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Edited by
Demetra Sfendoni-Mentzou

Introduction by
Hilary Putnam

PETER LANG
New York • Washington, D.C./Baltimore • Boston • Bern
Frankfurt am Main • Berlin • Brussels • Vienna • Oxford

PETER LANG
New York • Washington, D.C./Baltimore • Boston • Bern
Frankfurt am Main • Berlin • Brussels • Vienna • Oxford

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The Theory of Tragedy and of Science: Does Nature Have Narrative Structure?

Bas C. van Fraassen

1 Introduction*

Aristotle's *Physics* presents us with a clear view of the structure of nature and natural processes, and also, in conjunction with the *Posterior Analytics*, of the structure of the science that deals with nature. Similarly, his *Poetics* describes the structure of the human condition and human events as depicted in tragedies, as well as the structure of those tragedies that dramatize this aspect of human existence.

The similarity goes in fact much further. The action in the tragedies forms a tightly structured causal process, flowing from the character of the protagonists and the conditions in which they find themselves. What they represent is a paradigmatic example for nature as described in the *Physics*. Despite the great triumph of secular reason over the anthropomorphic mythical worldpicture which preceded Aristotle, I submit that to us, looking back, the world of Aristotelian science is still a human world writ large.

In Aristotle's nature, the effects flow from the natures of the individual substances involved precisely as human action flows from the characters of the agents. What happens fits a tight causal pattern; nothing moves unless it be moved by something, to use his phrase. To us this is still plausible at the level of zoology, chemistry, material science, medicine, and the like. But already in the seventeenth century fundamental physics moved inexorably toward what we might call the "choreographed universe," first of all through Newton's Law of Universal Gravitation, to be followed in due course by the great Conservation Laws, which became fully explicit only in the nineteenth century. Then chemistry and biology found themselves, again at a fundamental level, involved in a similar shift from local to global structure, in statistical thermodynamics and evolutionary theory. That shift took on its most radical character yet in quantum

mechanics, where even in very small systems, involving as few as two particles, the behavior is a function of the whole and not determined by the natures of the component parts.[1]

So Aristotle's worldpicture gave way eventually; can we see this tragic fate deriving from a tragic flaw? It seems to me that indeed we can detect a point of rupture, where the first signs of anomaly appear early on, namely in his treatment of chance and the improbable. This is an important subtopic for both the *Physics* and the *Poetics*. The puzzling, unresolved difficulties there, I will argue, reveal a more profound difficulty yet: an ambiguity pertaining to the very enterprise of representation, to which both drama and science belong.

This underlying difficulty does not simply affect Aristotle's view of science, but has continued to beset philosophical reflection on science to this very day. It comes to light especially in the philosophical debates over scientific realism, and I shall end with suggestions about how we can place this problem in a certain perspective. My aim is to arrive at some assessment both of what remains valid in Aristotle's conception of science and what remains problematic, not only in his view but to this very day.

2 Causality: Tragic Flaws and Substantial Natures

> *But the phenomena show that nature is not a series of episodes, like a bad tragedy.* (*Met.* 1090b20)[2]

2.1 Tragedy: Its Causal Structure

"Tragedy is a representation of a serious, complete action which has magnitude...." That is how Aristotle begins the definition of tragedy in the *Poetics*. In the explanation of this all-important phrase, we find that the action must flow from character, with necessity or probability. Circumstances can be exotic and surprising but the element of chance and unlikely or unbelievable incidents are to be shunned. If needed, they are to be kept off stage. The completeness of the action is assimilated to textual or narrative structure: what is depicted is a "complete action," the beginning must be a radical beginning from which the middle necessarily follows, demanding closure by the end (*Poet.* 49b25–26).[3]

What is meant by "following" here, like the flowing of action from character, is causal, and thus links us to the account of the causes (explanatory factors, kinds of αἴτια) in the books on science. This is something we must explore in some detail. For tragedy Aristotle lists the plot as the most important element (50b22), and requires it to have a strict causal structure:

> The plot, since it is a representation of an action, ought to represent a single action, and a whole one at that; and its parts (the incidents) ought to be so constructed that, when some part is transposed or removed the whole is disrupted and disturbed. (*Poet.* 51a30)

How is the text to depict its object? As serious, complete, and of a certain magnitude. That is the initial stricture, and whether or not it is satisfied is clear even on a very superficial reading. We can tell whether this is so if the author simply tells us what his text is about: the demise of the Royal House of Thebes or the evolution of the organic world will certainly qualify.

As the text proceeds it will, if successful, bring us to a full and deep understanding of its object. The main strictures on how it is to achieve this are further strictures on how it is to represent its object. If it succeeds it will lead us from an initial superficial understanding which harbors much suppressed puzzlement to a deep comprehension. Of course, this is the central contention in Aristotle's defence of poetry against Plato's attack on it in the *Republic*: that the mature audience's experience in the theatre is one of learning.

The audience is led through a series of recognitions—in the case of drama vicariously through the recognitions experienced by the characters in the play, though often ahead of them as understanding dawns on them before it dawns on the stage—to the region of the inherently intelligible.

How is this done? By depicting the object as what philosophers now call a causal process:

> By "complex" I mean an action as a result of which the transformation is accompanied by a recognition, a reversal, or both. These should result from the actual structure of the plot, so it happens that they arise either by necessity or by probability as a result of the preceding events. It makes a great difference whether these [events] happen because of those or [only] after those. (*Poet.* 52a17–22)

Since the tragedy achieves its aim only if all it contains is conveyed to the audience, the playwright's first task is to convey character—the audience must be able to assess actions as being in character and not in character, and must have expectations based on its understanding of the protagonists' character. This task can be performed only by giving the audience some clues which will trigger its prior general opinions as to the symptoms of character—in other words, the tragedy's representational design must draw heavily on the prior cognitive state of its historically given audience. It will be a more lasting drama if what it draws on is understanding of human nature in general rather than the mores, customs, and idiosyncrasies of its time; but the role of the reader and viewer is not eliminable.

The instructions for the form of depiction, when the object is to be represented thusly, we shall see linked, several times over, in the *Physics* and its doctrine of the four types of explanatory factor (αἰτία). For inquiry aims at knowledge; but we do not have knowledge until we have grasped the "why" of it (*Phys.* 194b19–20). In the *Poetics* we see this conviction concretely instantiated. Indeed, I submit that the *Poetics* presents us with the *paradigmatic* instance of this conviction.

