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THE PRAGMATIC-RHETORICAL THEORY OF EXPLANATION

Explanation is one of the most discussed notions in philosophy of science. This may be because there is little consensus among specialists on how explanation in a scientific context should be characterised. Three main approaches appear to be alive today: the *formal-logical* view, the *ontological* view, and the *pragmatic* view. Between these three classes of theories little agreement seems possible. Beyond the expectation that explanation is meant to provide a particular kind of information about facts of matter, there seems to be little agreement at all. Given this, the pragmatic view has at least one advantage, namely, its ability to accept the others. Alternative conceptions of explanation may be construed as promoting wholly possible goals of a given scientific explanation in so far as the pragmatic situation determines that it is appropriate to pursue these goals. What pragmatists deny is that any of these other views tell us what scientific explanation is or that they cover all forms of scientific explanation, i.e., that there is any *one* goal of scientific explanation.

1.1 Various approaches

The formal-logical approach considers scientific explanation as something quite distinct and very different from ordinary explanation. It holds that every scientific explanation should have certain objective features by which it can be completely characterised and understood. Following Carl Hempel, a scientific explanation is to be construed as an argument with a propositional structure, i.e., an explanandum is a proposition that follows deductively from an explanans. This kind of approach gives us a *prescriptive* account of explanation in the sense that a proposition counts as a scientific explanation if, and only if, it fulfils certain formal requirements. As Hempel remarked, summarising his own position, “Explicating the concept of scientific explanation is not the same thing as writing an entry on the word ‘explain’ for the *Oxford English Dictionary*.”¹ His approach offers certain norms with respect to which we can demarcate scientific explanations from other forms of explanation. Apart from Hempel’s original covering law model this view includes approaches

¹ Hempel (1965), p. 413

such as Wesley Salmon's statistical-relevance model and the unificationist theory of scientific explanation as elaborated by Michael Friedman and Phil Kitcher

The ontological view considers a scientific explanation to be something that involves causal mechanisms or other factual structures. The idea is that facts and events explain things. In particular, causes explain their effects. A cause tells us why its effect occurs. A scientific explanation is an objective account of how the real world is connected. The cognitive representation of the facts of the matter does not contribute to the meaning of explanation. An explanation is both true and relevant if, and only if, it discloses the causal structure behind the given phenomena. Furthermore, an everyday account counts as an explanation if it is reducible to science talk about causal processes.

The pragmatic view sees scientific explanations to be basically similar to explanations in everyday life. It regards every explanation as an appropriate answer to an explanation-seeking question, emphasising that the context of the discourse, including the explainer's interest and background knowledge, determines the appropriate answer. Thus, pragmatists think that the explanatory product presupposes the circumstances under which the explanation is produced. The similarity between different kinds of explanations is found in the discourse of questions and answers that takes place in a context consisting of both factual and cognitive elements. The claim is that we do not understand what an explanation is unless we also take more pragmatic aspects around a communicative situation into consideration. The pragmatic view regards explanation as an agent of change in belief systems. For his part, Hempel would not deny that this effect is the pragmatic consequence of explanation, but in his view this had nothing to do with its quality as explanatory. In fact, he saw his covering-law model as an abstraction from every pragmatic context:

This ideal intent suggests the problem of constructing a nonpragmatic concept of scientific explanation – a concept which is abstracted, as it were, from the pragmatic one, and which does not require relativization with respect to questioning individuals any more than does the concept of mathematical proof.²

In contrast, the pragmatic view holds that a response to an explanation-seeking question need not follow deductively from a set of premises; hence, their validation as explanations includes lots of contextual elements. It does not pretend to give us more than a *descriptive* account of explanation. Whether an explanation is good or bad, true or false, is not the issue as long as it fits into the general pattern of scientific inquiry. So the insight that can be associated with the pragmatic view of explanation is that scientific inquiry, and thus scientific explanation, is goal-oriented and context-bound. It is always performed relative to some set of interests.

The pragmatic view can be divided into different theories. One is the *cognitivist* theory of scientific explanation. I consider Peter Gärdenfors and Matti Sintonen to be among its proponents. As Gärdenfors explains it:

The central idea is that *the explanans should increase the belief value*, i.e., the probability, of the *explanandum* in a non-trivial way. The belief value of a sentence is defined in terms of a given epistemic state. This state is not the one where the

² Hempel (1965), p. 426.

explanation is desired, but instead the contraction of that state with respect to the explanandum statement.³

I believe, however, that this suggestion fails to convey what is essential about explanation. If somebody asks why something is the case, that person already knows what the case is, and the explanation will not increase the belief value concerning this fact, which is already *one*. If I observe one morning that my dahlias have wilted over night, my belief in this fact does not increase when I am told that this is so because there was a severe frost during the night. I am pretty sure that my dahlias are dead regardless of whether I ever get to an explanation. What the explanans does is to fill in some bits of information missing in my system of knowledge.

Gärdenfors may still be correct about a minor point. Although the explanans does not raise my belief value of the explanandum, i.e., of the proposition stating that my dahlias have withered, one could suggest that it does inductively increase another belief value, namely the one concerning the metaphysical belief that nothing happens to my dahlias without a cause. But this belief belongs to my background knowledge and is not what has to be explained. Moreover, I doubt that possessing a particular explanation will increase my trust in such a metaphysical principle.

The cognitive approach has one important thing in common with the formal-logical approach. They both conceive of the explanandum as a proposition. But this narrows the scope of their analysis. The aim of the cognitive approach is to analyse explanation by pragmatic means alone without any appeal to practical issues such as human interest. Matti Sintonen, for instance, includes the extra-logical contingencies of explanatory discourse in his five-placed analysandum. I shall reword his formula as:

S explained to *H* why *q* by uttering *u* in a problem context *P*.⁴

The rationale behind the utterance *u* can then be stated as follows: The role of *u* as intended by *S*, is to cause in *H* an epistemic change vis a vis *H*'s question.

The analysandum, however, does rule out that *u* has to meet certain formal requirements in order for it to cause an epistemic change. Rather one must imagine that *u* must somehow be relevant to the question "why *q*" in order to be successful in changing *H*'s belief states. Not every possible answer will do. Thus, what guarantees *u*'s relevance could still be some formal logic of explanation à la Hempel unless the elements of the problem context *P* somehow excludes that any inferential characteristic of relevance can be abstracted from the pragmatic context.

The basic notion is the problem context *P*. A response *u* is relevant to the question "why *q*" only with respect to this. The problem context has indeed both a

³ Gärdenfors (1990), p. 111.

⁴ Sintonen (1989). This and the following indented sentence are not quite Sintonen's own formulations. Instead I have borrowed the above formulation from a student of mine, Thomas Basbøll, who, in his MA thesis, criticised that Sintonen writes "Why *E*", where *E* for a proposition mentioned, rather than "Why *q*", where *q* stands for proposition used, i.e., a fact stated. A fact and a proposition are two different things: we explain facts with propositions.

material and an epistemic side. A problem arises in the tension between what is known and what is not known. Thus, the problem context can be characterised in terms of a set of propositions stating a series of known facts. This set belongs to *H*'s background knowledge. Furthermore, the problem context also includes metaphysical principles such as the principle that regularities will continue to remain regular. Finally, it contains a number of propositions the truth of which *H* does not know but which she suspects to be relevant in solving the problem. But why she suspects them to be relevant is an open question, which the content of the problem context does not help us to answer. Therefore neither Sintonen nor Gärdenfors have shown that the pragmatic account is superior to the formal-logical account. To win the day, the pragmatists must argue convincingly that some elements of scientific practice are relevant for understanding scientific explanation, i.e., elements that cannot be explicated in terms of non-pragmatic objectives.

