

## Interpretation in Science and in the Arts

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Both the natural sciences and the fine arts, throughout their respective histories, have widely been characterized as representational; that is, as activities whose primary goal is representation. By exploring the criteria for representation, we propose to show how even in supposedly simple cases of representational works of art and scientific theories we must inevitably admit that interpretation plays a crucial role. Admitting this role for interpretation brings to light how representation can be valuably incomplete or even sabotaged in these works. This leads to the question of whether there can be criteria for interpretation beyond the basic criteria for representation. We will first turn to art, where these issues more commonly arise, and then show parallels in the philosophy of science.

### 1. Art as representation

Today the idea that art is representational is met at once with examples of apparently non-representational art, which are (at least *prima facie* or putatively) counterexamples to that theory. This reaction allows, however, that art may have been representational in the past, before these new developments established themselves as art. Certainly the view of art as representation has been widely held; perhaps it is indeed the first to be voiced in Western philosophy. Plato's discussion of art in general, and more specifically of poetry, in the *Republic* stands as a paradigm example.<sup>[1]</sup> That such a view of art was dominant also (or still) during the Renaissance is evident, for example, in Vasari's survey of Italian art from the thirteenth to the sixteenth centuries:

painting is nothing more than the simple portrayal of all things alive in nature by means of design and color as nature herself produces them.<sup>[2]</sup>

But is this theory of art actually as simple as it seems? let us begin to answer this question by examining representation in what appears to be the most straightforward case. In Plato's example of a painting of a bed, the painting is related to the real bed in the same way the real bed is related to the Form. Whether or not he is oversimplifying his theory of Forms here, it is clear that the painting represents the bed in the following way. Suppose it is merely a line drawing; then the drawing is the projection of a solid geometric figure, from a certain perspective, onto a plane figure on the canvas. Logically speaking, such a geometric relation could also hold accidentally between a solid and some lines "drawn" in sand by rivulets of water. Such an accidental matching would not be a case of

representation, so the representational relationship must be one that is established intentionally.<sup>[3]</sup> Furthermore, it has been shown (particularly by Gombrich) that even in this simple case the viewer must learn how to "read" the picture -- the use of projection is a convention for coding the data selected for representation.

In sum, representation of an object involves intentionally producing another object which is related to the first by a certain coding convention which determines what counts as similar in the right way. With regard to this last point Plato discusses the examples of coding visual aspects of the object in painting, auditory aspects in music and song, and aspects of every (!) sort by means of words in poetry. These points apply equally to non-artistic, non-theoretical examples of representation, such as a snake-like sign indicating a bump in the road.

## 2. The first and second criteria of faithful representation

Although there are many ways to evaluate any particular representation (is it beautiful? does it have socially redeeming features?), the first criterion is accuracy, the criterion most closely related to the aim of representation. But even accuracy is not as simple as it seems. In the case of a subject-predicate statement, accuracy of description may be a straight yes/no matter -- it is true or it is false. In Aristotle's words, to be true is to say of what is, that it is, and of what is not, that it is not. But a representation which is not a simple verbal description cannot easily be judged by this standard. First of all, in such a case, accuracy with respect to what is depicted is no longer a two-valued variable, but a matter of degree. And secondly, what is depicted is invariably selected from what could be depicted. Somehow, completeness -- how much is included, and how much is left out -- needs to be distinguished from accuracy in a narrower sense, namely, as fit between what is shown and the part or aspect selected for depiction.<sup>[4]</sup>

To illustrate this, let us ask of the above line drawing of a bed whether it is accurate. It does have the shape required, which makes it a projection of the relevant three-dimensional solid on the two-dimensional page -- but not exactly, of course, not perfectly. This in fact makes the drawing seem fairly adequate. But it does not have the same dimensions as the bed; presumably the artist did not select size as a characteristic to be depicted. The narrowest criterion of adequacy for representation concerns the first point. It is the criterion applied if we say that a nose was drawn too large, a chin too round, the hair too wavy. We assume in that case that the artist did mean (or was supposed to) get those proportions right. In other words, this criterion of accuracy is indeed in some sense the most basic criterion, but it presupposes a context, in which the question of selectivity is already regarded as settled.<sup>[5]</sup>

But how is the selectivity itself is to be evaluated? In general, selectivity in narration or depiction lends itself to deception or misdirection) of several distinct sorts.<sup>[6]</sup> It is after all possible to give an appearance of completeness when the depiction is but partial, and to select perversely with

respect to interest and value even when accurate. On the other hand, selection may be of what is of special value, discarding the "irrelevant", "unimportant", or "inessential". [7] That is, if we look at the work with interests or values already at hand, selectivity can be the focus of criticism. The criterion applied, however, cannot be called something simple like "accuracy" -- completeness as such is clearly unattainable, so it is only completeness in some respect that can be required. In addition, it is clear that values which have nothing to do with geometric projection or matching of colors must be operative here, and they may well vary from case to case, context to context.

So even at the most basic level, the concept of representation has a curious complexity. For when something is offered as representation, it is thereby subject to two basic criteria -- the first, though straightforward enough, presupposing as given the selection of features rendered (hence only contextually applicable), the other importing some value ("from outside", so to say) to determine the features to be selected.

But now is that all? These points apply equally to any sort of representation, such as for example a census report. The census taker tries to include every person in his domain of responsibility, selects only certain respects to which to attend, for instance age and income, and then represents those accurately by writing the correct numerals on paper. The selection could be criticized, but only on the basis of a judgement of what information matters (to us, for our purposes, in this particular year, etc.), and then the accuracy criticized on the basis of whether the numerals written denote the correct numbers. But of course there must be more to representation in art -- and also, as we shall see further on, in science.

### 3. Representation as versus representation of

Today we have many examples of art that purports not to be representation at all, and these obviously lead us to question the idea that art is representation, or that its aim is representation. More interesting is the question of whether even in the case of art that seems explicitly representational, it is an adequate view of art to regard it simply in that way. Certainly we have many examples of art works that represent, such as paintings of the adoration of the mystical lamb, of an angel's annunciation to Mary, of a woman with a swan who was a god, of the Emperor Napoleon, of several men and women having lunch on the grass. They depict something, they are depictions of something. But is that the main point, is that the crucial thing to say about them?

These paintings are not merely depictions of this, that, or the other; unlike a census report, they do not only select some items and then simply encode them -- they represent their subject as something. The adoring are represented as devout, the women as undaunted, demure, aghast, or resisting, the men as arrogant or vulnerable. The question we want to raise here is: can the idea of representation as thus or so be conceptually accommodated under that of representation of this or that?