2.2 The Intelligibility of Nature

Poetry has cognitive value; the poet, and also we ourselves as audience and viewers, strive for intelligibility in human affairs, strive to make human fate and human actions intelligible to ourselves. Near the very beginning of the *Poetics* Aristotle insists that this is not a special didactic function of tragedy or even poetry. Rather, this cognitive function attaches to *representation*, of which poetry is a special form. The delight taken in dramatic representations is the delight we naturally take in learning:[4]

> (i) Representation is natural to human beings from childhood.... Also (ii) everyone delights in representations. An indication of this is what happens in fact: we delight in looking at the most proficient images of things which in themselves we see with pain, e.g. the shapes of the most despised wild animals and of corpses. (iii) The cause of this is that learning is most pleasant, not only for philosophers but for others likewise (they share in it to a small extent). For this reason they delight in seeing images, because it comes about that they learn as they observe, and infer what each thing is, e.g., that this person [represents] that one. For if one has not seen the thing before, [its image] will not produce pleasure as a representation, but because of its accomplishment, colour, or some other such cause. (*Poet.* 48b5–18; numbering inserted)

His account of this very same feature of science is unusually explicit. The natural path of inquiry "leads from what is familiar or evident *to us* to what is *by nature* clear or conclusive." This point is deduced: "The reason for this is that what is intelligible relatively to ourselves and what is inherently intelligible are not the same." Starting with what is naturally obscure but apparent to us we must seek the reasons why, and thereby advance to what is intelligible in itself (*Phys.* I., 184a15–21).[5]

2.2.1 Definition of Tragedy and of Science

Aristotle defines tragedy as a kind of representation:

> Tragedy is a representation of a serious, complete action which has magnitude, in embellished speech... by people acting, and not by narration; accomplishing by means of pity and terror the catharsis of such emotions. (*Poet.* 49b25–28)

He does not explain what representation is. That is a crucial question for us, which we will be forced to examine later. In effect, it divides this paper into two halves—in the first half we will take the notion of representation for granted.

As we can see, the definition of tragedy then has four parts, to specify the *object*, *medium*, *manner*, and *aim or function* of tragedy. This sets the pattern for an adequate definition of anything falling under the heading of representation.

We note in this passage that narration too is a manner of representation; language is a medium of representation, with various linguistic forms possible. That brings science as described in the *Posterior Analytics* within our range: we can begin with the following as outline:

> Science is a representation of *something*, in *a certain form of* language (by people speaking or writing *in a certain way*), accomplishing *by certain means* an *end or aim proper to this activity*.

So far this is just a pattern; throughout this paper I shall be attempting to fill it in.

Object and aim are of course the most important factors to specify. But we can begin by asking about the medium and manner—to this it seems to me the answer is made clear in the *Posterior Analytics*. The language must be the canonical language of syllogistic logic, and indeed, the "body" of science will consist entirely of necessary universal proportions. The manner of presentation will be demonstration, in principle in perfect syllogistic form, what later came to be called presentation "more geometrico."

This conviction survives today in the updated forms of the axiomatic method, notably in the logical positivists' axiomatic "snapshot" view of what scientific theories look like in principle. But it has been controversial for some time. In fact, when Galileo said that the book of nature is written in the language of geometry, he was using the word "language" figuratively. What the language-speaking scientist presents is the geometric structures—as we would now say the mathematical models. But with these few remarks I will leave the topic of medium and manner.

This leaves us with the two most important factors, as I said: the object and aim of the representation.

2.2.2 *Causality in Natural Processes*

Since Aristotle did not give us a definition of science that fits the pattern exemplified by that of tragedy, we must ferret out the object and aim from his more general discussions. The aim receives explicit statement at a number of points, the object does not. However, we can try to infer the proper object of scientific representation from the examples he gives and what he says about them.

We may well be in a good position to do this, precisely because Aristotle does do something for science which does not do for tragedy—and the lack of which in the *Poetics* has been the source of constant difficulties concerning that work. I mean this: Aristotle presents us with a sustained attempt to deduce the character of a good scientific theory from the stated aim of science. Indeed, Aristotle's procedure in the *Physics* suddenly highlights with startling clarity what is missing from the *Poetics*.

If κάθαρσις is the aim, why does he not explore the aim of κάθαρσις, and prove from THAT precisely what he requires, a tightly structured causal plot, is needed? That would have helped a great deal, not only to have some rationale for the dramatic unities but also to understand just what catharsis is meant to be.[6]

To show how the constraints on a good scientific theory follow from the aim of science, we must first see how Aristotle states the latter, and then look at the standards it apparently implies.

The causal structure of scientific explanation derives directly from that aim, which is "reasoned knowledge"—knowledge with explanation as opposed to bare information.

> All inquiry aims at knowledge; but we cannot claim to know a subject matter until we have grasped the "why" of it, that is, its fundamental explanation. (*Phys.* II., 194b19–20)

Now, the question *"why?"* has a fourfold taxonomy, in the famous doctrine of the four causes. This doctrine has various statements, both in the *Posterior Analytics* (71b30–72a6) and in the *Physics* (II., 194b22–195a3, 198a12–25). The aim of science is therefore, according to Aristotle, to provide knowledge of nature with explanation of why it is the way it is, the latter being information that identifies the explanatory factors:

> ... the natural philosopher must try to understand them all if he is to deal adequately with the "why" of anything in terms of each type of explanatory factor: the material, the form, the agent, the "where-fore." (*Phys.* II., 198a23–25)

What standards for, and constraints on, science are implied by this stated aim?

Aristotle gives us many examples of tragedies in the *Poetics*; similarly he gives us numerous examples of scientific theories in the *Physics*. Many

of them are exhibited for criticism, as not meeting the standards he sets. Let us take a look at one, whose shortcomings illustrate how the aim of science can be served only by theories that take a certain form.

In the *Physics* he discusses explicitly what we now call the theory of evolution by natural selection and chance variation, as one bad example. I will quote this at length, for it is thoroughly revealing of just what Aristotle has in mind.