What is missing from their analysis is *H*'s own interest in the problem. What *H* considers as relevant is partly determined by her background knowledge and partly by what she finds desirable to know. Thus, I believe that personal interest should be added into the problem context. This means that the problem context contains both beliefs concerning how the world is and beliefs about how one wishes the world to be. The upshot is that an explanation is not something that is entirely objective, but is always an account seen from a certain cultural or personal perspective.

In an earlier paper I have defended a stronger version of the pragmatic view that also attempts to focus on the practical interest of the interlocutor and the respondent.⁵ I call this theory the pragmatic-rhetorical one. It maintains that an explanation should be seen as a reaction to a question concerning an issue where the interlocutor lacks information. Explanations are determined by the rhetorical practice of raising questions and providing answers in the sense that explanations are intentional communicative actions, they are concrete answers to definite questions, answers that have to fulfil certain rhetorical demands of purposiveness, relevance, asymmetry, etc. seen in relation to our background knowledge. As communication, explanations are context-dependent, goal-oriented, intentional and potentially persuasive. The answers are relevant and informative with respect to the context in which the questions are placed and the background knowledge of the interlocutor and the respondent and perhaps even interests.

I want here to develop this idea further. In addition, I will argue that from a certain perspective, the requirements of the formal-logical approach or the ontological approach can be adopted by the pragmatic approach.

1.2 Why is explanation a matter of pragmatics?

What are the reasons for changing from a formal-logical to a pragmatic treatment of explanation? I believe there are a number of good answers.

First, we have to recognise that even within the natural sciences there exist many different types of accounts, which scientists regard as explanatory. In the

⁵ Faye (1999). See also Faye (2002), Chapter 3.

natural sciences you find not only nomic accounts, but also mathematical, probabilistic, causal, functional, and structural ones. Nomic accounts may seem to fit the requirements of the formal-logical approach reasonably well. But I doubt that they always do. For law statements often contain *ceteris paribus* clauses, saying that they are true only if certain idealisations are fulfilled, but these conditions are never of this world. Thus, no law statement applies directly to the world; rather a law statement is true of a model. Furthermore, law statements, such as Newton's laws of motion, never refer to any particular object; they express merely how various properties are interrelated. The model represents some concrete system whose change we want to explain by picturing it according to certain interpretative standards. What we have is that causal explanations are usually carried out with the help of models, which do not have deductive connections with a theory.

Models give us causal explanations; laws do not. Nancy Cartwright has offered a fine illustration of this.⁶ In quantum mechanics there is a phenomenon called radiative damping. It appears as a broadening of the spectral lines. The atom is represented in a model with the nucleus surrounded by electrons in various energy levels. It decays spontaneously from an excited state; it emits a quantum of energy into the radiation field, which then may be reabsorbed by the atom. The reaction of the field on the atom both provides the line width and causes a shift of the line called the Lamb shift. There are, nevertheless, six different ways of handling the line broadening using three different equations. None of them has priority; none of them gives us *the* correct covering law. What we see is rather that these different approaches are useful for different purposes. So while the causal explanation is the same, the theoretical treatment may differ depending on which mathematical technique that works, which again depends on the physicist's capacity of finding a good approximation that fits the problem. The upshot of this and similar examples is that, in general, physicists select a particular covering law on pragmatic criteria. No theoretical description applies directly (i.e., without interpretation) to the world. Hence, these pragmatic criteria cannot be neutralised through a logical abstraction but are essential for grasping the notion of a scientific explanation.

Second, if one is looking for a prescriptive treatment of explanation, I see no reason why the social sciences and the humanities should be excluded from such a prescription. If they are included, the prescriptive account must include intentional and interpretive explanations, i.e., accounts providing information about either motives or meanings. Also, the practise of natural sciences implicitly contains these kinds of accounts although they often play a methodological or meta-scientific role in explaining how to carry out, say, nomic or causal explanations. We can only make full sense of the entire scientific enterprise, including the development of new theories, in case we can make room for some kinds of interpretative explanations as well.

Third, the meaning of a why-question alone does not determine whether the answer is relevant or not. Also pragmatic elements concerning the presentation of the question have a significant role to play. Take a question like: "Why do birds

⁶ Cartwright (1983), p. 78 ff.

migrate to Africa?” Which response would be relevant to this explanation-seeking question depends on which words the inquirer emphasises. Hempel and Oppenheim construed an explanandum as a proposition and an explanans as premises from which this explanandum logically followed. Bengt Hansson, however, was the first who pointed out that the two utterances like “Why do *birds* migrate to Africa” and “Why do birds migrate to *Africa*,” where the emphasis varies, express the same sentence but nevertheless mean different things.⁷ Unless we take into account such differences in utterance meaning, it is unclear what the inquirer asks to have explained. Does the questioner want to know why *birds* migrate to Africa, or does she want to know why it is *Africa* that birds migrate to? Since the formal-logical approach treats only propositions, which are acontextual, it will not be able to capture this difference.

Hansson proposed constructing a “reference class” for the explanation-seeking why-question. The idea was to capture in precise terms the nuances in meaning that could only be conveyed by style, emphasis, stress, italics or the relative position of the words. The meaning, he argued, of “Why did Adam eat *the apple*?” “Why did *Adam* eat the apple?” “Why did Adam *eat* the apple?” and “*Why* did Adam eat the apple?” are “not independent of the tacitly understood reference class.” This reference class contains things that might have been different and therefore not mentioned by the question. It varies in each of the four cases. For instance, the reference class for “Why did Adam eat *the apple*?” includes not only apples, bananas, grapes, figs, dates, and other fruits and vegetables in the garden of Eden, but also the snake and other edible animals. A relevant answer to this why-question should give the reason why Adam chose to eat the apple instead of a banana, a fig, a date, etc. In general, a response *R* to the question *Q* is explanatory if it informs the questioner *I* about why *P* exists in contrast to another of the many relevant possibilities *X*.

A why-question will probably be fixed by a reference class that is indefinitely large, and we may never come to know all members. Understanding a why-question, however, is a matter of being able to decide, for any given possibility, whether or not it belongs to the reference class. But we do not possess an infinite capacity to imagine all the members of reference class. This is where the context of the question shows its importance. The context helps us narrow down the alternative possibilities. In the story about Adam and Eve, we are interested in knowing why it was the apple that Adam ate, and not any other particular fruit, because God had allowed Adam and Eve to eat all kinds of fruit except the apples. He had explicitly forbidden them to eat the apples from the tree of wisdom. But Adam ate the apple because Eve convinced him to do so after the snake had tempted her to taste it. They ate the apple, rather than any other unspecified fruit, because by eating it they would gain wisdom.

Someone might want to argue that the formal-logical model could handle the difference in emphasis by abstracting the logical features from the pragmatic context differently for each way of emphasis. Every reference class would then consist of a set of propositions; most of them would be false, but each of these propositions

⁷ Hansson (1975).

could figure in a formal inference. There are, however, severe problems with such a suggestion, for it is the context, and only that, that determines which proposition is relevant.

Fourth, John Searle has correctly argued that the meaning of every indicative sentence is context-dependent.⁸ He does not deny that many sentences have *literal* meaning, which is traditionally seen as the semantic content a sentence has independently of any context. What he holds is that our understanding of the meaning of such sentences happens “against a set of background assumptions about the context in which the sentence could be appropriately uttered.” Thus, the background does not merely determine the utterance meaning whose context dependence may, like indexicals, already be realised in the semantic content of the sentences uttered. Also an extensive background of assumptions, practices, habits, institutions, traditions and so on determines the literal meaning of sentences. The background consists of a network of assumptions and, as Searle maintains, such background assumptions cannot be made entirely explicit as a determinate part of the truth conditions of the sentence. Rather the truth conditions of the sentence will vary with the variation of the background assumptions. These cannot be turned into objective implications of the sentences in question, and therefore cannot form part of the semantic content.