At first sight, it seems so. To represent the men as arrogant, would seem to be simply a matter of selecting certain characteristics for representation -- their hair color, their posture, and also their

arrogance. In just the same way, the census taker selects annual income and age, among the characteristics to enter in his or her report on the individual. But we shall argue that this is not the case, and consequently that the view of art as representation is seriously undermined. Certainly, the form of words is preserved: we say "representation of the men as arrogant". Certainly also, the importance or extent of the involvement of representation in art is not denied: it is not possible to have a representation as thus or so, except in the sense of having a representation of something as thus or so. But we will try to show that when attention is directed to how art (and also science) represents as, interpretation takes on a crucial role, at various levels, and the pristine simplicity of the idea of mere representation, in the paradigmatic sense of a geometric projection, is altogether lost.

With this conclusion, we can arrive at an understanding of how failure of representation and even sabotage of the project of representation can also play a legitimate role in art. That would be inconceivable, even self-contradictory, if our concept of art were simply that of a mode of representation.

Consider for a moment that painting of a luncheon on the grass. Let us agree, if only for the sake of argument, that the men are represented as arrogant. How is this achieved? Perhaps we have in this painting an exact representation -- a certain geometric solid has been precisely projected onto the two-dimensional canvas, and the colors-as-seen have been correctly filled into the corresponding areas, up to a certain varying level of detail -- of just those aspects which the painter selected for depiction. But what of the arrogance? Unfortunately being arrogant is not equatable with having any one particular set of physical characteristics, and looking arrogant is not universally equatable with any set of visual characteristics describable in terms of shape and color. So how exactly have the men been represented as arrogant?

Could it be that there is a particular representational code, such as a lifted eyebrow to indicate scepticism, which here conveys the arrogance? Does this painting perhaps belong to an artistic tradition which uses a highly elaborate set of apparently naturalistic details as symbols with recognizable iconographies, as in the religious art of the Renaissance? Are these men shown in a conventional posture of arrogance, in the way that in Medieval religious art men and women are depicted in conventional postures of sorrow, supplication, anger, and so forth? The answer would seem to be no to all these questions.

Of course, the artist could not depict the men as arrogant if they could not, in similar circumstances, convey their arrogance to us via some set of depictable characteristics. But "arrogant" (like e.g. "complacent", "offended", "friendly", "hypocritical") is an adjective of interpretation. Whether or not a certain action, posture, or facial expression counts as arrogance depends on the whole social, cultural, and historical context in which it appears. How does all that get into this plane figure filled with colors?

It doesn't. The artist succeeds not by accuracy of represented details that univocally express arrogance, but by creating or provoking the relevant impression in the viewer/reader addressed. <sup>[8]</sup> To

represent the men as arrogant, the artist must enable us to see those depicted men in the depicted situation as arrogant -- from within our culture, at a certain point in time, and with our specific history. Success in this respect, however, rests not only on what he does or shows. For if he did the same thing with another audience or public (who encounters the work in a different social, cultural, or historical context) the resulting interpretation could be markedly different. This is seen readily in the case of the plays of Jean Cocteau. For example, in *Orpheus* the deliberate choice of words carries additional connotations in certain social sectors, which affect the interpretation of the work.<sup>[9]</sup> Some conventional signs may be involved in interpretation, but for most attitudes and emotions -- which tend after all to take on ever new complexities -- there are no such blatantly recognizable signs as the lifted eyebrow and clenched fist.

What succeeds as coding clearly varies tremendously from one context to another, and may not rely on conventions that are at all widespread. Equally, cues offered by the artist may not be recognizable in the viewer's own context. Quite frequently, in trying to interpret a work the viewer needs to look to the context in which it was created, focussing on the actual process of creation (the available materials and techniques, for example, if it is a work of visual art), or social, political, intellectual, or historical influences. A clear example is Carl Schorske's examination of the works of Gustav Klimt in terms of the intellectual and political climate in *Fin-de-Siecle Vienna*.<sup>[10]</sup> For his interpretation of Klimt's mural *Philosophy* (*Das Wissen*, the first of a series of three murals commissioned in 1894 for the new university of Vienna), Schorske draws upon Wagner, Schopenhauer, and Nietzsche, figures admired by the intellectual circles to which Klimt belonged. Most striking is the assertion that we can possibly identify the philosophic priestess at the bottom of the painting as Nietzsche's drunken poetess in *Thus Spake Zarathustra*. Schorske sees her as "affirming the World of Will", clearly enough an extrapolation from Nietzsche's philosophy. Such a reading can derive its support only from an examination of the actual historical context; while clearly not uniquely forced even there, it cannot be even plausibly advanced independent of that context.

Thus there is no uniqueness and no context independence of interpretation with regard to a given artistic representation. It is similarly, and not independently, the case that when we view other people in the context of ordinary life, there is no certainty that our interpretation matches either what is really going on or what we were intended to make of it. That is an unavoidable consequence of the irreducibility of the psychological to the physical, mental activity to behavior, mind to body. The mere idea of representation is too poor to tell the story of representational art, because it is too poor to tell the story of perceptual experience itself.<sup>[11]</sup>

Selectivity thus plays an additionally crucial role in representation, as we must now conceive it. It is not just that the artist happens to think some elements or aspects of his subject more worthy of note than others. To evoke an interpretative response, attention must be drawn to selected aspects, by hiding or omitting others. The role played by selectivity in representational art is derivative from the



role it plays in all other communication, explicit or implicit, conscious or subliminal. <sup>[12]</sup>

Before continuing the argument, we should emphasize that the conclusion we are drawing here is very modest. There may well be reasons for taking it further than this. At this point, however, there are still three alternatives:

- (a) pure or mere representation of something -- e. g. the representation of a colored cube as a colored cube, by faithful reproduction (via a known code) of some of its features (such as by geometric projection yielding a plane figure, with matching colors filled in), or the numerical encoding of age and income of the population in a census;
- (b) representation with a conventionally dictated interpretation -- e. g. the representation of a person as sceptical by drawing a face with raised eyebrows, as evil or good by accompanying horns or halo;
- (c) interpretative representation, which succeeds by evoking from a public which encounters it in a certain cultural/historical context a reaction which classifies the work as a representation of its subject as having attributes predicated by certain adjectives of interpretation.

