledge. It is in relation to the formulation of the research question that the network begins to take shape; as the problem is clarified it also becomes clear which actors have an interest in its solution. The problem becomes the object of their research. However a common problem does not guarantee the existence of one common goal. The actors of the problem network must attempt to gather the greatest possible number around such a denominator, i.e. a common notion of what the right answer would be. Identifying the goal is vital to the organization of the network, because it determines its division of labour, which in turn, defines the scientific practise necessary for problem solving.

If a number of diverse actors are to find such common ground, negotiation is necessary, what Latour (1987. p. 108) calls translating interests. This can be done in a number of ways. The most common solution is a compromise in which nobody gets exactly what they want but enough to stay on board. The network is not defined once and for all. It is constantly restructured in accordance with the demands of problem solving. Furthermore those actors who wish to partake must pass through an "obligatory passage point". This is the basic assumption about the nature of the research object on which all members of the network must agree.

More often than not several networks are trying to answer a given question, each believing in a different solution. Which of these truths that will be accepted by all the networks is determined in the discourse. It is not individual scientists who discuss a question, it is rather that the networks voice their opinions through particular spokespersons. With the passing of time a number of stable discourses on related and intertwined subjects are produced. Parts of the basic questions are solved but the main problem remains, and with it the discourse. These and their related networks constitute a scientific discipline. The individual actor-network is only partly within the boundaries of the discipline, because it has a number of contacts to the surrounding society. The more resources, both textual and material,
that a network can amass to back its view, the stronger their texts will be in the discourse. That doesn't imply that the text is independent of later users, but that it less likely that they will use it in a different manner than originally intended. One consequence of this is, as Schaaning (p.213) points out, that the truth of a statement is socially defined. It doesn't matter whether it corresponds with "reality" (all competing statements do, one way or the other) but that it is accepted and used as true. When a statement is used sufficiently often over a period of time the circumstances surrounding its creation recedes, thereby making it easier for the actor to believe. As an answer is agreed on, its competitors will be weeded out. According to Latour no description of nature is right in an absolute sense, it is simply given the right of way on the road of scientific progress, thereby becoming a fact. It simply appears otherwise in retrospect because the winners write the history of an objective, value-free science. That is why it is so important to study science in action, before the facts are created.

5. Knowledge Organization.

Considering this view of science, any attempt to find an absolute theory of knowledge organization is meaningless. Instead the basis should be that "Knowledge organization always serves pragmatic purposes and should reflect this" (Hjorland 1997. p.46). Hjorland argues that an organization of knowledge is done with the purpose of assisting the scientific disciplines in their work (1997. p.160). The primary goal for research is not to retrieve already expressed statements, but to create new knowledge. The work already done is merely a tool, and the fact that they are arranged in an orderly fashion simply makes them easier to find.

At this point two questions must be answered: Firstly, what do we understand by the concept of knowledge and, secondly, what purposes does organizing it. If we believe Latour's claim that any discipline consists of competing networks, organizing must serve these. Latour's somewhat vague definition of knowledge is: "How to be familiar with things, people and events, which are distant." (1987, p.220). As I have shown, Latour denies that one can be familiar with anything in any objective way, as facts. Those statements that are considered facts are of little interest because they are not the focus of the discourse. It is on the unsettled questions that the majority of statements are published, creating a textually based discussion. It is this discussion that needs organizing. Therefore we must talk of knowledge as something that is created within each community of interests. Knowledge (claims, statements) about the same entity is created differently in each network. Those who organize this must represent both the claims of the various networks and their discourses, as well as the conditions of production. I believe that this is what users need. The mobilization of resources described above depends on the actors being able to see which resources are available and who to mobilize against. Knowledge organization is the organization of statements in a discussion, and should reflect not only what is said but also who says it and why. It is the librarian's task to deliver this transparency. Since no networks or cluster of these, the disciplines, are alike, the structure of the knowledge to be organized must also differ. It follows that the organization and representation of knowledge must differ with the discipline. The librarian has to research the structures of each discipline as well as the discourse if the representation of the latter is to succeed. It is not possible to form universal rules on how to do this in practice. What is needed are anthropological and sociological research into the conditions of text production within the sciences. What I will do is to attempt a theory on the matter.

Latour notes (1996, p.57) that actor network theory is a semiotic theory. The structures of both discourse and network can be read like texts, i.e., as constructs of signs and codes. Discourse cannot be analyzed without considering its meaning, since the texts that constitute it are created to be read and understood. This is not the case with the "social texts", the social structure of the network. However this does not render them meaningless.