Searle illustrates his point using the example: “The cat is on the mat.” Any assertion of this sentence logically implies the presence of a cat and the existence of a mat. A basic assumption, which is not implied but tacitly presupposed, is that there is a gravitational field defining *up* and *down*. The sentence is true only if the mat supports the weight of the cat. A space-cat, travelling in outer space under weightless conditions, would be no more on the mat than the mat would be on the cat. But the existence of gravity does not follow logically from the notion of “being-on.” (Even a person without any knowledge of gravitation would have no problem of understanding the meaning of the sentence.) Searle’s point is that any attempt to make the basic assumption part of the explicit content of the sentence would not help. For such an explication could then be extended endlessly since there will be no logical point to stop. For instance, the solidity of the cat, the mat lying horizontally, and the firm ground supporting the mat, are also among the assumptions which then had to be included in explication. In fact, sometimes the sentence may be true without some of the riders are being satisfied.

The example here focuses on the context dependence of the word ‘on’, but also the words ‘cat’ and ‘mat’ are, if not more, context dependence. We may conclude that a sentence like “The cat is on the mat” does not have a set of truth conditions that uniquely specifies a truth value in a particular situation of utterance unless this set is taken to comprise features whose existence is not logically implied by the sentence.⁹ These features do not invariantly belong to a determinate set of truth

⁸ Searle (1978).

⁹ Collin (1999) criticises Searle for holding that the meaning of a sentence is a function of its truth conditions, but that a sentence only possesses truth conditions given a certain setting. I think, however, that Searle is consistent though not very explicit in his suggestion. As I read Searle, he imagines that the

conditions of the sentence, and therefore are not part of its semantic content, but belong to our background knowledge of a non-linguistic kind.

Taking this analysis to be correct, the consequence is that also the meaning of scientific statements contains features that are not part of the semantic content. Hence, any attempt to make a formal abstraction from the pragmatic context, as Hempel had in mind, in order to establish an objective model of explanation, is doomed to fail. Even though they are understood literally, the meanings of the explanans and of the explanandum are always relative to a set of background assumptions. The truth is not fixed with respect to a determinate and invariant set of truth conditions. It presupposes conditions that are only determinable with respect to the actual situation in which the explanation takes place and which therefore cannot be taken into account by a formal-logical model. These conditions are often buried in *ceteris paribus* clauses. Generally, they reflect the explainer's background, i.e., her interests, beliefs, assumptions, practices, habits, institutions, and traditions.

Fifth, many explanations take the form of stories. Arthur Danto has argued that what we want to explain is always a change of some sort.¹⁰ When a change occurs, we have one situation before and another situation after, and the explanation is what connects these two situations. This is the story. We have a beginning, the middle, and an end. Indeed, this model of explanation does not only reflect complex historical-intentional explanations, but causal explanations fit in as well. A wooden farmhouse lies on the plain, when lightning strikes the house and flames consume the house. The change is taken to be the cause that explains why a new situation follows the original, where the new situation is the effect of the change. However, stories are not logical arguments. They are told from a certain perspective, which is determined by the interests and background knowledge of the explainer.

Sixth, a change always takes place in a complex causal field of circumstances each of which is necessary for its occurrence. Writers like P.W. Bridgman, Norwood Russell Hanson, John Mackie, and Bas van Fraassen have all correctly argued that events are enmeshed in a causal network and that it is the salient factors mentioned in an explanation that constitute the causes of that events. For instance, oxygen needs to be present in a certain critical amount for the farmhouse to catch flames, but we normally cite the lightning as the cause. Most of these standing conditions, or other necessary factors, do not interest us, nor do they need to be covered by the answer in order to provide a causal explanation, nor may they be explicable. Rather, it depends on the speaker's interests which of these necessary factors he picks up as *the cause*. The farmer himself may regard the bolt of lightning as the *real cause*, whereas the insurance company may consider a defect lightning conductor as the *real cause*. As van Fraassen aptly sums up, having quoted Russell Hanson with approval:

In other words, the salient feature picked out as 'the cause' in that complex process, is salient to a given person because of his orientation, his interests, and various other

truth conditions of an indicative sentence consist of two parts: One is invariant from one setting to another; this constitutes the semantic content. Another varies from setting to setting. But both contribute to fixing the truth value in a particular setting, i.e. a situation of utterance.

¹⁰ Danto (1985).

peculiarities in the way he approaches or comes to know the problem-contextual factors.¹¹

That we have a tendency to select the salient or the most perspicuous event, e.g., the bolt of lightning, as the explanatory cause, does not only depend on our interest (i.e., how we want the world to be) but it also clings on our general background knowledge as such (i.e., knowledge of how the world is). Imagine, for instance, that a lightning conductor normally protects the farmhouse, but that it has been taken down for replacement. Assume, also, that you know that the plains are a high-risk lightning area and that lightning had struck the farmhouse many times before, but that nothing else had happened due to the effectiveness of the old lightning conductor. In this case you may, in virtue of the known facts, point to the absence of the lightning conductor as the real cause rather than the lightning itself.

Nothing of what has been said here implies that causal explanations are subjective. The causal field as such exists objectively regardless of the fact that all the necessary factors may not be entirely explicable. What it tells us, however, is that there does not exist only one correct way of explaining things, since any correct explanation is still given in the light of the speaker's interest and background knowledge.

We may add a further point to this analysis of causal explanations as being highly context-dependent. It is well known that any counterfactual analysis of causation makes causation very contextual. This is due to David Lewis' and Robert Stalnaker's theories of how to evaluate counterfactuals in terms of similarity between possible worlds. Any appeal to a similarity relation between such worlds is not a purely objective matter. The standards of similarity between possible worlds are selected on a partly subjective basis since they depend on the conversational purposes for which we assert these counterfactual sentences. But even if we, as I personally prefer, say that the idea of causation is a primitive notion and therefore cannot be fully grasped in counterfactual terms, this would not solve the problem of the contextuality of causal expressions as we have already seen. Causal statements still logically imply counterfactuals. One would therefore expect that whatever is contextual about causal explanations will reappear as contextual elements in connection with the assertion of corresponding counterfactuals.

Seventh, the level of explanation depends also on our interest of communication. In science an appropriate nomic or causal account can be given on the basis of different explanatory levels, and which of these levels one selects as informative depends very much on the rhetorical purposes. If a toxicologist tells the jury in a courtroom that the victim died because she had been poisoned by strychnine, he gives the explanation most relevant for this particular purpose. He chooses a level of explanation which is an appropriate account within the judiciary system and which suits the audience's understanding. Had he chosen a chemically more accurate and detailed explanation of why this particular toxin killed this particular person, telling how the molecules of the strychnine had interacted with the cells of the body, the explanation would be on a different level. He would no longer

¹¹ van Fraassen (1980), p. 125.

focus on the causal mechanism of the substance on a living body but on the effects of the molecules of strychnine on the individual body cells. An explanation on this level may be relevant for other toxicologists. Similarly, a physicist might provide a causal explanation on even a lower level trying to give an account of the process on the atomic level. This possibility is indeed only relevant to other physicists.