The stronger position which one might take would be to insist that (a) is at best a limiting case of (b), and (b) a limiting case of (c), which describes a continuum of cases which can only be arbitrarily subdivided. A still stronger position results if one then adds that not only is there a continuum here, but that no case is pure, no limiting cases can really exist. That would entail that there is no representation free of interpretation, in any nontrivial sense -- not even census reports, architects' blueprints, or police artists' composite drawings. It would mean that explicitly accepted and recognized coding conventions never suffice to determine or dictate the meaning uniquely. <sup>[13]</sup>

We are not taking such a stronger position at this point, because it is not needed for our argument. As long as there are clear cases of (c), which are not instances of (a) or (b), our point will stand. For if that is so, it will not be tenable to say that art is merely a species of representation, but only that it involves representation, and in addition, crucially involves interpretation which is not uniquely determined by the character of the representation. Moreover, the basis we have advanced for this, comes not from recent developments in art, but rather from reflection on art of a quite traditional, "representationalist" sort. The problem with the concept of art as representation is not that we have admitted examples of "non-representational" art. There have in any case always been works that would be difficult to classify as pure, deliberate, single-minded attempts at accurate representation. In how many respects, for example, is El Greco's Christ like any man one could possibly expect to encounter in the Temple court? The problem is rather that representation as such is too poor, too meagre a concept, to allow us to say much about any art at all.

Ultimately, we shall argue that we are now in a position to see how it can be crucial to art to defeat the purposes of representation, to violate the criteria which would apply if representation were the aim. But first let us consider to what extent our argument thus far could equally apply to views of science.

#### 4. The parallel case for science

Art, we have argued, is at least not simply representation of something; but crucially involves interpretation. But what of science? Does science perhaps have as aim exactly the faithful representation which art cannot or does not mean to achieve? Its medium is language, and the body of science is a body of information, a putative description of what there is in the world, and even of what the world as a whole is like. The criterion of accuracy divides again into two, as we saw for representation in general: it is easy enough to say something true, impossible to say all that is true about a given subject. Selectivity in science is deliberate, purposeful, and subject to evaluation as well. We ask not only if a given science provides accurate information about the aspects it has selected for attention, but whether it has selected well, whether it answers all or many of the important questions. Just as before, such evaluation draws on values current or imposed in its context, for what is important in the welter of data that assails us is not "written on the face of" the data, nor is it yet another datum among them.

There have certainly been a succession of views of science, of the sort typically labelled scientific realism, which take the aim of science to be correct description, or more generally representation, of what there is. However there have been major shifts in even these views due to revolutionary upheavals in science in recent times. Compare the following sentiment from the middle of the nineteenth century:

Now there do exist among us doctrines of solid and acknowledged certainty, and truths of which the discovery has been received with universal applause. These constitute what we commonly term Science....<sup>[14]</sup>

with even a very conservative form of scientific realism in our century:

Science aims at a literally true account of the physical world, and its success is to be reckoned by its progress toward achieving that aim<sup>[15]</sup>

The difference between the first and second is not with respect to truth as defining aim -- the difference lies instead in the erosion of certainty, with its concordant disentangling of the two concepts of truth and of certainty. The end in view is still truth, but this does not imply that we can have even potential certainty that this end has been attained. The two concepts are now [by scientific realists in the mid-twentieth century] seen as logically independent.

In the light of our discussion of representation, we can compare this sort of view of science with a contrary view. On such realist views as the above, science too is seen as simply representation. Recalling the amendments which were necessary for the view of art as representation,

we arrive at the contrary view, that even when science produces a representation of some part or aspect of the world, interpretation is also involved, and indeed, enters at several different levels. It is easy to imagine how a relatively conservative philosopher of science might respond: "Precision, accuracy, univocity, invulnerability to deconstruction or alternative interpretation are evidently the very hallmarks of rigor in the sciences -- which is perhaps, if you right, the very reason why scientific texts won't be literary texts as well, and why science is not art." But let us scrutinize the sort of representation science provides.

Newton represented the solar system, accurately in many respects -- the respects which he selected for thematic presentation -- but he represented it as (what we now call) a Newtonian mechanical system. Obviously he abstracted from the facts, but does this consist -- when perfectly successful -- simply in deletion of certain aspects, the ones not selected for representation? If so, abstraction can presumably introduce no inaccuracy or falsehood -- what it produces is the truth remaining after we ignore some of the truth to be found. But this irenic account of what Newton did -- what he called his induction, his rigorous derivation from the phenomena -- is too simple and too comforting, too good to be true.

How the solar system appears to Newton's God, how it appears in the view from nowhere, is not how it appears to us. Attending to what does appear, and has appeared to us, can we apply the interpretative adjective "Newtonian"? Newton showed us that we could, by constructing a mathematical model and showing that it provided an adequate representation of the solar system. God created the world, Newton represented it as a Newtonian mechanical system, and we saw that it was good. Later Einstein represented it as a relativistic mechanical system, and again we saw that it was good -- this time even better. The conclusion to draw is that the phenomena, to the extent Newton knew them, admitted his sort of representation -- allowed being represented as a Newtonian system -- but did not dictate that. They could equally be represented as an Einsteinian, relativistic system. We can draw a parallel here to the work of a portrait painter: he or she represents the subjects as arrogant, or as complacent, and the fact is that their comportment, as displayed to him, allowed both interpretations.

But someone might object: a serious disanalogy between science and art can be pressed here, after admitting to a minor analogy. By viewing the works of, for example, the Impressionists, or the Fauves, we might become enabled to see nature, and humanity, in a new way. Analogously, Newton showed us how to see nature in a new way. Certainly, the new way of seeing involves the application of an interpretative attribute -- the fact is only that the phenomena (how nature has appeared to us) admit of being classified as the appearances of Newtonian systems. Newton was wrong only in thinking that the interpretation was unique. Quite possibly Einstein's models do not fit the recorded phenomena prior to 1700 any better than do Newton's. The fact remains that, since they are a feasible alternative, the phenomena did not compel Newton's interpretation uniquely.

This admitted analogy -- so the objection would go -- must be followed by a much more important disanalogy. The viewer may react to the painting, by seeing the men on the grass as



arrogant, or as complacent -- the painting represents them as admitting both interpretative responses. This does not deny that if there was or had been a real situation as original, that way of painting it was not compelled, but only allowed or admitted along with other alternative possible renderings. Thus there are two levels at which nonunivocal interpretation enters the scenario. With regard to science, the real situation corresponds to the solar system, the way the situation appeared to the painter corresponds to the recorded celestial phenomena (the data), and the painting corresponds to Newton's model. So science, like art, interprets the phenomena, and not in a uniquely compelled way. But one might object that science itself does not admit of alternative rival interpretations. While there is ambiguity in the painting, and crucially so, there is no ambiguity in the scientific model. And so while the literary text is an open text, the scientific text remains closed.