> Writers on nature generally reduce their explanations to "necessity." Since hot and cold (and so forth) naturally function in certain ways, they say, it is by necessity that states of affairs are as they are and arise as they do. [....] So, they ask, why should not nature act, not to some preferred end—but as it rains, not in order that crops may grow, but by necessity? Rising vapor must cool and, having become cool, must turn into water and descend, whereupon crops happen to grow; so, too, if crops on the threshing-floor are spoiled, the rain did not fall in order to spoil them, but this is simply the way things come about. Hence, why should not even bodily parts like teeth have developed in the necessary course of nature—sharp front teeth suited for the tearing of food and flat back teeth suited for the crushing of food? May they not have been produced, not to some end, but by coincidence? And may it not be so with all bodily parts supposedly having some inherent end or purpose? Those organic structures, then, which came into the world as if they had been produced to some end, survived because they had been automatically organized in a fitting way; all others, like the man-faced offspring of oxen in the theory of Empedocles, have perished and continue to perish.
>
> However, this or any similar line of reasoning in objection [to natural ends] cannot be sustained in the sense in which it is usually pursued. All natural products like those mentioned are either always or for the most part generated in definite ways, which is not the case with any products of luck or of chance. (*Phys.* 198b10–35)

Note that the theory's "object"—what it represents—is the entire course of natural history. This is a natural process, not a human action, but it is certainly serious, complete, and of a certain magnitude.

However, this early formulation of the theory of evolution left much to be desired. A simple objection, still heard today of course, is that the chance coincidences on which it relies are simply too much of a coincidence, and too unlikely to be credible. To this specific complaint I shall return below. The more important reason, to which this objection points, is precisely that the theory does not give us the reasoned knowledge, the illuminating explanation, which it is the aim of science to produce. The representation of this large-scale natural process, the history of life on earth, must be such as to accomplish the aim set for science. A good sci-

entific theory must remove, by these means, the obscurity and lack of unintelligibility which even the most familiar phenomena share when simply seen as mere fact and happenstance.

That is Aristotle's standard. We need to have a starting point, requisite to understand even the surface story of the phenomena. ("All teaching and all intellectual learning come about from already existing knowledge," *An. Post.* 71a1–2.) But there is a deeper knowledge to be had, gained from listening to dramaturge or scientist. Each will reveal the heart of the matter, in the universal and necessary conditions of human and natural existence; and the insight so gained is new insight, into what is neither apparent nor familiar but, though far from common understanding, intelligible in itself.

It is precisely in this fashion that poetry is superior to history, in that, although not representing the correct details of what has ever happened or will happen, it presents deeper universal truths. The desire to know and understand leads to a demand upon science to display "the reasons *why*." It is clear in the *Poetics* that this aim is not alien to poetry, might in fact have been included in the definition of tragedy. Right at the beginning, the *Poetics* explains our pleasure in representation as pleasure in learning. Later generations, led by Cicero's simplifications, codified the aim of poetry as "to delight and to instruct." This omits the crucial point that the delight derives from the learning, a point that is clear throughout *Poetics* as a corollary, as it were, to the concept of reasoned knowledge of the *Posterior Analytics*:

> It is the function of the poet to relate not things that have happened, but things that may happen, i.e. are possible in accordance with probability or necessity. (*Poet.* 51a38-39)

> The difference [between historian and poet] is that the former relates things that have happened, the latter things that may happen. For this reason poetry is more philosophical and more serious than history; poetry tends to speak of universals, history of particulars. (*Poet.* 51b 4–10)

The theory of evolution by natural selection and chance variation does not "deal adequately with the 'why'... in terms of each type of explanatory factor." It does not offer us a highly structured causal plot, and so it is not even a *candidate* for a full-fledged scientific account of the matter. That is Aristotle's view, and we still argue today about whether the modern theory of evolution is (a) a counterexample to Aristotle's view, or (b) in accordance with that view with the idea of explanation suitably liberalized, or (c) has been supplied with a tightly structured causal plot after all in molecular biology.

3 Anomalies (of Chance) and Ambiguity (of Aim)

3.1 The Achilles Heel: The Banished Element of Chance

The chance factor, which Aristotle criticizes here when it is introduced in science, is most resolutely banned from tragedy as well. The banishment has two reasons, both of which the above theory clearly violates, *mutatis mutandis*. The first reason concerns the structure taken as a whole. We have already seen (*Poet.* 50b25–33) how a tragedy must represent a complete action, and that this implies a causal structure in which later developments "flow from" the preceding conditions with necessity or probability. The structure is required to be very tight indeed: "its parts (the incidents) ought to be so constructed that, when some part is transposed or removed the whole is disrupted and disturbed" (*Poet.* 51a30).

The second reason is that chance, being one form of the improbable, leaves the action unintelligible. The plot, as we have just seen, must give us a causal process, in which what happens follows from and springs naturally from what came before. This is a matter of possibility, probability, and necessity: "It makes a great difference whether these [events] happen because of those or [only] after those" (*Poet.* 52a). In the tragedy's plot all action must stem from character, must flow from the protagonist's nature, in a way that comes from both his virtues and his flaws (*Poet.* 54a 33–37).

There is in fact a tension in the idea of what is to be found "offstage," unobserved but causing the observed actions from behind the scenes. The unfortunate fact in both drama and nature is that the observed actions are not entirely explicable in universal and necessary terms. Recourse must be had to distinctly curious features of the universe, attributed and postulated as crucial features of the explanation, but a very far cry from intelligible in themselves. In the human narrative character fails as sufficient explanatory factor. The sly, clever Oedipus who made his fortune with his intelligence, solving problems where no one else could see a solution—that Oedipus is slow to understand what everyone sees before him, what Tiresias knows and causes Jocasta, perceiving it, to rush distraught from the room—that same Oedipus is blind to precisely the facts that concern himself most closely.

Similarly, in nature the pervasive constant characteristics, invariant through change and essential to the substance, seem often not to suffice for a causal account.

The theory of evolution by natural selection and chance variation does not meet such criteria. There is, as far as Aristotle can see, only a farfetched unlikely possibility, which does not match the appearance of design. If offered as drama, the theory would fail badly. But does he really lay such strictures on science as well as on tragedy?

He certainly does. In this case, the strictures are explicitly justified by the stated aim of inquiry into nature.

Thus we see Aristotle struggling with chance and luck, and with the inexplicable behind the scenes as well as in front of them. He has three reactions to this problem, prominent in three different places.

First Reaction: Banish from View. In the *Poetics* he is willing to countenance the improbable, the out of character, and even the supernatural, provided it happens off stage and preferably outside the drama altogether.[7] The audience may be willing to treat as believable what it hears by testimony, setting its questions aside, which it would have jeered as dramatic failure on the stage. That is the crucial qualification to his ideal: "In the characters too..., (the poet) ought always to seek what is either necessary or probable, so that it is either necessary or probable that a person of such-and-such a personage says or does things of the same sort, and it is either necessary or probable that this (incident) happens after that one" (*Poet.* 54a33–37). Otherwise, he says, the incidents may be included in the story only if they are left offstage.