The question remains, however, whether all these explanations at various levels can be carried out as independent accounts, or whether every macroscopic explanation is in principle *reducible* to a microscopic explanation. In fact, supposing the latter, we must draw the conclusion that the atomic explanation, or the subatomic explanation, is basically the correct scientific account since very other explanation can be reduced to it. Such a view fares well with the formal-logical view. But fails, nevertheless, because we want to have a scientific explanation of what killed the person, and evidently to be identified as a dead body presupposes some everyday conditions. It does not make much sense to describe a dead body in terms of molecules, atoms, quarks or superstrings. The conclusion seems to be that every level of explanation is relevant with respect to certain problem contexts and not with respect to others. There exists not *one* correct explanation. The communicative situation, including the interest of the audience and the descriptive level of the explanandum, determines what is considered to be the appropriate explanans and the communicative situation changes all the time. This corresponds with the pragmatic-rhetorical theory.

Eight, scientific theories are *empirically underdetermined* by data. It is always possible to develop competing theories that explain things differently and, therefore, it is impossible to set up a crucial experiment that shows which of these theories that yields the correct account of the data available. The Bohmian theory of quantum mechanics is, for all we know, empirically equivalent with the orthodox quantum mechanics, although each gives a very different picture of the quantum world. The former is a deterministic theory and explains quantum phenomena in terms of hidden variables, whereas the latter is an indeterministic theory that explains everything probabilistic in terms of observables.

The various reasons outlined above place explanation within the domain of the erotetic practice of science. Explaining a phenomenon amounts to answering a question, in particular a why-question. But the formal-logical approach completely ignores such an interrogative perspective. It does so because it does not realise that even scientific explanations rest on other than scientific conditions. A scientific explanation reflects a certain understanding of the context, including the questioner's interest, and encapsulates many everyday presumptions that form our background knowledge.

1.3 *Explanation as Speech Act*

From the examples discussed above, it should be clear that scientific explanations as such cannot be grasped in terms of formal logic or semantics. Explanation comprises an important pragmatic dimension, which cannot be ignored since it forms an essential part of a complex understanding of explanation. This

dimension is important because explanation is an appropriate answer to an explanation-seeking question and pragmatic elements like intention and the context determines what counts as an appropriate answer.

This kind of insight is also what drives Peter Achinstein in his understanding of explanation as a speech act. He argues that explanation can be understood as a process or a product. The product is the content of the linguistic performance that the person makes while producing an explanation. But he also holds that the process concept is primary, because any characterisation of the product must take account of the intention behind the explanation. Hence, he calls his account *the illocutionary theory*. Says Achinstein, "Explaining is what Austin calls an illocutionary act. Like warning and promising, it is typically performed by uttering words in certain contexts with appropriate intentions."¹² While this approach escapes some of the problems we saw in Gärdenfors' and Sintonen's cognitive theories, it, too, fails to answer certain central points, specifically on fleshing out what such notions as the explanatory context and intentions really mean. Is it possible to say something more precisely about the intentions and the context?

In the process of developing his illocutionary view Achinstein lays down two aspects of explanation:

If *S* explains *q* by uttering *u*, then *S* utters *u* with the intention that his utterance of *u* renders *q* understandable.

If *S* explains *q* by uttering *u*, then *S* believes that *u* expresses a proposition that is a correct answer to *Q*.¹³

Oddly, this preliminary formulation overlooks that an illocutionary act is always directed towards somebody. *S* explains *q* to an audience. Thus, the kind of intention the speaker *S* has is to make a certain fact *q* understandable to an audience.

What is problematic is the notion of understanding if it is to add anything new to our concept of explanation. If "understandable" means raising the probability of the belief concerning the fact to be explained, then we are not better off with Achinstein than with Gärdenfors. But this is not what Achinstein has in mind. He gives the following definition of understanding:

A understands *q*, [if, and] only if there exists a proposition *p* such that *A* knows of *p* that it is a correct answer to *Q*, and *p* is a complete content-giving proposition with respect to *Q*. (Here *p* is a proposition expressed by a sentence *u* uttered by *A*.)¹⁴

¹² Achinstein (1983), p. 16.

¹³ Achinstein (1983), p. 16-17.

¹⁴ Achinstein (1983), p.42. The quotation expresses only a necessary condition but later he takes it to express a sufficient condition as well (p. 57)

An example may illustrate the idea. Consider the fact that Nero played his fiddle after he had set Rome on fire. The question would then be “Why did Nero play the fiddle?” and a straightforward complete content-giving proposition with respect to this question is “The reason Nero fiddled is that he was happy.”

How shall we understand the phrase “to be a correct answer?” A correct answer is, according to Achinstein, one that has to be *true* as well as *relevant* to the question. I wish to argue, however, that Achinstein makes a serious mistake by thinking of explanations in terms of *correct* answers. My objections to his view are the following: First, a person *A* may understand *q* regardless of whether she knows the correct answer that explains the existence of *q*. Second, *A* may believe that *p* is a correct answer to *Q*. In many cases, however, we cannot say that she knows that *p* is true, and therefore that *p* is a correct answer. Third, what establishes that *p* is a relevant answer to the question *Q*? It cannot be that *A* knows that *p* is a correct answer to *Q*. This would be highly question begging as Salmon pointed out.¹⁵ And, as mentioned above, *A* need not know whether *p* is true anyway. Fourth, there may be no single complete content-giving proposition with respect to *Q*. If there can be many such propositions, which one should we then choose and on what conditions?

Salmon suggested instead that there must be a causal mechanism that provides us with an objective relevance relation. But not every explanation is a causal explanation and even causal explanations consist only partly of a description of an objective relationship. Hence, such a relationship can only be one of several constraining factors that may determine the relevance of a given answer. Explanation is an act of communication. It is goal-oriented and context-bound, so we cannot understand the relevance of the explanatory content without having knowledge of the goal and the context involved.

1.4 *The rhetorical situation*

An explanation is, I shall argue, an answer to an explanation-seeking question that the explainer puts forward in a problem context whenever she has the intention of solving the inquirer’s problem with her information-giving answer. Avoiding any accusation of posing a question-begging definition, it must then be possible to define an explanation-seeking question independent of what we mean by explanation. *I hold an explanation-seeking question to be a question that expresses an epistemic problem.* This does not suffice, however. Not knowing the time is a cognitive problem for the person who must be at a business meeting at a certain hour. But asking somebody what time it is, is asking about a fact not about an explanation of a fact. We must be able to avoid cognitive problems of this sort. Thus we may add a further requirement. The epistemic problem must be brought to an end when the question is answered with reference to other facts, and when this connection, by being brought to the questioner’s attention, improves her understanding of the fact mentioned in the question. I think these remarks will do for now.

¹⁵ Salmon (1989), p. 148.

We have also pointed out that the context of the problem in which the respondent utters his answers is insufficient to catch the notion of explanatory relevance. Besides the problem context the notion of explanatory relevance also relies on interests and perspective. Thus, an explanation is a communicative act depending on the intention of the explainer, the problem of the inquirer, the background knowledge and interests of both the explainer and inquirer, and not least the facts of the matter that provoked the problem. Taken together these various elements create a certain rhetorical situation that I shall name the explanatory situation.

The notion of the rhetorical situation was made famous by the American rhetorician Lloyd F. Bitzer who in 1968 set out to characterise situations that invited a discursive response. Bitzer argued that rhetorical situations are governed by exigencies, that is, urgencies that call upon a speaker to address an audience capable of modifying the urgency if persuaded to do so. In the case of scientific explanation I think that these exigencies can be identified with the epistemic problem. According to Bitzer:

A work of rhetoric is pragmatic; it comes into existence for the sake of something beyond itself; it functions ultimately to produce action or change in the world; it performs some tasks. In short, rhetoric is a mode of altering reality, not by the direct application of energy to objects, but by the creation of discourse which changes reality through the mediation of thought and action. The rhetor alters reality by bringing into existence a discourse of such a character that the audience, in thought and action, is so engaged that it becomes mediator of change. In this sense rhetoric is always persuasive.¹⁶

This is exactly why I take explanation to be a work of rhetoric. The aim of an explanation is to induce new beliefs in the person who asks an explanation-seeking question. Moreover, I think that we cannot understand the notion of explanation unless we take its intended functions into account.