But the history of science puts the lie to this story, and in successively more radical ways. Gravitation, the only force treated successfully by Newton himself, is a central force, with the center supplied by the gravitating mass. In the eighteenth century, it was taken as a principle of mechanical modelling that all forces in nature are central forces. Was this an addition to Newton's science? We must first reflect on this question itself, and ask what kind of answer it requires. Does it ask whether Newton deliberately omitted the principle from the principles of mechanics, or whether he indicated it tacitly, so that it was there for him but as a principle which had not risen to the level of explicit formulation? All Newton's models are of the type admitted in the eighteenth century; it is as if he already had that principle as well. But "as if" is all we can say. Should we instead take Newton's science to be defined solely by what was explicitly stated? But in that case all the Newtonians would appear to have misunderstood Newton's mechanics. For, to take one example, Laplace only formulated the common understanding when he used the dramatic device of an omniscient genie to convey that the Newtonian world picture is entirely deterministic. But if we look only to explicitly formulated principles, we must say that this science was not deterministic. The law of conservation of energy was not recognized as an independent and needed addition until the nineteenth century -- perhaps partly because non-conservative systems had not been sufficiently well conceptualized -- and the science allows for indeterminism before that is done.

What retrenchment could come next? Newton managed to create in this audience (the physicists and educated lay public of the modern era) the impression of total determinism with such force, that their own view of science began to include it as a criterion -- the telos of science is representation as deterministic. The task of science is not finished till that is done -- and of course, except for details, it has been done -- that is the implicit conviction of the nineteenth century, in the most visible quarters. It was not shared by all, Charles Sanders Peirce being an honorable exception, for example, and indeed it was compelled neither by the phenomena, nor by the science, nor by its success. Science itself admitted of different interpretations, at each stage, even if at each stage, one interpretation seemed to be dominant. [\[16\]](#)

The admission of alternative interpretations is spectacularly visible in philosophy of physics

today, with respect to quantum mechanics. The basic tension, which had to cause vacillation, and hence suspicion that the theory cannot have a satisfactory interpretation was perhaps first made fully explicit in Wheeler's commentary on Everett.<sup>[17]</sup> On the one hand QM is putatively the fundamental science, in principle encompassing all sciences as parts, and in principle affording a complete description of the world. On the other hand, much of it developed in the form of a theory of partial systems -- systems studied in relation to an environment, in terms of input from and output to that environment. The question is then whether the title of Davies' book The Quantum Mechanics of Open Systems really describes the entire theory (with every aspect of an environment being potentially part of a described system, which will itself however always be described as open to an environment), merely a sub-theory, or a proper extension of the theory. Interpretations of quantum mechanics presently available differ on this question; and even when they agree, they differ in other significant ways.

So in science too, we find interpretation at two different levels: the theory represents the phenomena as thus or so, and that representation itself is subject to more than one tenable but significantly different interpretation. As in art, we find the persons involved (those who create the work, those who peruse or appreciate it) often unconscious of the non-uniqueness of their interpretations and of the creative element in their response as readers. The texts of science too are open texts.

## 5. Interpretation and the spectre of ambiguity

We have argued so far for the rather modest (today perhaps not even very novel) contention that, both in science or in art, representation on canvas or page does not uniquely dictate how we are to understand it. We should now inquire into the role and importance of the multiplicity of interpretations which the work admits. Is this to be taken as a defect, an obstacle which the artist and/or scientist strives mightily to negate? Does the artist or scientist's success consist in blinding us to all but a very narrow range of interpretations, and thus determining our interpretative reactions? Or is there rather a special value or virtue to be found through this interpretational multiplicity? We shall again focus solely on art, for the time being; we shall then return to the question whether the case for science is parallel.

Before looking at specific examples, let us carefully distinguish two possible attributes of a text or work of art that both suggest multiplicity of interpretation. The first is openness (as in "open text") and the second ambiguity, narrowly construed. A work is open if (or to the extent that) it does not dictate its own interpretation. The closed text is the paradigm of bad literature: the text tells us that the heroine is in love, that her sighs are sighs of sadness and unselfish devotion, that her joy is untainted with misgivings. We are not allowed to remain puzzled for long if she throws a tantrum or an axe; all is explained. The reader is not guided so comfortably in his reading of, for example,

Madame Bovary or Straight is the Gate. As a minimum, the openness consists exactly in leaving open a number of interpretations, of different ways to view the action as manifesting character, purpose, and emotion.

But of course that is not all there is to it, since that minimum could also be achieved by quite ordinary vagueness. The work draws our attention in some definite ways to certain of the interpretations logically left open, thus giving them some degree of privilege, making them salient or at least more salient than the others. If the reader/viewer simply interprets the work in one definite way, unconsciously closing all the gaps left open, then the viewing experience is not subjectively different from that evoked by a closed work. The value of the openness, and of the presence of alternatives in interpretation, is then lost. In the open work, the openness must be exploited, and that can only be achieved through a selective privileging of certain interpretations. But typically the process goes a step farther, and we have not merely openness to interpretation, limited in one way or other, but a tension or conflict between the interpretations which saliently present themselves. That is ambiguity (in the narrow sense indicated above, for which we reserve this term here), an effect which goes beyond the presence of alternative interpretations. It consists in the tension, the conflict between interpretations which are made salient in such a way as to undermine each other, to prevent the irenic embrace of one or other of them for any length of time.

In the case of both qualities (though especially in the latter) it is very clear that the work in some way flouts the aims of representation as such. Openness means deliberate incompleteness, deliberate absence of answers to questions which selection of represented detail did bring to the fore, and even deliberate salient making of alternative possible answers, as if to taunt the understanding, to challenge it to creativity of its own. Ambiguity means even more: it is sabotage of any possible effort to eliminate the openness, to remove the equivocation, or to settle on a single picture to the exclusion of others. If these features of works of art do indeed contribute crucially to their value or attractiveness as works of art, then it seems that the value of art consists partly in something that conflicts with the criteria of representation.