> There should be nothing improbable in the incidents; otherwise, it should be outside the tragedy....(*Poet.* 54b6–7; see also 60a26, 61b9)

> The improbable must be off stage to be believable: but must still have a rationale of its own, no deus ex machina allowed even there, but the strictures are loosened, we can accept chance and arbitrariness, acausal sequences, uncaused correlations, ... if sufficiently far off stage. (*Poet.* 54a33)

Here we see the seamy underbelly of the neatly structured causal account or plot.[8]

Second Reaction: Place outside Scope. The second reaction is that of the *Posterior Analytics*, where he simply classifies the particular and infrequent as outside the scope of science.

> To sum up, then: demonstrative knowledge must be knowledge of a necessary nexus, ...; otherwise its possessor will know neither the cause nor the fact that his conclusion is a necessary connection. (*An. Post.* I., 75a12–15)

> Demonstration and science of merely frequent occurrences—e.g. of eclipse as happening to the moon—are, as such, clearly eternal: whereas so far as they are not eternal they are not fully commensurate. (*An. Post.* I., 75b33–34)

This loophole in science, so to speak, was exploited in the medieval Aristotelian tradition to open up space for free will and miracles. What is necessary and universal in nature has been laid down at creation in eternal laws, and these are the proper domain of science. But these laws leave much of what actually happens ungoverned. Thus there is room for many individual spontaneous occurrences that are not determined by nature's necessary structure but that also do not contravene those eternal, universal necessities.

We still come across this conception of science sometimes when some apparently extra-scientific view tries to claim scientific respectability. One example is special creation and miracles: if science only has as its domain the prevalent general, normal patterns of natural history, then it leaves room for exceptions. What happens always or for the most part, to use the Aristotelian phrase, is correctly detailed by science, the defence claims, but we describe the exceptions to the general pattern.[9] In W. Somerset Maugham's novel *The Magician* this is also the defence of magic. After describing magic in tones reminiscent of today's scientific realism ("Magic has but one dogma, namely, that the seen is the measure of the unseen." p. 38) the Aleister Crowley figure explains:

> You should be aware that science, dealing only with the general, leaves out of consideration the individual cases that contradict the majority.... Now there are some of us who choose to deal only with these exceptions.... (p. 40)

Third Reaction: Hidden Determinism. The third reaction is that in the *Physics* where he denies that chance ever ultimately plays a real role—not only is it not acceptable as an explanatory factor, the complete story will always eliminate it. Aristotle first mentions this as a view some have: "Nothing happens by luck, they say, but everything called 'by luck' or 'by chance' has some determinate explanation." But then he goes on to endorse it explicitly:

> In one way there are things which happen by luck, namely, accidentally, so that luck is in some sense an accidental factor; but in another way nothing happens by luck, namely, absolutely. (*Phys.* II., 197a11–13)

3.2 Two Burning Questions

Reflecting on these reactions to the question of chance and Aristotle's motivation, we must naturally ask now precisely how they fared in the subsequent history of science, and how they are related to the underlying view(s) of what science is.

3.2.1 *Is there a Fourth Alternative?*

Modern science broke with the medieval Aristotelian tradition in part by insisting that everything in nature, no matter how particular or infrequent, is within its scope of inquiry and explanation. Contemporary science accepted chance as ineliminable, even if not without a struggle.

But while two of Aristotle's reactions have gone by the wayside, it appears that the first one, the *Poetics*' advice to keep the inexplicable offstage when admitted, is one of science's perennial and lasting tactics. The second law of thermodynamics is now construed as having improbable exceptions, but so improbable that we are assured we will never witness them. The indeterminism rampant at the level of elementary particles is washed out for macroscopic objects. Sixteen dimensions and things which are at once neither and both particle and wave are acceptable when they come with an explanation of why such innovations do not affect how we can accurately picture the happenings at our own middle-sized level.

Even more to the point with respect to Aristotle's doctrines, the causal pattern he insisted on as crucial to intelligibility is missing offstage—precisely where Aristotle thought it would have to be supplied whenever that which is apparent to us does not display an apparent causal structure. We have today two striking examples in the interpretations of quantum mechanics: the GRW model and Bohmian mechanics. In the former, the chance events are too rare and small to appear in any humanly or technologically accessible processes; in the latter, the apparent chances derive from an "initial" distribution, a brute fact beyond the reaches of theory.

Still, Aristotle would presumably have been astonished at the exploitation of this gambit that he allowed dramatists in moderation. He did not propose it as a gambit for science, and here we see the first main difference between his views on tragedy and science. It would seem that the way in which science has escaped the Aristotelian form for science is by placing itself under Aristotelian dramatic form, with a vengeance: the familiar, apparent to us, may now be scientifically represented as unintelligible to us, provided the unintelligible is kept far offstage.

But perhaps I am exaggerating here. There is another possibility: that what counts now as successful representation is not the same any more, that success in representation has different criteria now from those that Aristotle laid down.

3.2.2 *Chance and the Representation of Nature*

Perhaps what Aristotle and many centuries of subsequent reflection saw as the aim of representation in science, the aim to represent nature as instantiating universal necessities and tightly hierarchical causal patterns, is not its aim after all.

Let us consider for a moment whether we can illumine the understanding of nature by thinking of how we could read the *Physics* in the light of the *Poetics*. There again a crucial point springs forward. In the *Poetics*, the discussion of structure is explicitly focused on the structure of the representation rather than of the object represented, while in the *Physics* it seems at first sight the other way round. For in the *Physics* the discussion of structure seems almost entirely focused on the structure of the things and processes to be represented.

Looking back to the *Poetics* we notice that *actually* the attribution of structure is often not to the poetic work but to the human affairs depicted, perhaps not explicitly but often identifiable as tacit background assumption. We may be on the track here of a crucial ambiguity, which appears already at the heart of the theory of tragedy as well as that of science.

There is indeed a striking ambiguity in Aristotle's definition of tragedy. What is meant by saying that the object represented must be serious, complete, and of a certain magnitude? At first sight, this is an independent specification of *the sort of thing the text must be about*. But as we read on, all that follows suggests the alternative reading:

The text is *to represent* its object *as* serious, complete, and of a certain magnitude... to which are then added further more specific qualifiers, as we shall see.

The ambiguity is this: do we have here a stricture on what the text can be about, a criterion of selection before the representation even begins—or a stricture on how the text depicts its object? Should we read this as: a tragedy

(i) *must have as its object* a serious action, complete, of a certain magnitude, ...; or

(ii) *must depict its object* as a serious action, complete, of a certain magnitude, ...?