Bitzer maintains that the rhetorical situation consists of three elements prior to any discourse: 1) the *exigence*; 2) the *audience* to be constrained in decision and action; and 3) the *constraints* that influence the rhetor and can be brought to bear upon the audience.¹⁷

Any *exigence* "is an imperfection marked by urgency; it is a defect, an obstacle, something waiting to be done." There are numerous exigencies, but the only rhetorical ones are those that can be modified or changed. Also, a rhetorical exigence must be modified only by means of a discourse; other forms of changes are not rhetorical. Bitzer claims, moreover, that in a rhetorical situation there will be a least one exigence that controls and organises the situation: "it specifies the audience to be addressed and the change to be effected." Next is the *audience*. A rhetorical discourse requires an audience because a rhetorical discourse is one that can influence people to chance and thereby to make decisions and actions. Finally, in every rhetorical situation exists a set of *constraints*. These constraints are created by

¹⁶ Bitzer (1968/1999), p 219.

¹⁷ Bitzer (1968/1999), p. 220 f

persons, events, objects and relations that have the power to confine the decision and the action necessary in order to change the exigence. Bitzer mentions beliefs, attitudes, documents, facts, traditions, images, interest, and motives as some of the main sources of constraint. In addition to these, the orator brings in further constraints, apart from the manner in which his discourse harnesses the constraints already given by the situation, that is, his own personal character, his logical proofs, and his style. But just as important constraints, I may add, are the orator's background knowledge and his entire worldview.

How does the rhetorical situation help us to understand explanation, in particular scientific explanation? In fact, Bitzer denies that scientific discourse requires the same kind of audience as a rhetorical discourse. He argues that science does not need an audience to produce its ends since scientists can produce a discourse expressive and generative of knowledge without engaging another mind.¹⁸ I think, however, that this statement conveys a superficial understanding of the scientific discourse. First and foremost because science is a highly social enterprise. I agree that a single scientist can establish empirical knowledge without engaging an audience. She may observe a lot of low-level scientific facts such as that a mercury column, at the same temperature, is higher at the sea level than at the top of Mount Blanc. But a scientific explanation is usually not the result of observable knowledge. It most often expresses some hypothetical beliefs because, in general, scientific explanations appeal to invisible facts that the explainer believes explain the phenomenon in question. The scientific community as a whole must accept any such theoretical assumptions to elevate them to scientific knowledge.

It goes without saying that an explanation always has a proper audience, namely at least that person who originally raised the explanation-seeking question. Bitzer defines his rhetorical audience as persons "who are capable of being influenced by discourse and of being mediators of change." This description fits the inquirer, also if she is the same person as the explainer. The answer she eventually produces changes her beliefs or modifies her state of mind from ignorance to knowledge. During this process the scientist will bring her explanation to a larger forum. Through journals or conferences she will express her response to a certain question to her fellow scientists, who may have asked the same question and struggled with finding a proper explanation. In the end, if she is successful in convincing them of her suggestion, it is not only her mind that has undergone changes but the entire scientific community's.

What then can we say about the rhetorical exigence? Bitzer sees it as an imperfection that specifies both the audience to be addressed and the changes to be made by the discourse. In the case of explanation the rhetorical exigency is the lack of knowledge, which a person signals openly when asking why *P*. This both controls and organises the situation. A person's lack of knowledge is an imperfection that can be remedied in virtue of an explanatory response. And the question points to the person who is the primary object of explanation.

Indeed, giving a reason why something is the case is constrained in several ways. It seems that every constraint that confines ordinary explanation can also

¹⁸ Bitzer (1968/1999), p. 221.

influence a scientific explanation proper. First, the explanatory situation is constrained by the fact of the matter. To be successful as a scientific explanation the response to a why-question cannot deny or ignore obvious facts. Second, the contrast class also constrains the explanatory situation. The actual explanation should be more probable than any other explanation in terms of the contrast class. The explainee will not be convinced of the response if it is far-fetched with respect to what else she believes; that is, if the response appeals to assumptions that are not part of the common scientific background into which she has been trained and socialised. There are exceptions, of course. She may convince herself if new theoretical considerations or new empirical evidence support such an explanation. But also her personal beliefs, interests and perspective play a role in producing a response, or accepting a response, as the explanation. Alone the fact that an explanation cannot bring in all the appropriate facts at once makes an explanation a result of a selection. But we should also remember that explanations can be empirically underdetermined and that it may be impossible to select the best explanation among different theoretical proposals. Likewise, a constraining factor can be what kind of actions the inquirer may want to take on the explanatory information. In general, we may say that the explanatory situation must meet the requirement that the response to an explanation-seeking question is relevant, but what counts as relevant features are not merely objective facts, but social and personal facts as well.

Thus thinking of explanation as a rhetorical discourse helps us to grasp the essential notion. The explanation is called into existence by a situation: the situation which an explainer understands as an invitation to create and present an explanation. We have called this *the explanatory situation*. Furthermore, not every response will do since not every response fits the explanatory situation. It must be a fitting response; it has to be relevant in the sense that it has to provide the wanted information. Seeing a situation as one that invites a fitting response makes sense only if the situation itself somehow prescribes the response that fits. A response has to meet the requirements of the situation, which are partly objective and partly subjective.¹⁹ The exigency, which generates the need for an explanation, is an epistemic problem of why something is the case, and the explanation is meant to give the solution to this problem. The person who formulates the problem may also address and solve the problem, but the explanatory situation requires that such a solution is always formulated in terms that can be understood and communicated to other scientists who struggle with the same problem. Most often someone within the community raises a question and somebody else answers it.

¹⁹ Bitzer takes a strong realist stand on the rhetorical situation by saying: "The exigency and the complex of persons, objects, events, and relations which generate rhetorical discourse are located in reality, are objective and publicly observable historic facts in the world of experience, are therefore available for scrutiny by an observer or critic who attends them. To say the situation is objective, publicly observable, and historic means that is real or genuine – that our critical examination will certify its existence." (p. 223). This is at the same time a meta-rhetorical stand. The rhetorical situation itself may contain features which belong to the perspective of the persons involved in the discourse and which may not be publicly observable. These features exist nevertheless and may be revealed by other means.

1.5 Explanatory relevance

An important requirement of an explanation is that the response to an explanation-seeking question is relevant. An answer that is considered irrelevant does not function as an explanation. What then establishes explanatory relevance, and how much does it depend on the problem context? It seems that no single feature characterises explanatory relevance, but that formal, semantic, methodological and pragmatic elements of the explanatory situation play a role in the way it suits the response. The features I am talking about are descriptive as well as normative. We may say that relevance is always measured against the explanatory situation including 1) the background of the inquirer, 2) the epistemic problem revealed by the interlocutor, and 3) the objective state of affairs, which has generated the epistemic problem.

The background of a scientific inquirer contains metaphysical beliefs, theoretical assumptions, empirical knowledge, practical skills and social training, as well as cognitive and methodological values. Different such inquirers share to a large extent the same beliefs, practices and values, but some of them may vary from scientist to scientist. For instance, scientists have different metaphysical views on the world and this will influence what they take as a relevant response. Einstein never accepted quantum mechanics as an adequate theory of atomic processes because he believed that the world was deterministic, whereas Bohr did not share the same predilection for determinism. He considered quantum mechanics as the only proper account of atomic phenomena.