Let us take Klimt's striking painting The Kiss (1907-8), as an example of a work of which our experience is consistently and overwhelmingly characterized by the apprehension of ambiguities, or tensions between seemingly contradictory features. The scene is both wonderfully enchanting and somehow sinister, and while there is something open and carefree about it, it seems also clandestine, our viewing almost voyeuristic. This is very much the result of the ambiguity in the subject matter of the painting, for it is unclear even what exactly the viewer is witnessing. On one level the description seems simple: a man and a woman, kneeling, embrace. But is it an act of extreme intimacy and tenderness, or of violence and victimization, a moment of pleasure or pain? The woman's tilted head, closed eyes, and arching hands suggest a sort of ecstasy, but perhaps equally repulsion. Does she hold her left arm folded close to her body, her hand resting on the man's, to draw him closer to her, or to protect herself, poised to pull his hand away from her face? And do his large hands express coercion and force, or do they deny their apparent strength in an act of gentleness? The expression on the

woman's face, as well as the position of the two bodies, also enhances this ambiguity.

The couple's position in relation to its environment is ambiguous as well. Are they as steady as the organic form encapsulating them would have us believe, or are they about to fall, as suggested by their somewhat precarious position on the edge of a rather unusual cliff? The environment is, on one hand, rather abstract; the figures are seen on a fairly homogeneous, partially metallic ground, covered with gold flecks and mottled gold rectangular forms. Yet the cliff which supports them, covered with flowers and vines, is relatively naturalistic and organic in contrast to this otherworldly space. Even the passage of time is affected by this contrast. The static patterning gives the scene an air of eternity, while the seemingly momentary curling under the woman's toes brings the viewer back to a reality in which time is passing, and the scene he sees cannot last.

It might be objected that we chose as example a work in which the subject itself has a certain ambiguity -- perhaps as if we attempted to show the importance of ambiguity to literature as such by pointing to ambiguous statements and behavior on the part of characters. But the picture is also spatially ambiguous, for the dense decoration of the cliff, the abstract metallic background, and the extensive patterning incorporated into the couple's bodies strongly suggest a two-dimensional space, while the more conventionally naturalistic way in which selected parts of the figures are painted creates the illusion of three dimensions. Such an effect is achieved through differences in the way contrasting areas are painted. The patterned areas are relatively finely divided and painted homogeneously within divisions so as to detract from the brushwork (see, most obviously, the black rectangular patches on the man's robe), while areas depicting flesh are more continuous but mottled, and painted with a mixture of colors (close study of the woman's shoulder reveals the presence of greenish brushstrokes in the overall reddish fleshtone). The juxtaposition of these areas, for example, the woman's shoulder and arm broken by the overlay of her dress and the man's garment, make the contrast still more striking. Three-dimensional areas seem to emerge and recede back into the planar surface because of such strategic breaks in their continuity.

There are additional tensions in the two-dimensional patterning, for the outlines of the figures and the amoeba-like form engulfing them are markedly organic, whereas the geometrical pattern elements seem extremely inorganic. Although the patterns themselves are painted in an inorganic style, they depict, in part, organic things. What begin as rectangles and spirals resemble flowers and eyes on the garment of the woman, and become, further down the composition, more clearly recognizable as flowers and vines. The differentiation of forms is unclear: human forms seem to emerge and melt back into the more abstract forms, and in what we perceive as a whole, we sometimes see autonomous or separate parts. There is a sense of unity but also of division; are we to resolve this image into one unit or its composite parts?

These numerous tensions contribute to a general ambiguity in the realistic status of the painting. It seems both naturalistic and otherworldly, establishing a reality we recognize through subject matter and to some degree the depiction of it, but then challenges it with incongruous characteristics -- elements that do not seem to fit into this reality but are recognized as magical or

fantastic, somehow out of keeping with the interpretation which this "realism" suggests.

The question remains whether such tensions, which appear to play a dominant role in our experience of this work, are crucial to art as a whole. The sort of analysis we have just applied, to bring out these ambiguities, can however be extended to other works, to uncovering tensions in more technical or abstract ways. To maintain some continuity, we should choose another representation of a person, for instance, Frauenkopf--Blauschwarzes Haar [Woman's Head -- Blue-black Hair], a watercolor by Emil Nolde, executed in 1910, shortly after Klimt's Kiss. The watercolor and ink wash face does not exhibit the more blatant stylistic variation of Klimt's work, but grows more intriguing the longer it is viewed. If we ask what it is that is initially so attractive about this image, the answer is not the ambiguity of realistic representation, although the image is by no means overwhelmingly realistic in the conventional sense. Instead, the strength of the heavy black ink lines that form the woman's face and hair seems to be the most appealing feature of the work, and the very lines of the eyebrows, nose, and chin are somehow oddly attractive in both their confidence and contour. Upon further consideration, one realizes that the patches of yellow and aqua wash that shade the face also pull the viewer toward the image, especially as complemented by the touches of rose-colored wash at the eyes, nose, and mouth. But what is it about these particular configurations of ink on paper that make them so appealing? Is it simply the lines, and shapes, and colors that have such appeal, devoid of the subject matter they depict?

Let us focus on a particularly interesting area of the composition in the upper right corner. The tangle of hair that falls lightly over the woman's face is composed of strong overlapping lines of blue and black ink, featuring an especially attractive thick line (presumably a curl or lock of hair) that stands apart to the right of the others. Its separation from the larger mass of hair is highlighted by the presence of white (absence of orange wash) between them. Granted this area, and especially the outstanding line, are particularly compelling. But are they compelling simply as lines and mass alone, or does their attraction result from their incorporation into the image, their role as representing hair?

If we view this area of the paper in isolation, so that its relation to the rest of the image is unacknowledged, what happens to these lines? It seems that they are still quite interesting, and to some degree compel us to continue looking at them. But they are not as interesting as they were when viewed in the context of the entire image. That is not to say that the image as a whole is more interesting than this isolated patch of it (although indeed it may be), but that this particular area itself becomes more interesting given knowledge of the rest of the image, or rather when imbued with the representational value that knowledge and recognition of the image provide. Thus, these lines, intriguing in themselves, become even more intriguing when viewed as hair. And in like manner, the yellow and blue patches of color on the face take on added interest when they are not only surrounding thick blue-black lines, but when they are shading the face of a woman.

Do we then, however, just look at these things for their representational value? Does the context overshadow the components such that, because the face is more interesting than the isolated lines, we like the lines better, knowing in theory that they are there, but never quite perceiving them as



lines? This is a difficult question, but since what intrigues us about the lines when they are in isolation continues to attract us when they are viewed in the context of the face, we might think that we are still aware of them as lines, that we still recognize the confidence and organic quality of the stray line in the upper right when we view it as a lock of hair. Anyway, are we ever really taken in by the illusion suggested by the image, seeing it as a real face and forgetting that it is constructed of lines and watercolor washes? It seems that we appreciate the face with a constant awareness of these lines and shapes.