Perhaps the question is moot unless we are already somewhat sceptical of the aim.

There are two ways in which the question may be moot, and at first they pertain to tragedy and to science respectively. The first is: there is nothing represented, the only action is the represented action, so there is no distinction between the two things I distinguished. At first sight this pertains to tragedy, for even if it is loosely or even closely based on actual events, those are not depicted there as they would be in a history or documentary—the depicted action is a fiction. The second way in which the point may be moot is: the representation is of a real thing or process, hence must be accurate, hence must represent the action as serious, complete, etc. if and only the real represented subject is thus in fact. This one might say pertains to science, since it must aim at the truth.

However, the categories blur if we try to characterize them in this way. Aristotle maintains that the delight in tragedy is a special case of delight in representation, and that this delight is delight taken in learning. What we learn in tragedy, however, is learned through viewing a fiction, which conveys universal truths through its falsehoods of detail—thus being more philosophical than history, as he says. This implies a demand of accuracy in some aspect of the representation, which would presumably be violated if a certain *sort* of action which is not in fact serious, complete, etc. were represented that way. On the other hand, when discussing science, Aristotle pays attention to many scientific theories, most of which he considers inadequate—thus being examples in which the representation does not match the subject represented. We can ask whether they are still good examples of scientific theories, and hence whether, to be a good scientific theory, they must represent their subject as thus or so. Indeed, in the case of the theory of evolution by chance variation and natural selection, as we have seen, Aristotle objects to the form of the theory, which does not meet his requirements for how science is to proceed.

Hence I want to persist with this distinction, even if it is in certain respects (or indeed in all the best and most successful cases) only a distinction of reason. I will not pretend that it is minor to me—with my latter day scepticism, it is for me a crucial real distinction.

4 "Science Is a Representation of a Serious Action, Complete, ..."

> *... [it] is not that language mirrors the world but that speakers mirror the world—i.e. their environment—in the sense of constructing a symbolic representation of that environment.* (Hilary Putnam)[10]

4.1 What Is Representation? The Background in Plato's Dialogues

Aristotle does not tell us what representation is. The term is crucial to his definition of tragedy, but is left undefined. I venture a guess: that for his own academic audience, Aristotle is speaking against the background of the Platonic discussions of the subject. Of course, in one form this suggestion has been standard, namely that we can read Aristotle's *Poetics* as a defence of poetry against Plato's attack in the *Republic*. Plato has it that poetry is representation, and that representation itself is a lie, being at three removes from reality. More specifically, poetry creates an appearance that resembles its object, but is actually so unlike it as to seduce us into error.

Resemblance does not suffice for representation, and no specific resemblance is ever necessary for it.[11] This is not a reason to dismiss Plato's treatment of the subject. Plato had considerably more to say about representation, taking us well beyond the oversimplification in terms of resemblance. I take it that Aristotle and his audience were aware of these discussions (and quite possibly of still more that are lost to us). So I'll begin by outlining the view of representation that emerges from two other dialogues, the *Sophist* and the *Cratylus*.

4.1.1 The Sophist: Distortion Crucial to Representation

Plato makes two important points about representation in the Sophist; I will explain these in reverse order of appearance.

The Stranger speaking in the *Sophist* divides particulars into images and non-images ("real" things). Each sort can be made by humans (artifacts) or by nature (by the Divine: "I'll assume divine expertise produces the things that come about by so-called nature" (265e).[12] Images thus include paintings and poems on the one hand—dreams, shadows and reflections, on the other. Like nature we make both things and images of things: "housebuilding makes a house itself and drawing makes a different one, like a human dream made for people who are awake" (266c–d).

The distinction sounds like an ontological one, as if the world is neatly divided into real and "unreal" things. But we may wonder if Plato did not write that way partly in order to lead his students and other readers to draw a further distinction for themselves: that a real shadow may be an unreal human or animal. (But then, what is a reflection in the water? The water is real, and there is an appearance of e.g. an upside down tree in the water—could we add that the reflection is itself a real thing, though an unreal tree? Which real thing is that? The water?) However, my purpose here is not to follow the *Sophist's* discussion of truth and falsity, appearance and reality; it is only to ferret out what is said about images.

A bit earlier, Theatetus has expressed a rather simplistic "mere" resemblance view of copy making:

> *Vis.* Whenever we call [the Sophist] a copy-maker he'll ask us what in the world we mean by a "copy"....
>
> *Tht.* Obviously we'll say we mean copies in water and mirrors, and also copies that are drawn and stamped and everything else like that. [...] What in the world would we say a copy is, sir, except something that's made similar to a true thing and is another thing that's like it? (*Sophist* 239d–240a)

but the Stranger reminds him that they had already gone beyond that. ("Let's recall that one part of copy making is likeness-making. The other kind was... appearance-making..." (*Sophist* 266d).) The reference, to jog

Theaetetus' memory, is to an early part of the dialogue, which is of special importance to us. There the Stranger first distinguishes the art of likeness-making, "by keeping to the proportions of length, breadth, and depth of his model, and also by keeping to the appropriate colors of its parts." But not all image-makers do that:

> *Vis.* Not the ones who sculpt or draw very large works. If they reproduced the true proportions..., the upper parts would appear smaller than they should, and the lower parts would appear larger, because we see the upper parts from farther away.... (*Sophist* 235d–236a)

Thus distinguished from *likeness-making* is *appearance-making*, in which distortion, sabotaging resemblance, is crucial to the successful representation. Certainly, one thing is an image of another only if the former resembles the latter in some respects, yet it may be crucial to successful representation to make the image *different from* the original in certain respects.

4.1.2 *The Cratylus: Likeness versus Image; The Element of Convention*

Simplistic versions of the resemblance view of representation receive two further blows in the last third (starting at 422e) of the *Cratylus*. Here begins both the discussion of representation (imitation, μίμησις) in general, and Socrates' attempt at a secular/scientific theory of the origin and structure of language in general. His first sally is the assertion that just as music and drawing imitate sound on the one hand, figure and color on the other, so language imitates (expresses, represents) the essence of things (428e). Giving the wrong name, or addressing someone by a wrong name or description is taken as parallel to saying of a picture which is the likeness of a man that it is of a woman or conversely (430b–e). The correct attribution is "the mode of assignment which attributes to each that which belongs to it and is like it" (430c). Correctness and accuracy are here certainly characterized in terms of greater resemblance:

> *Soc.* And further, primitive nouns may be compared to pictures, and in pictures you may either give all the appropriate colors and figures, or you may not give them all—some may be wanting—or there may be too many or too much of them—may there not?
>
> *Crat.* Very true.
>
> *Soc.* And he who gives all gives a perfect picture or figure, and he who takes away or adds also gives a picture or figure, but not a good one. (*Cratylus* 431c)

Here the "mere resemblance" view of representation appears on Socrates' lips, somewhat surprisingly; but Socrates himself will soon put us right on this. When Cratylus draws the parallel with language too simplemindedly, the discussion immediately shifts into a subtler gear. Socrates replies, in partial contradiction to the above: "I should say rather that the image, if expressing in every point the entire reality, would no longer be an image."