A similar difference may exist between methodological values. Among them we find simplicity, accuracy, consistency, inter-theoretical unity and coherence, and fruitfulness. Thomas Kuhn correctly pointed out that methodological values are vague and that different scientists may apply them differently, but even if they did not, these values would sometimes be in conflict with one another.²⁰ Some scientists prefer a more accurate explanation, while others look for explanations having a broader perspective and better explanatory resources. Kuhn's example *par excellence* was what happened when astronomers had to choose between the geocentric and the heliocentric explanation of the planetary movements before Kepler added his laws and Newton came forward with his classical mechanics. The geocentric explanation had its spokesmen because it was in agreement with the current physics of that time. But others gave their support to the heliocentric explanation since it was overall simpler than the geocentric explanation.

Two scientists may share the same methodological values; they may apply them in the same way, and put them into the same hierarchy of importance in case of a conflict. Nevertheless, they may disagree with respect to the relative weight these values have in those cases where the values work together. Still, they may agree on everything concerning these methodological values and prefer different explanations, assuming that the accounts given as a proper response are empirically underdetermined. So apart from common criteria of relevance, which scientists share due to their scientific training, we also find individual criteria. These rely on the

²⁰ Kuhn (1977).

scientist's previous experience, the type of work she has done until the time of inquiry, whether she has had success within her earlier field of work, the kind of concept and techniques she masters, and so on. Some scientists may prefer mathematically developed explanations; others seek more visualisable accounts. Among the individual criteria figure non-scientific values too. Kuhn argued, for instance, that the young Kepler accepted that the heliocentric explanation gave a relevant account of the planetary movement because he was occupied with hermetic and Neo-Platonist thoughts at that time.

The second feature of the explanatory situation, which determines that the response is relevant as an answer, is *the problem* that creates the question. The scientist understands a lot of facts, but in relation to these facts there is perhaps something that she doesn't understand, and an explanation is relevant only if it can provide information about what she is missing. But the response is adequate not only with respect to what is informed but also with respect to how it is told. She may not understand why a certain phenomenon exists, why a certain anomaly appears, and she will ask for an explanation that reflects the kind of epistemic problems she has. The nature of this problem points to *the genre of explanation*, that is, points to which format a response must take to be considered relevant. Here we find explanatory genres such as nomic, causal, probabilistic, functional, functionalist, structural, intentional, and interpretative explanation. All are responses to why-questions but it is the particular problem in question that prescribes the relevant genre.

A scientist may want to understand why a particular event occurs; hence a causal explanation, in which one appeals to the cause of this event, will be that kind of account which is relevant for getting to such an understanding. Another scientist hopes to grasp why a certain property helps an organism or an artefact to be successful. Here an appeal to its actual effect, instead of an appeal to its cause, may be considered relevant to gain the appropriate understanding. The effect is not intended to explain why this particular feature exists, but to explain what the particular function of the feature is, and therefore why it helps the object possessing this feature contributes to the object's existence. The same is the case when it comes understanding people's actions. The epistemic problem is to get to know why they did as they did. We usually perceive people to have motives for fulfilling certain goals, and we see their actions to be the means of realising those aims. Hence a social scientist will regard as relevant a response which explains the action in relation to the intended effect, the goal, and not the actual cause, the motive.

Likewise, the *real world* constrains the explanatory situation and thereby determines the relevance of the explanatory discourse. All serious requests for knowledge are formed as information-seeking questions, and an answer to these questions, if the answer does not merely consist in stating a fact, gives us explanation. Thus, explanations are answers that provide information of a fact by relating it to other facts. But again not every fact will do, nor every form of a relation.

If a response reflects a fact, which by no means could have had any *real* relation to, or any influence on, the fact whose existence gave rise to the question, the response will not be relevant and therefore not be an explanation. I have, for

instance, previously argued that it is fully legitimate to claim that certain patterns in the English cornfields, which have been reported now and then, are due to beings from outer space. Such an answer is relevant, although highly improbable, as an explanation because it refers to something that could make such patterns in case it was real and had visited the earth. Facts like the height of the Eiffel tower, the date of my birth, that some mammals lay eggs, or that supernovas are exploding stars, cannot figure legitimately in a response, if the answer should count as an explanation. They do not belong to the right ontological categories that can stand in the appropriate connection to the cornfield patterns. In other words, an answer is only to be considered as an explanation if it does not commit a category mistake.

Among the explanatory relation the causal connection seems to be by far the most effective. It is not spurious, it is real, and it is observable. The explanatory virtue of causes is that causes exist in the world, they connect facts or events together, and that we think of the cause as what brings about the effect. Because of these features any answer that appeals to a cause is taken to be highly relevant and therefore to provide an explanation of the effect. But we have to remember two things: causes take place in a network of circumstances and no single fact or event among those constituting this network is objectively *the* cause. It is the entire network as such that constrains the explanatory situation, while we select those we find most interesting. Furthermore, there are other real relations than causal relations that can constrain the explanatory situation and condition the answer to be an explanation. Not every relation in nature is a causal one. And in a world of structures, functions, meanings, rules or interpretations there are other kinds of relations that play the same kind of constraining factors. The exigence of the explanatory situation in these cases is the lack of knowledge concerning them. Beneath these relations we may find causal one, but this would be irrelevant as long as our cognitive goal is to get to know things in terms of their structures, functions, meanings, rules, and interpretations.

1.6 *Explanatory force*

What gives an explanation its force to explain a certain fact? An explanation consists of a description of the event to be explained and of the events that are invoked to account for it. The explanans itself is only an explanans *relative to* the explanandum: it is towards that its explanatory force is directed. The question is whether very explanans must stand in the same kind of relation to its explanandum in order to be explanatory? Let us see what the rhetorical-pragmatic theory has to offer on this issue.

Before we proceed an important distinction has to be made. We must distinguish between *explanatory relevance* and *explanatory force*. The former notion means that the explanatory answer fits the explanation-seeking question in the sense that there exists an appropriate thematic connection between the two. Whether the accessible information is seen as relevant or not is determined, as we have seen, by our background knowledge, our interests, and the nature of the epistemic problem. The latter notion, however, reflects the fact that an answer is successful in getting the

interlocutor to believe it answers her question and therefore that the facts are as stated by the explanation.

The pragmatic-rhetorical view holds that logic alone cannot account for explanatory force. The formal-logical approach takes the explanatory force to consist of the inferential link between the explanans and the explanandum. If the explanans logically entails the explanandum, then and only then does the explanans have the power to explain the explanandum. It assumes that there is a logical fact of the matter which gives an explanation its explanatory force, and whenever the interlocutor grasps this objective state of affairs, she understands how and why the explanation explains. But we have already argued that there is no such deductive link between a theory, a set of propositions, and those propositions that state the facts we want to explain. And even if there were such an inferential connection, fundamental laws could still not explain anything because they do not describe the real world.

The pragmatic-rhetorical theory also insists on the issue that truth has little, if anything, to do with explanatory force. Nor has truth anything to do with explanatory relevance. A theory of explanation should be able to specify what an explanation is regardless of whether it is true or false. Truth is definitely not sufficient because the explanans is never true, if it is true, relative to the explanandum. Nor does truth seem to be necessary.

Looking into the history of science we see more often than not a hypothesis be promoted as yielding an appropriate explanation of observed facts, a hypothesis that later turns out to be false. Among today's assumptions, which scientists acclaim, many will probably be false too. In spite of their falsity they are nevertheless thought of as vehicles of genuine explanations. False hypotheses are the rule, true ones the exception. Hence, truth cannot be a necessary condition either.