But in fact, what seems so intriguing is this dual nature of what we perceive; on one hand, we know it is a lock of hair, but it exhibits such a wonderful quality of line. This ambiguity may be what makes the image so appealing -- the tension between the representational quality of the image and the blatant admission of its construction, the ambiguity between line as line and line as the subject it represents (in this case, line as hair). The first thing to attract us about the drawing, already admitting recognition of the representational image, was the quality of line, which suggests, by contrast, the apprehension of line as line. Thus the ambiguity was actually present, even in that first impression of the image as appealing by virtue of its lines.

#### 6. Could ambiguity have value in science?

As our examples show, contemplation of a work of art consists to some extent in becoming more aware of the openness and the ambiguities, and these can contribute crucially to its value. Indeed, we tentatively advance the stronger thesis that this is crucial to aesthetic value in general, and not just in certain examples. But what about science? The argument in the section before last purports to establish at least the pervasive openness of science to interpretation. On the one hand, what science gives us is a representation of the phenomena which involves interpretation, since its character is not uniquely determined (but rather, as we say, "underdetermined") by the data. On the other hand, the scientific theory is itself an open text, subject to diverging interpretations -- what the theory represents the phenomena as is itself not a hard datum. Here even important alternatives are often present without coming fully to light in the awareness of those involved, and when some do come to light, they are largely ignored in the day to day engagement of the working scientist. But in retrospect such interpretational elements -- such as that Newtonian mechanics was regarded as an essentially deterministic theory, and temporal relations as absolute rather than relative -- are seen to have thoroughly constrained scientific thinking.

But in the case of art we have seen something more: not only the openness of the work, but awareness of the openness of the work, and not only openness to alternative interpretations, but the conflicts and tensions between these interpretations can contribute crucially to the value of the work. Isn't it true that in science, the admissability of alternative interpretations creates the demand to settle on one of them? Even more, doesn't the appearance of ambiguity, of any tension between ways of taking a theory, create quite urgently the demand to resolve and eliminate that ambiguity? In other words, aren't those features which we have argued to be of value in art, just defects when they are

found in science?

Recent history of physics includes a famous negative answer to these questions, namely Bohr's views on complementarity. But that answer does not any longer enjoy the high regard it once had. Scientists educated in classical physics had two sorts of pictures, two sorts of models, which were mutually exclusive: the wave picture and the particle picture. Different processes were modelled in these two different ways, and no process could be of both sorts. For a while in the twentieth century, scientists were using both sorts of pictures for the same processes, though in connection with different experimental set-ups. Sometimes the behaviour of light, for example, admitted representation as a wave in a medium and sometimes it admitted representation as a stream of particles. Bohr's quite revolutionary idea was that this could be accepted as a normal and satisfactory state of affairs, that a theory could simply offer two families of models, with some prescription about when to switch from the use of one to the use of another. The idea was workable only, however, if that prescription itself was not equivocal, and hence only if the scientist's apparatus could be exempted from this, and could be said to have a univocal description. But the only univocal description available was that of classical physics, which unfortunately predicted wrongly even at the macroscopic level of the apparatus. Today there seems little hope of re-instituting complementarity as the key to interpretation of physics.

It seems to us that for the philosopher there nevertheless remains an important question: Are these ambiguities found in science, its openness to interpretation, valuable? The disanalogy with art will remain if all we've done is to point out defects in the scientific practice of obtaining a univocal interpretation both of phenomena and of theory. However, the question of value should be subdivided into two. First we ask whether ambiguity and openness have been of value to science in practice, or instead hampered its progress. Then we must ask how different philosophical views rule on whether ambiguity and openness are defects, or alternatively, can be valuable to science.

As to the first question, no philosopher should prejudge the history, sociology, or psychology of science. At every point in the history we see both blindness and insight, and the two are inseparable. The insight that Newtonian mechanics lent itself to being the mainstay of a deterministic world-view, blinded the Enlightenment to the possibilities of indeterminism. Prima facie, at least both that insight and its correlate blindness are to be credited with inspiring the spirit of research which led to such triumphs, and also to the phenomenal limits, of classical physics. But then the previously unseen alternatives -- the previously undetected gaps, vaguenesses, and ambiguities -- became visible as it was realized that science did already have resources to begin the study of discontinuity and chance in nature.

As to the second question, we must admit that a naive scientific realism would entail that ambiguity, vagueness, and gaps are all defects. The latter two spell incompleteness of achievement with respect to the literally true story of the world. The first also obstructs, sabotages, such achievement as it drives thought into several different directions at once -- the aimed for achievement continues only with the elimination of conflicting interpretations. But what if the empirical

predictions remain invariant under all ways of resolving the ambiguity (all ways of opting for one interpretative completion over its rivals)? Then empiricism sees no defect. Indeed, the only way to truly enhance understanding science, for the empiricist, is not to resolve such ambiguity, but to find out in how many different ways it could be resolved. Each tenable interpretation will throw new light on the theory, by showing that this is how the world could be as the theory describes it; all such new light is valuable. And since each of those ways of seeing the world is potentially a good way to respond to new phenomena as yet unexpected or even unimagined, they are not to be chosen among, but valued and appreciated. Indeed, the tensions created by ambiguity, like the paradoxes about infinity and infinitesimals that plagued modern mathematics, may well be the crucial clues to creative development.

## 7. Are there criteria for interpretation?

Our inquiry into the criteria for representation led us to interpretation, and the inadequacy of views of art or science as (simply) representation. But does the admission of interpretation lead us into a mire of pluralism? What are the criteria proper to interpretation, if any? We have some idea of what is a faithful representation -- as well as of the difficulties inherent in that idea -- but what makes for a good or better interpretation? First of all, are there basic, minimal criteria (such as those relating to accuracy and selectivity in the case of representation), and if so, are there ways of assessing interpretation that go beyond those minimal ones?

Suppose someone offers an interpretation of a work of art, a text, or a scientific theory. At first sight, it must always be a valid question whether this is an admissible interpretation at all. If it is, there must be further valid questions, surely, about how good it is as interpretation, and whether it is better or worse than its alternatives. It is possible that such questions can arise meaningfully only in very rich contexts, if only because an interpretation makes no sense if divorced from its cultural, social, and historical context. In that case we must inquire also into the extent to which values "from outside" enter into such evaluation, in the sense in which that is so already for evaluations of the artist's selectivity.