The three basic entities of semiotics are signs, codes and social context. The first two
need an individual sender, whereas the latter is created collectively. A sign is an entity which, if it is recognized as a sign, refers to something else: an object, a concept, a situation, etc. When reading a sign the recipient interprets it and creates his own sense of it, the interpretation. This sense need not have anything to do with the object of the sign (Fiske, p.43); the sign of a broken glass on a parcel does not mean that it contains glass, broken or otherwise. A code is a group of signs connected in order to express a more complex meaning. The code's structure, its grammar, is determined on the social level by its users. Here the most important thing is that codes may be used to control the number of possible recipients, by choosing some that are group specific. The social context is the society in which signs and codes are used. Actor-networks can be read as any of the three: It is a sign of an object, nature, which it signifies in a particular manner. The discipline is simply a more general sign. The network is also a code: It consists of a number of signs, the actors, which interact in accordance with a grammar, the possible connections that the actors may make at a given time. Finally it is also the social context for the individual's text production.

If the librarian reads the discipline's structures as texts, it should be possible to uncover the relationships between the actors. Since such structures are dynamic, the result will be a snapshot. Brier points out (1996, p.34) that any network of signs is a network of meanings. These may not be particular important in the analysis of the network but probably is in its representation. The actors are creators of text but at the same time they are also signs with significations which I believe should be included in the representation. The meaning of the actor-sign is the field in which it has authority, its position. In discourse it is official capacity, not the individual, that is listened to.

Parts of the discourse's material side, for instance who publishes the journals of the discipline, can be analysed without regard to what they signify. If one wishes to see discourse as a process, i.e., how and why they position themselves and each other the way they do, it is necessary to look at how meaning is created and used. Signs and codes are linguistic entities, so it must be possible describe the discourse as language use. Meaning and use must in other words be explicable from the point of view of the philosophy of language. As described above, Latour believes that meaning is created collectively, through use. A similar notion can be found in Wittgenstein's theory of language games. They occur as parts of a form of life which are the social context of the language users and their game. Language games are actions with the purpose of communicating a meaning. A language game consists partly of denoting objects, partly by using words. It is the latter which is of interest here, because it is Wittgenstein's point that words do not mean what they denote, but rather what their use implies (Andersen & Christensen, 1998. p.44). In order to understand what a word means it is necessary to study how it is used. Within a language game a word has a limited, fairly well defined, number of meanings. A game involves more than one actor and it is a social incident. Since this is determining for the meaning of a word, it follows that it is impossible for the individual to have a private understanding of the word. The use, and thereby the meaning, of a word is not determined once and for all, but varies over time and context. Gradually a number of related uses of the same word arise which are considered correct "moves" within the particular game. One might say that the rules are made during the game. Anyone who reads a word reads its meaning from the context; if the word is used in a way and connection resembling earlier experiences, the meaning must the same way it was then. Language use is learned through experience. One might also say that the use of words and the rules of the language game have not been properly understood until they can be used correctly.

If we extend these thoughts beyond words to include signs and codes in general, we have a potent tool for analysing and representing discourses. The actors write texts to express themselves in a form that can be communicated. These texts must be represented as authonomous entities, but also as signs in a language game/discourse. Every time a message is
transmitted to other actors in a network, it may be likened to a move in a (language) game. Wittgenstein believed that the language users are equal in the game (Andersen & Christensen, p.43). Latour disagrees. Meaning is created or agreed on within a community, but the degree of influence that each member has on the outcome very much depends on its power. The librarian must identify the language games within the discipline of interest.

We might distinguish between two kinds of language games: Scientific discourse which takes place on the discipline level between different actor-networks, and the games within each network. Both levels consist of texts, but a feature particular to the disciplinary level is that almost all of them are formally published. Whether the texts are thought of as texts or signs in a game, they must be represented in a manner that reflects both their meaning and their parent game. Brier point out (1996, p.37) that scientific language games are special cases because they explicate many of the rules for the creation and use of meaning. Every discipline has rules of methods which define what is considered a scientific proof and how to go about getting it. The rules of the language game are more clearly defined in the sciences. The claims that a discipline agrees within itself are facts are signs whose meaning has been fixed once and for all. To make sense of a scientific text, it must be seen on the background of the language game of its parent network, i.e., in its original context. The document is a result of an examination and/or discussion of the research object within a network, and has a fairly stable meaning in this context. The representation of the document should reflect not only its meaning, but also its place in the conceptual structure of the network. The meaning of a document as a sign in the discourse is determined by the use that others put it to.

I believe I have shown that a theory of knowledge organization based on actor-network theory can be useful. An emphasis on discourse and discipline as an inseparable whole consisting of actors with individual agendas may be a valuable perspective, because it shows that knowledge and facts are not simple things. Furthermore, actor-network theory implies that in order to understand the nature of knowledge, which might be a good idea if we are to organize it, we must study its conditions of production in practice.

References