As long as the scientific community thinks of a theory as true, nobody has problems with the suggestion that it can explain what it has to explain. However, no one wants a false explanation because it gives us wrong and useless information, which will mislead us if we want to take action based on this information. So, eventually known to be false, scientists then reject the theory as what gives us the wanted explanation.

So truth in itself may not be necessary for explanation, but what may be necessary is the *belief* that the explanation is true. Undoubtedly we often acknowledge something as an explanation, even though we know that it is false. We do so because we see the answer as relevant for the explanation-seeking question. For instance, Lamarck's suggestion that acquired attributes could be inherited in a new generation was used to explain the development of the biological species. After Darwin, biologists have accepted this hypothesis to be false; however, they may still maintain that it is but a *wrong* explanation. This and many similar cases indicate that we can accept a response to a why-question as a possible explanation without this acceptance being accompanied by a belief in its truth.

Again, we may come up with a distinction between *look-alike* explanations and *proper* explanations in order to say that potential explanations are only look-like explanations. In real life, lying to his wife about the lipstick on his collar, a man may

tell her that the bus had stopped very abruptly, and a lady's face had bumped into his shoulder. He knows that it is not true, and she does not believe him. She thinks of it as explaining away things. It appears as an explanation, but is it a proper explanation? In other words can a response to a why-question show itself as an explanation without being one? Intuitions concerning this point seem to be divided. In case one holds that a belief in the truth of the response is required to have a proper explanation, the man's lie does not count as such.

Assuming that look-alike explanations are not different from proper explanations, we must then be able to specify what makes such responses be like proper explanation. Look-alike explanations and proper explanations must have some essential feature in common. What is it? Both provide reasons why something is a fact. This must be the form of a causal story. The man appeals to a possible, causal connection between the lipstick on his collar and an imagined episode on the bus, hoping that his wife then would believe him. In other words, his response is relevant in virtue of its reference to this possible connection, although it is false and his wife does not believe him. Hence, it seems justified to say that any relevant response to an explanation-seeking question is an explanation.

Accepting this analysis means accepting that an explanation is a response that is considered to be relevant for an explanation-seeking question. So an explanation may lack explanatory force. The man could speak the truth, or he may tell a lie, in both cases his explanation would not be successful in explaining the fact. As long as his wife doesn't believe him, the explanation has not fulfilled its purpose. She refuses to embrace the explanation not because she doesn't see it as relevant, but because she has not been convinced that things are as she is told. I don't think it discounts the discussion to think that she has no problems imagining things happening as stated in her husband's explanation. But she possesses no evidential support and may instead have counter-evidence like love letters to her husband from an unknown woman, disrupted phone calls, etc. What is missing and what would make the explanation successful is her trust in her husband. The man has lost his authority as an explainer. The wife therefore thinks that the explanation is very implausible, although she deems it to be an explanation.

Thus, an explanation has, as an act of rhetorical discourse, the force of explaining a fact if, and only if, it can persuade the audience to think of it as being correct. Its ability to convince an audience rests on both the explanatory relevance and the explainer's ethos. An explanation has explanatory relevance in relation to the problem context it addresses. But this is not sufficient to make the explainee believe that things are as the explanation says they are. If an explanation is successful or unsuccessful in explaining the facts in question, it is partly due to the rhetorical situation, which includes the explainer's ethos.

Also in science do people sometimes accept explanations because of the explainer's ethos. It is well known among historians of science that an experiment or an assumption will be given more credit than it deserves in case a famous scientist supports it. Even a wrong formula may find long time acceptance in the scientific community only because of the reputation of the person(s) who made the calculation. A couple of years after the advent of the relativity theory, several physicists, among them Max Planck and Albert Einstein himself, produced

separately a formulation of the thermodynamical laws in accordance with the special principle of relativity. Their treatment was adopted by many textbooks over the years until H. Ott as late as 1963, and independently H. Arzeliès in 1965, discovered that the old formulation was not satisfactory. In particular this was so because Planck and Einstein had used generalised forces instead of true mechanical force in the description of thermodynamical processes.²¹

In his discussion of this very instructive example of how the explainer's ethos plays a role in the audience's belief in her explanation, Møller describes the laws of relativistic thermodynamics in terms which neither fits the formal-logical nor the ontological approach. Let me quote at length:

The papers by Ott and Arzeliès gave rise to many controversial discussions in the literature and at the present there is no generally accepted description of relativistic thermodynamics. This is because many different formulations of the thermodynamical laws are possible, since the principle of relativity alone does not determine them uniquely. In fact, from this principle we may conclude only that the classical laws of thermodynamics are valid in the momentary rest system S^0 of the matter, independently of the motion of this system with respect to the fixed stars. However, there is a wide spectrum of possible ways of describing relativistic thermodynamics in any other system S , since the basic laws may be assumed in a rather arbitrary way to depend explicitly on the velocity of the matter relative to S . In this situation we must have recourse to arguments of simplicity and convenience.²²

Thus, Møller maintains that the selection of a relativistic thermodynamics is empirically and theoretically underdetermined and which of the many possible formulations one prefers, depends on methodological and pragmatic criteria such as simplicity and convenience. Again we see an illustration of the fact that there is not one correct covering law, and therefore not only one explanation.

1.7 *The logic of explanation*

Looking in *Oxford English Dictionary*, one will see that the verb "to explain" is given two, seemingly different meanings. The term means either to make something plain or clear or to give or be a reason for something. This distinction reflects the difference between description and explanation. So we have description-giving explanations and reason-giving explanations. These different kinds of explanation seem to correspond to different types of questions. The description-giving explanation would be the result of a how- or what-question, whereas reason-giving explanations are responses to why-questions. But things are not so obvious and straightforward, as they seem to be.

²¹ Møller (1972), p. 107, 219, and 232 f. for details and further references. Møller also used the old formulation in the first edition of his book that was published 1952. For instance, the Joule heat developed in the electric body per unity of time and volume with respect to a moving frame S would in the old formulation be expressed as $\varphi^0(1-u^2/c^2)^{3/2}$, whereas in the new formulation it becomes $\varphi^0/(1-u^2/c^2)^{3/2}$.

²² Møller (1972), p. 233.

There can be no doubt that the appropriate answer to every why-question is a reason-giving response. This is the essential feature of the logic of discourse to which a why-question is subjected. Consider a question like:

(1) Why do some birds *migrate* to Africa in the autumn?

An appropriate reaction to this question is to say:

(2) The reason that some birds migrate to Africa in the autumn is that they would not be able to find food during the winter in Europe.

The question and the answer only make sense, of course, within the broader context of the geography of the Earth and the annual climate changes on the Northern Hemisphere. In fact, the answer that cites the lack of food is no more relevant than one that refers to the lack of daylight, cold temperature, or snow coverage. All these facts are parts of the same overall causal story where the lack of food is the perspicuous result.

Another appropriate answer is:

(3) The reason that some birds migrate to Africa in the autumn is that they have an instinct to do so.

This answer (and question) requires an even broader context, including the biological evolution and selection, to make sense.

I think that it is because the stated reason in either (2) or (3) is meant to *justify* the existence of a puzzling fact (the migration) that explanations are often only associated with responses to why-questions. It is this element of justification connected with stating a reason that intuitively get people to think of explanation as a reason-giving answer and, therefore, being an answer to a why-question.

I have previously argued that scientific explanations may be reactions to other kinds of questions than why-questions such as how- and what-questions. Already William Dray and Michael Scriven²³ noticed this, but also Sylvain Bromberger and Peter Achinstein and the late Wesley Salmon²⁴ have denied that all explanations are answers to why-questions. Furthermore, I have argued that the distinction between description and explanation is concerned with pragmatics, neither with logic nor semantics. I shall briefly elaborate on these issues.