Let us for a moment consider the alternative. Suppose that there are no objective or publicly valid criteria to be applied to interpretation, and that judgments of admissibility as interpretation, and of how good an interpretation is (as interpretation of the work in question) are only a matter of personal taste. What, in effect, is the critic or reader then doing? His reaction to the work has in that case the character of a psychological subject's reactions to a Rorschach test. No one investigates whether there are geometric or color correspondences between the blot and things mentioned -- mother, blood, sunburst, spider -- in the subject's response. That response is only investigated in its own right as a clue to the subject's mood disorders. The question whether the response was an interpretation admitted by the ink blot does not arise. But to do the same with a painting, a poem, or the text of Einstein's "On the Electrodynamics of Moving Bodies" is to miss the point.

But what sort of criteria can there be? A familiar and obvious interpretation occurs when we

read The Pilgrim's Progress as an allegory of the spiritual life. This reading it implies in the first place that the text is a representation of a journey. Here we are surely at a level where no more is involved than conventional coding, the dictionary meanings of the words. Similarly, the interpretation of a certain painting suggested by its title, The Adoration of the Mystical Lamb (the Ghent Altarpiece), implies in the first place that it is a representation of a lamb surrounded by people. Again, no more than conventional coding need be appealed to here; no creative viewer/reader response is called for beyond that to be expected from a minimally educated person in our culture. If now someone were to offer an interpretation of that painting as one of Leda and the Swan, we expect to be able to criticize it on this very basic level. If this interpretation implies that the painting is or includes a representation of Leda and of a swan, then we can say: even the criteria for representation rule out that interpretation. Questions about the value of the interpretation would be moot, for the work is not even a representation of what it is said (implied) to represent.

What this suggests is that there are indeed minimal criteria of interpretation, but they are the criteria already for representation. <sup>[18]</sup> We can make the parallel point for science, both with regard to its interpretation of the phenomena, and with regard to interpretations of theories. As example of the first, suppose that someone proposes an explanation of why the sky is blue. It should be possible to answer: "That is lovely as an explanation, it is original, coherent, unifying, intellectually exciting -- but the phenomena do not admit that interpretation." The theory may have every internal or cultural value imaginable, and not fit the data. In that way science -- conceived of as interpretation of the phenomena -- submits to public criteria. As example of the second, if someone, for example Sir Karl Popper, offers an interpretation of quantum mechanics, we can say: "How wonderful! What a cosmic, inspiring vision of the world, and how intellectually satisfying! But the 'no-hidden-variable' theorems show that any theory which does admit your interpretation will make predictions at odds with those of quantum mechanics. Therefore that theory does not admit your interpretation." The point is that quantum theory does not even count as a representation of Popper's world, at the very basic level of accuracy with respect to the empirical phenomena.

The question is, however, what sort of criteria could come into play beyond this? What we should like to be able to say about an interpretation includes that it gives us real, new insight into the work in question. We have a sense of discovery, of seeing what was there all along, but had not been discerned before the interpretation was offered. This suggests a relation between the work and its interpretation which is objectively there, and yet goes beyond the very minimal sort of adequacy described above.

We have no substantial answer to offer to this question. But perhaps it is possible at least to remove an assumption which, if tacitly held, may certainly obstruct the inquiry. That is the assumption that insofar as a response to a work cannot be evaluated in terms of its relation to the work itself [or more liberally, to the work in the publically accessible cultural and historical context], it is either arbitrary or of idiosyncratical or autobiographical interest only. The threat of the nihilistic

possibility, that the critic's response is, beyond the most minimal level of adequacy, no different after all from free association to a Rorschach blot, may just come from the assumption that there is nothing else for it to be.

There are certainly philosophies of art which are at odds with that assumption. Consider for example Collingwood's view that the work of art properly speaking, is the artist's imaginative construction. He may have created this by or through the production of a material work -- and that production will have shown every sign of being a problem-solving activity, as the artist tries to "get it right" -- but what was created cannot be identified with the resulting object, score, single performance or written text. The audience - or reader - response consists then also in an imaginative construction, evoked by the material work [which functions therefore always as language does paradigmatically]. In that case, the beholder is a "secondary" artist, so to speak, who creates a work of imagination related to the real work of art. The important question is not how accurate a reproduction of the artist's own imaginative construction results, but how valuable the product at second remove is in its own right. The great artist facilitates, evokes, guides our lives of the imagination, in which we too should hope to be more creative than docile.

Reader-response theories of literature obviously come to mind here as well. The literary text -- unlike the cartoon or genre novel -- is an open text, which does not dictate or normatively dominate the reading. We should add that, in order not to quibble but take advantage of the new distinctions so allowed, we must acknowledge that the artist brings into being much more than the original "work of art proper" -- the material work is the temporally persisting focus of a sequence of imaginative creations, which can alternately be viewed as a single imaginative work evolving through centuries, liberated from the confines of any one individual mind, including the artist's. The weight placed on criteria relating an interpretation to its reference's [original] structure is therefore not written in stone; it is itself a theoretical bias brought to this problem area.

Let us close by looking again into a possible parallel at the level of scientific theorizing. In the case of Newton, there was the original work of imagination, completed by the writing of the Principia. Since then there have been countless such works evoked in response, from the amateur who looks again at the moon after laboriously working through Newton's elegant solution to the two-body problem, through the teachers who expressed their understanding of Newton's work conditioned by their own philosophical and scientific milieu, to the great Laplace, Lagrange, Hamilton,... whose readings progressively transformed the science. Taking for granted (for just a moment longer) that we can very simply divide such a theory as Hamilton's into the part which exactly duplicates the Principia and a novel remainder, it is clear that our evaluation is not at all restricted to the former. We can criticize or laud the addition, but do so in its own right, not merely because it has no clear pedigree in the original. Again, although representation of the original is not what is at issue, the criteria are not independent of questions of representation. There is a question clearly whether, even if all future phenomena admit classification as Newtonian systems, Hamilton's modelling will prove as fortunate. It is debatable whether Hamilton thought he had merely rewritten Newton's theory in alternative



formulism. If so, it appears he was more creative than he himself appreciated -- the new way of seeing things was essentially novel. But with respect to other sorts of criteria, the verdict is by no means "everyone to his taste"; Hamilton's theory is required to be good physics.