To demonstrate the point, Socrates introduces a striking thought experiment. He asks Cratylus to imagine that some god makes an image of Cratylus, and, being a god, makes a perfect copy: "not only a representation such as a painter would make of your outward form and color, but also creates an inward organization like yours, having the same warmth and softness, and into this infuses motion, and soul, and mind, such as you have, and in a word copies all your qualities." Then Socrates asks:

> Would you say that this was Cratylus and the image of Cratylus, or that there were two Cratyluses?
>
> *Crat.* I should say there were two Cratyluses.
>
> *Soc.* Then you see, my friend, that we must find some other principle of truth in images, and also in names, and not insist that an image is no longer an image when something is added or subtracted. Do you not perceive that images are very far from having qualities which are the exact counterpart of the realities which they represent? (*Cratylus* 432c–d)

This does not mean that the role of resemblance in gauging accuracy is simply jettisoned. A little later that role is reasserted (434a–b).

So resemblance plays an important role but cannot be the entire story. Drawing the parallel with language, Socrates now attempts to find some synthesis of the pure conventionalism which he has been combating throughout the dialogue with the resemblance view which is now seen to be inadequate by itself:

> I quite agree with you [Cratylus] that words should as far as possible resemble things, but I fear that this dragging in of resemblance, as Hermogenes says, is a shabby thing, which has to be supplemented by the mechanical aid of convention with a view to correctness. (*Cratylus* 435b-c)

That the copy of Cratylus made by the god to duplicate Cratylus entirely is not an image of Cratylus shows that resemblance is not sufficient to make for representation. That images of things may remain so through small changes, and may be so despite too little or too much color shows that imaging requires at most resemblance in certain respects. And finally, when names and images are ranged under the same category of

representation in general, we must admit even some extreme cases of pure convention without resemblance—but this is pretty clearly kept outside the subcategory of images in contrast to text. Add to this the teleological view of the *Sophist* and we have the rudimentary theory of representation that forms the Platonic background to Aristotle's discussion of poetry as a species of representation.

4.1.3 Mimesis and Teleology

Plato's discussion of natural (as opposed to humanly created) images makes sense (as Paul Woodruff[13] says of μίμησις in Aristotle) only in a context where it is taken for granted that things (and events, processes?) have a τέλος, a function, something they are "for." We can accept that at least within contexts defined by human interests and values, where things are made or co-opted for specific purposes and activities, they have a defining "point" or "aim." Thus we can accept this form of definition for representations which are pictures, paintings, poems, charts, maps, models. The function may be to delight and/or instruct, but in the case of art it may be to delight and/or instruct through effects on the emotions, and in science perhaps only through effects on opinion and intellect. That may or may not be so, in the last analysis, though it may be plausible as a first approximation.[14]

4.2 Striking out on Our own: A Functional View of Representation

It may be a little quixotic to try and insert an answer to the ancient question here: "What is representation?" But since the point of this paper is that we may regard the *Poetics* and the *Physics* as parallel attempts to elaborate definitions of tragedy and of science both as subspecies of representation (both as defined by the aim to represent something, and in a certain manner, to a certain purpose), we need at least a sketch or preliminary answer to this question. Let us regard it as a prolegomenon, and let us include only so much as is strongly suggested by the background to Aristotle's discussion in Plato, adding only what from a contemporary point of view cannot be left unspecified in some way or other.

4.2.1 Plato's Two Counterexamples

So Plato has two examples, in the *Sophist* and in the *Cratylus*, to defeat a simple resemblance view of visual representation. The first is that painters and sculptors must deliberately produce images which are in some respects unlike the original in order to create the appearance of likeness to our perception. Thus the proportions in large statues or statues to be displayed high above us must be unlike human proportions if they are to look to us as having the right proportions. Similarly, when a landscape is drawn in perspective, the drawing looks to us as the real thing does, though the drawn road narrows toward the horizon and the more distant trees are drawn smaller than those nearby. Visual representation is not copying, even though resemblance in some more or less complicated fashion is crucial to such representation.

The second example is that of the perfectly copied *Cratylus*: the god would make a duplicate human being, not a representation of one. Left open here is the possibility that an imperfect copy will automatically be a representation. But that possibility is certainly removed by the *Sophist* example, for there the differences emphasized have an indispensable role in producing a perceived likeness for us, under proper conditions of viewing.

4.2.2 A Crucial (Teleological) Distinction—and a Modern Example

But then we still have the possibility that a representation will be any imperfect copy which has, to us, under proper viewing conditions, the same appearance as the original. It is so easy to imagine how Socrates could deal with such a suggestion! Suppose the god makes a copy of Cratylus with only one kidney, or with seventeen fewer hairs, or a slightly crooked left ear.... Has he produced a representation of Cratylus or another human being? If Cratylus opted for the latter the first time, he must do so again.

But let us insert a distinction here. Under some circumstances, we might well say that in either case, the god has produced a representation of Cratylus—the only point Cratylus must accept is that in general, in such a case, the product would not be an image. Consider the following more modern and more realistic example. I own a famous photo of the Eiffel tower; I make a photographic copy of that photo. Have I produced another representation of the Eiffel tower, or have I produced a representation of the famous photo?

Surely this question cannot be answered immediately. If I use the copy as an illustration in a lecture on photography or in a book on that subject, the copy I made is a representation of the photo. If instead I send it to you with a note saying "wish you were here, Paris is beautiful" then my copy of the photo is an additional image of the Eiffel tower, not of the photo. In the same way we can imagine a god who makes a copy of Cratylus to display a rare specimen of Greek manhood to his fellow gods or for his own contemplation—in that case he did produce an image of Cratylus, although it is also true that he produced another human being.