Indeed many requests of knowledge in terms of a how- and a what-question can be re-phrased as a why-question. A what-causal question as

(4) What causes some birds to migrate to Africa in the autumn?

²³ Scriven (1962), p. 173-174.

²⁴ Salmon (1989), p. 138.

can be replaced by (1). Hence (2) and (3) are both possible answers to (4). But also a what-question such as

(5) What do you mean?

may be reformulated as

(6) Why are you saying so?

But it is not every how- or what-question that can be translated into a corresponding why-question without a loss of meaning. Again, it is the context that decides.

The translation-argument does not settle the debate. We have to show, one may argue, that it is impossible to find any why-question that matches the response. The important issue is whether or not a response to a how- or a what-question can always be construed as if it also were a response to a why-question. A positive claim does not hinge on the claim that non-why-questions cannot be constructed for explanatory answers nor that these explanation-seeking non-why-questions are somehow disguised why-questions. The suggestion is only that if a proper answer to, say, a how-question should count as an explanation, you must also be able to find to this answer a matching why-question. In other words, the claim is that it is necessary that an explanation is a *potential* response to a why-question; however, it is not necessary that it be an *actual* response to a why-question.

The idea behind this suggestion is that an explanation is identical with an answer to all kinds of *wh*-questions as long as it states a reason. Therefore, it must always be possible to find a why-question that matches the reason-giving answer. Consider the following question:

(7) How do birds from the Northern Europe actually *migrate* to Africa?

This how-question cannot just be replaced with

(8) Why do birds from the Northern Europe actually *migrate* to Africa?

These two modes of questions mean something different. The how-question asks for the *actual manner* in which birds migrate, whereas the why-question asks for the *actual reason* why birds migrate. In both cases the inquirer's emphasis determines that it is the migration which the answer should inform about. The straightforward, but highly relevant, response to this how-question would be that birds do fly (instead of walking, swimming, etc.), whereas the proper response to the why-question cites the lack of food in Northern Europe during the winter (instead of the lack of daylight, cold temperature, snow coverage, etc.). Thus, since the answer to (7) does not contain a reason, it cannot be an explanation.

It has been recognised by several authors that *how-possibly* questions are genuine explanation-seeking questions. Take a question like:

(9) How is it possible for birds to migrate to Africa?

At the first sight (9) expresses that a person who poses the question is under the mistaken impression that the occurrence is physically impossible or highly improbable. This is Hempel's interpretation. But there are several other adequate interpretations. The correct understanding depends on the explanatory situation. The question may, for instance, just as well render, not the person's disbelief, but her lack of knowledge concerning what kinds of properties birds have that allow them to be heading in the right direction. The intended meaning of the question is then something like "How do birds find their way to Africa while migrating?" or "How are birds able to navigate their way to Africa?" The relevant answer to this question depends on whether the birds are only nocturnal migrators, only daylight migrators, or both. The response may therefore refer to the birds' internal star mappings, or their magnetic sense, and/or their ability to correct the course by the sun as well as by landmarks. One answer is

(10) The reason that it is possible for nocturnal migrators to migrate to Africa is that they can navigate with the help of the stars.

Here we can easily find a why-question that matches this response to (9):

(11) Why is it possible for birds to fly straight to Africa?

Another possible interpretation of (9) would be that one saw the question posed in an explanatory situation in which the person had been thinking of the distance between Northern Europe and Africa:

(12) How are small birds able to fly such a long journey?

In this case (10) would no longer be an appropriate response. Instead an answer such as

(13) The reason that it is possible for birds to migrate the long distance to Africa is that they can find enough food while resting,

would reflect the intentions behind the question. Again (13) is an appropriate response to the following why-question:

(14) Why is it possible for birds to travel the long distance to Africa?

Thus, any satisfactory answer, also those to how-possibly questions, gives us the reason for birds finding Africa, and as a consequence, it seems, it is possible to find an appropriate why-question that corresponds with the how-possibly question.

Let us return to the how actually-question. But let us look at another example taken from Salmon. Instead of (7) we could say

(15) How did mammals (other than bats) come to be in New Zealand?

The answer to this question is that human beings came in boats and later imported other mammals. Salmon regarded this answer as a genuine scientific explanation. It is not an explanation of why they came there, but an explanation of how they got there. Thus (15) cannot be reformulated as

(16) Why did mammals (other than bats) come to be in New Zealand?

Here an appropriate response is

(17) The reason that mammals came to be in New Zealand is that people wanted to use them except for mice and rats,

whereas the proper response to (15) cannot be expressed as a reason-giving answer. Does this mean, then, that a story about how mammals came to be in New Zealand does not count as an explanation? Salmon said no, but he never told us why.

Some may hold that answering a how actually-question merely gives us a description, because such a response does not provide us with a reason as answering of a why-question normally does. In my opinion such a reply is wrong. It is correct that only a response to a why-question (or a matching what-causal or how-possibly question) yields a reason. If one thinks of explanation in terms of giving reasons, then answers to how actually-questions cannot act as explanation. The case is closed. But if one takes an explanation to be an answer that has been selected from on a huge repertoire of possible responses, then the case is still open.

I think that many answers to how- and what-questions, which cannot be replaced by a why-question, function as genuine scientific explanations. Think of responses to questions like “How did the Universe begin?” “How did the Egyptians build the Pyramids?” and “What kind of chemical bond connect Na-atoms and Cl-atoms?” In every case of explanation, we explain one fact by relating it to another fact in contrast to a whole class of possible facts, i.e. the contrast class, in which each member might have been mentioned in an alternative explanation. An answer counts as an explanation in the explanatory situation because it is informative in virtue of the fact that other answers are possible.

When, in some rhetorical situations, we think of an answer to a how- or a what-question as a description but in others rather as an explanation, it has something to do with whether or not the question poses an enigma. And whether it constitutes a riddle depends on our background knowledge. The answer to (7), that birds fly, is seen more as a description than an explanation, because it is part of common knowledge that nearly all birds fly, and this is how they prefer to move around over longer distances. This is not something which science has discovered. This is something we know. How birds migrate does not normally represent an epistemic

problem to anybody. We are quite certain that we will never discover that migrating birds don't fly. But, again, the question could signal the presence of a real epistemic problem in the context. Other answers to (7) are possible, responses which we may then take to be explanations. What I have in mind is those explanatory situations where the person who asks the question wonders about whether or not birds migrate in all kinds of weather, flying day and/or night, making stops or flying non-stop, etc. If (7) expresses an epistemic problem, an appropriate answer relies on scientific investigation, and the result of this investigation is the subject of the explanation.

Accordingly, the answer to (15), namely that human beings came in boats and later imported other mammals, functions as a scientific explanation. Here the information provided by the answer is not part of common knowledge. How mammals came to New Zealand represents an epistemic problem, not merely to a single person but to the scientific community as a whole. The information that solves the problem has been uncovered through scientific research. Therefore it is also possible that biologists and historians one day will reveal that mammals already lived in New Zealand when humans arrived in their boats.

The upshot of our discussion is that responses to how- and what-questions also function as explanation in spite of the fact that erotetic logic of these kinds of questions does not allow us to formulate reason-giving answers. The distinction between description and explanation is a pragmatic one. If a response addresses the epistemic problem, which has been raised in a question, in a relevant and informative way, the answer yields an explanation. If the answer does not approach any epistemic problem because the question does not express one, it merely functions as a description.

1.8 References

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**FEJL! BRUG FANEN HJEM TIL AT ANVENDE TITLE PÅ TEKSTEN, DER SKAL
VISES HER.**

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