How does this discussion reflect back on art? Parallels are more evident for some arts than for others. How would Vasari, Walter Pater, John Berger, and Northrop Frye each read the others' work on painting? Their mutual critique would not disappear in bland harmony, once each had noticed every detail the others point out! Even more remarkable is the transformation of literature as it appears through successive critics' pens; an extreme example is perhaps J. Hillis Miller's deconstructionist reading of Crabbe's "The Parting Hour" as compared with readings of forty or fifty years before. Even if the written text were to remain letter by letter the same -- through the successive stagings and performances -- this constant is only the focus of an evolving multiplicity of interpretations. Those interpretations are evaluated, but only partly in terms of literal faithfulness to the text. Other criteria are not logically independent of questions of representation, but extend beyond it. Can other readers, in our culture, read the work in this way fruitfully, or even without strain? Can I really read Hamlet as Freudian case history, without ending in amusement at Freudian pretensions? The communal judgement that the interpretation is strained, forced, malapropos, or egregious will typically seem to be made in terms of fidelity to the original text, but will largely get its bite from expectations of the role this reading or staging could play in the evolving tradition of interpretative responses focused on this work.

What we have suggested here, in effect, is that the problem of evaluation of interpretations of a work of art or of science, is to be subsumed under the problem of evaluation of art and of science themselves. Without being able to say what the criteria are for interpretation, beyond the most basic ones (for accuracy and completeness of representation) we suggest that there are such criteria, and that they are essentially the same as for the initial creative activity.

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[1] In Book II (373b), the "mimêtai" include painters, musicians, poets, actors, and choral dancers; the discussion in Book X (596e-603a) starts with the painter (compared with the carpenter, but at three removes from truth (597d, 602c)), concentrates on the poet, and ends with an analysis of the ways in which song, music, and dance are suited for mimesis. Of course, this was by way of setting for Plato's critique of poetry as a snare and deception, to be banished from the republic. But the core of his polemic, the view of art as representation, is explicitly shared by Aristotle's Poetics, although the prosaic Aristotle wrote it to refute the poet Plato's rejection of that art (Poetics 1449b, 25-28).

[2] cited in E. H. Gombrich, Art and Illusion (Princeton:

[3] We recognize that the word "representation" is commonly used also in a wider sense, in which someone might be said to produce a representation accidentally or unintentionally. We limit ourselves to discussing representation in the narrower sense here outlined. If one person unintentionally produces an object in which someone else spots a striking similarity to George Washington, for example, and the second person displays the object as a portrait, then the first person has not represented Washington (as we use "represent") but the second person may have succeeded in doing so.

[4] Henceforth the word "accuracy", when unqualified, will be used in the narrower sense here explained.

[5] For both accuracy and selectivity, one could ask whether the limiting case is in fact possible, that is, perfect accuracy of depiction with respect to some selected feature, or total completeness of selection of features for depiction. But the existence or possibility of the limiting case is not required for evaluation of more and less to be possible. For example, there is no longest distance; however, the possibility of comparing distances gives the concept of distance its legitimacy.

[6] This too can be illustrated by Plato's discussion; see Republic Book II, 378a, 396c-d; Book X, 598a-b, 605a-b (in view of 604: the person is analyzed as having various parts, some more and some less noble; the imitative poet tends to select the less noble parts for representation).

[7] Aristotle appears to make the role of a certain selectivity crucial to his defence of poetry: "... poetry is a more philosophical and serious business than history; for poetry speaks more of universals, history of particulars. (Poetics 1451b, 8-9; Else tr.) By showing selectively and variously what can happen, and what will happen "according to probability or necessity", the poet can represent universal patterns in human history and human affairs, while the historian, so much less selectively, portrays particular happenstance.

[8] As noted in section 1, we are discussing intentional representation, the case in which the artist tries to, and perhaps succeeds, in carrying out his intention to represent the subject in a certain way. It is not to be assumed either that this is what makes his activity art, or that the value of the work of art depends on success in this respect. We are inquiring into just what is involved in those cases in which art does involve (intentional) representation.

[9] "In the context of a largely homosexual audience, at one

level, the play can become a kind of private experience during which some groups understand allusions of which others are unaware: from a certain point of view, misogyny becomes the center of the work (women destroy the creator Orpheus, women attempt to destroy the artist's inspiration) ...." Lydia Crowson, The Esthetic of Jean Cocteau (Hannover, N. H.: University Press of New England, 1978), 54.

[10] Carl E. Schorske, Fin-de-Siecle Vienna: Politics and Culture (New York: Vintage Books, 1981).

[11] This, of course, is an area of philosophy of mind in which issues have been hotly contested of late. See Lynne Rudder Baker, Saving Belief (Princeton : Princeton University Press, 1987) and Hilary Putnam, Representation and Reality, especially his chapter "Why functionalism didn't work".

[12] Note well the layered structure of levels here at which interpretation enters. The artist represents some men on the grass. He must succeed in getting us to see the painting as a representation of those men as arrogant -- as well as, or in some way through, getting us to interpret as arrogant the way those men comport themselves. In other words, the viewer must be provoked into interpreting what he sees as (a material object which is) a representation, that represents its subject matter as thus or so.

[13] In the philosophy of science we have such a strong position concerning the language of science in the denial (e. g. Sellars, Feyerabend) that there even could exist a pure, not theory-infected hygienic observation language. This is now widely accepted.

[14] William Whewell, "on the Nature and Conditions of Inductive Science", in J. J. Kockelmans (ed.), Philosophy of Science -- The Historical Background (New York: The Free Press, 1968), 51.

[15] Jarrett Leplin (ed.), Scientific Realism (Berkeley: University of California Press, 1984), 2 (from the editor's Introduction).

[16] "seemed", because the remaining incompleteness in the interpretation was of course, ex hypothesi of dominance, not perceived. We should also add that the incompleteness is different at different historical stages. Perhaps after the addition of the conservation laws, mechanics as officially codified (say, around 1890) was deterministic. The diverging axiomatizations of classical mechanics that appeared over the next 100 years, show however that the treatment of mass had still been left ambiguous. Those who took Mach's and Hertz' monographs on mechanics seriously could have perceived this already then but

this sort of awareness grows slowly.

[17] Contrasting one specific formulation of these two ways of viewing quantum mechanics, John Wheeler wrote "Our conclusions can be stated very briefly: (1) The conceptual scheme of "relative state" quantum mechanics is completely different from the conceptual scheme of the conventional "external observation" form of quantum mechanics and (2) The conclusions from the new treatment correspond completely in familiar cases to the conclusions from the usual analysis." Review of Modern Physics 29 (1957), 463-465. This contrast is not essentially bound up with the specific account (by Everett) on which Wheeler was commenting.

[18] This point is not affected if we think that there is no sharp division, but only a continuum of representations, with more and less by way of involved interpretation -- or, on the other side of the coin, a continuum of interpretations from the minimal case of geometric projection to elaborate and sophisticated reader response. It is after all possible to make meaningful, non-arbitrary divisions in a continuum; and indeed, most predicates do exactly that.