In Plato's view, a shadow or reflection in water exists in order to create an appearance of another real thing. While we may reject this teleological view of nature, we must admit that in my example, the photo-

graphic copy did exist, was produced by me, in order to create an appearance—in the one case of the famous photo, in the other case of the Eiffel tower. The appearance created may be more or less "lifelike;" and here, as we saw, Plato introduced a new element that we can also invoke. He points out that when we nevertheless take something as proper representation, despite its inaccuracy, custom and convention play a role (*Cratylus* 434–435). Without custom or convention, the very small measure of resemblance between a smiling human face and the symbol :-) would mean nothing; but almost as soon as e-mail became common, everyone understood this symbol as representing a smiling face. When we see it, we take the writer to have put it there in order to give us the appearance of a smile.

It is perhaps a much more modern point that this element of convention or custom, though less in more nearly complete copying processes, is never entirely absent. A photo is transparent to us; not so to primitive cultures.[15]

4.2.3 A Definition of Our own?

After these preliminaries I want to venture, quite tentatively, a proper characterization of representation.

First, I reject the idea that there are natural representations; or to put it positively, assert that there exists a representation only when we make or use something to represent something to someone. There are of course those things that Plato lists as examples of natural representation: dreams, shadows, reflections in the water. Below I'll consider whether these are counterexamples (note for now that Plato immediately classified them as divinely made, thus seeing no exception to the link between representation and intentionality).

Secondly, the target audience may be quite indefinite; it may be ourselves or posterity or an imagined or envisioned model viewer or reader. But this node in the definition must be kept, for we must be able to say that something represents this or that to one person or group and not to another.

Thirdly, since I make or use something to represent something, we must ask what it is to make/use (of)... to.... Let us take as example: I use a rock as hammer, to hammer in my tent pegs. This means that I pick up the rock and bestow on it, for a limited time perhaps, the function normally served by a hammer. A hammer is something produced specifically to serve that function, while a rock is something found and appropriated to serve it, if at all. Therefore, a representation will be something produced or used to serve a certain function, and it is precisely its having that role which makes it a representation.

Fourthly, then, we must describe that function. Actually, I think that the function is complex, and I'll divide it into a primary function and a secondary function.

Suppose I display a table top model with pump, bellows, and two sieves; pointing to these parts I say: this is the heart, these the lungs, the kidneys, ...The primary function of the pump in this contraption is to display its resemblance, in certain respects, to the heart. But it has a secondary function, namely to convey to the audience that it is serving that specific primary function. Something has gone wrong if the audience takes it, not that *the heart pumps* but that *the heart looks like a pump*!

Remember that these things have a function only in that I bestow a function on them, that I use them for something in a certain way; not in and by themselves. Thus to put it more explicitly, the success of my representation hinges on my having made or chosen things that do resemble the organs in the specific ways I have in mind—and equally on my conveying, in this display, to the audience, that I have made or chosen them specifically to display that very resemblance. Thus it is also crucial that I have made or chosen those things, and displayed them in such a way that I have made it possible for the audience to discern the *relevant* resemblance. Here the character of the target audience is a factor: I can rely on custom and convention, as well as background knowledge and beliefs, characteristic of this audience.

Before applying this view of representation to science, let us take an example from contemporary art. I'll choose the well-known urinal entitled "Fountain." which caused a certain stir when it was first exhibited. What I will say about it will not nearly plumb the depths of its artistic significance, but if I'm right so far, it will describe a surface layer of meaning that plays some role in its appreciation.

First of all, the primary function of this urinal, as displayed on exhibition, is to display its own resemblance in certain respects to a fountain. I think the relevant resemblance is, at least in part, that both urinals and fountains, when in use, are basins into which water is falling or streaming. If so, the choice was apt because the urinal does in fact resemble a fountain in that respect—the factual presupposition of resemblance in that respect is important of course. The secondary function of this urinal is to convey to the viewing audience that it is serving that particular primary function. This is accomplished quite simply by the label or catalogue listing "Fountain." A historical moment: representational art of a radically new sort... but trading on its being "readable" as a representation of a fountain in the traditional sense, and as it were commenting on its own place in history. (But let us leave such additional and "meta" functions aside for now, since they are not common to all types of representation.)

4.2.4 A Derivative Sense for "Natural" Representation

Meaning spreads on words like butter on a warm day. The most we can hope for in such an attempt as this, is to delineate a core meaning, and to specify derivatively various uses of the same terms that depart from it.

In the above account I have emphasized use, and the functions bestowed on objects through our use of them. But of course, this is not normally an individual matter. We are born into a world full of meaning, value, and function, which is a given as much as are colors and tastes, phenomenologically speaking. So let us distinguish active and passive representation. The former occurs when I create or use an object specifically to represent something; the latter when I encounter one so used, and am properly receptive. In the latter case we can say "it represents such and such to me," although we have had no hand in the establishment of its functional role, and indeed, the origin of that role may be lost to us in the mists of history. I would only insist that we are born into this world full of meaning exactly because we are born into a community of conscious beings, as members thereof. (Nelson Goodman's concept of "entrenchment" applies here.) Therefore this distinction does not reintroduce the idea of "natural" representation which I eschewed above.

In this light consider an example, I think due to Hilary Putnam. An ant walks in the sand, tracing a line; as it happens this line forms the pattern of a handwritten inscription of "Coca-Cola." This could happen millions of years before humanity, or today but in a part of the Kalahari desert never visited by humans. Is this track the word "Coca-Cola"? Does it denote a soft drink—or, indeed, anything at all? Well, what we can say is that if I were to see the track, a case of passive representation would certainly occur: to me the track would indeed represent a soft drink. But this would be in part because I am a member of a community in which shapes of that sort have a certain function already.

As another example, let us take the very first photograph which, I have been told, resulted from an accident in a laboratory.[16] Imagine that this is true, and so its production was unintentional. I imagine that nothing needed to be done when the first photo was produced to give it its representational role. Suppose it was a photo of a candlestick; everyone seeing it immediately took it to be an image of a candlestick. But I submit that this passive representation (later followed of course by many active photographic representations) occurred in part because the viewers belonged to a society in which drawings and paintings have that representational role. In other words the first photo was like the ant's track in the desert. It is in itself just an object among objects, but coming into a world already charged with meaning it acquires meaning, in that it plays a certain role as soon as it is encountered in proper circumstances. The same goes for Plato's examples of shadows and reflections in the water or on shiny surfaces.

Again, we must not forget that these proper circumstances include the prior shaping of the audience or viewer. Just as today in our society there are still many illiterates and even more people do not know how to read maps, so there are also societies whose members would see our drawings, paintings, and photographs only as flat colored objects. Passive and active representation equally rest on previous practices in many intricate ways.

Finally, an example that I see as definitely beyond the pale of my account. We are all acquainted with theories in cognitive psychology, some ancient, some modern, and some contemporary, which postulate the existence of mental representations to explain vision, memory, thought and intentional behavior. What entities are these? In some theories they are non-physical, in some they are brainstates or something of that sort. Now it is pretty clear that they do not fit my account. They are neither like the hammer nor like the rock; they are not like the ant's track and not like the world's first photo. They were neither created nor co-opted for use by human beings to serve certain functions. Nor do we encounter them and take them as instances of sorts of things that have such functions.

It might be possible, I suppose, to liken them to Plato's examples of "natural" representations, such as shadows and reflections in the water. Indeed, the relevant passage in the *Sophist* includes dreams:

> *Tht*. What kinds of things?
>
> *Vis*. Things in dreams, and appearances that arise by themselves during the day. They're shadows when darkness appears in firelight, and they're reflections when a thing's own light and the light of something else come together around bright, smooth surfaces and produce an appearance that looks the reverse of the way the thing looks from straight ahead. (*Sophist* 266b–c)

But dreaming is among the phenomena putatively explained by such psychological theories, through the postulation of mental representations. So we can't very well just say that mental representations are dreams and the like, or we would lose that explanatory function. Unless we re-institute the idea of "natural" representation, the only way to continue here would seem to be precisely Plato's recourse to divine consciousness, suggesting that mental representations are once created or used in the appropriate fashion not by the humans who have them but by their Creator. Indeed, Theatetus' question above came precisely after that contention (*Sophist* 265e–266d). But such hypotheses are not part of those psychological theories.

Therefore I conclude that we have to do here with a less straightforward meaning relation—in fact with the sort of *metaphoric* or *analogical* extension of language that typically accompanies the introduction of new scientific theories. Mental representations are representations only in the

tenuous sense that elementary particles have spin, color, or flavor. No use denying scientists their liberal prerogative of linguistic innovation! But we'll certainly confuse ourselves if we take them to be speaking literally, in the previously established sense of the words they coopt.

4.3 Representation *Versus* Idolatry

> *Scientific models certainly have their rightful place. But when does a model become an idol, that is, when is it taken for something other than a model, becoming "reality"? [... C]onfronted with the black void of pure instrumentalism, the temptations of reactionary idolatry are very near. Having lost the gods, we fall in love with the beautiful idols we can raise in their places. Atoms, quarks, tiny black holes... they are reified, garlanded, and dragged forward to assume a place in the temple.* (Zajonc, *Catching the Light*, pp. 35 and 302)

Science is representation; it furnishes us with images of nature and natural processes, including those of which we ourselves form part. But, except in a derivative sense, there is no representation except representation by someone, through the use of something, to someone. The locus of representation is consciousness, so to speak: a shadow or reflection in the water is not in and of itself a representation. Almost any thing, however, can be a representation of almost anything else, namely if we select certain aspects of resemblance between them, and bestow certain functions on the former through our use or display of it in some way.

What does this view of representation imply about science? Strictly speaking, nothing that a scientific realist would need to deny. But this view of science and of representation opens up space for more moderate or more liberal ways to think of science. The models which we tend to take very seriously are the latest purveyed by our most successful theories: the latest model of the atom, the electromagnetic field, the cosmos.... That is also where we are most likely to leave ourselves uncritically in the grip of the simplistic resemblance view of representation: the best representation is the perfect copy, and this is our best representation, therefore ... don't you think ... everything in the model is precisely the way it is in reality?

But with a proper view of representation, we need not reason this way. Our best model is the thing which fulfils most perfectly the specific function we have bestowed on it. Here we speak teleological language, and we can be open to suggestions about what precisely the *telos* of scientific representation is.

Take an example: the nineteenth century model of the sun as a sphere composed of a fiery fluid. Certainly this model resembles the sun in certain respects: the molten iron in a foundry or the molten lava erupting from a volcano resemble the visible substance of the sun. However, there is more to the model: it comes as precisely the sort of model suitable to the representation of molten metal, with respect to the then current theories of heat and fluidity. Hence the assumption that this model fits the sun, in more than the most apparent respects, leads to predictions and retrodictions concerning the rate of heat loss, and hence also of the temperature of the earth's atmosphere in the past and future. Since life as we know it is not possible on the surface of the earth if that temperature is significantly less than what it is today, the predictions could be, and were, used to refute Darwin's theory of evolution. For that theory needed millions of years more than the physicists calculated to have been available.

The downfall of this model was not due to direct inspection of the inner structure of the sun. Disagreement with the outward manifestations, together with the availability of new resources for physical modelling spelled its downfall. What I want to point out as noteworthy is that in each part of this discussion, the resemblance at issue is a partial one, important from one point of view or another, to the physicist and to all of us engaged in terrestrial survival.

It is not difficult to speak of science in precisely the terms Plato made available for the discussion of images and representation. Above I suggested a format for an Aristotelian definition of science (analogous to the definition of tragedy). Let me suggest completing it in this fashion:

> * *Science is a representation of nature, in mathematical deductive form, accomplishing by these means the reliable prediction, description, and control of actual observable and manipulable aspects of our world.*

This is an empiricist view of science, stated as subspecies of the view that science is representation, in certain forms and subject to certain constraints. It gives, to be honest, a lower status to science than many would applaud, and a higher status to us, the representors, than to science, the representation we create. For it denies to science the role of being the true mirror of nature, and denies it a claim on our loyalty as sole source or measure of what is real.

But empiricism is not instrumentalism. The empiricist view implies that scientific representations are meaningful, as stories and as pictures, as dramas and as architectural blueprints. They have meaning and content, they say much and have much to tell us about the world we live in—and about ourselves—when we constitute ourselves as their proper audience. Their importance is in their usefulness to us, and that is why we create these beautiful, complex, awe-inspiring mathematical images, to have them fulfil the function we bestow on them in order to serve some of our most important intellectual and practical aims.[17]

I submit that to be dissatisfied with this much is to hanker for idols, as Zajonc says. We enter, at this point of the dispute between realists and empiricists, the realm of value judgement. The realist may sense in empiricism a certain impiety, perhaps, toward these awesome human creations, or may experience a sense of lèse-majesté if we place human existence at the center even when we reflect on the theory of nature. But for the empiricist it may be a welcome release from some of the many idols to which Francis Bacon pointed out our tendency to succumb, or freedom from dominance by a worldpicture that can certainly be valued in ways falling short of pious submission.

NOTES

* I want to thank Fran O'Rourke, for calling my attention to the passage in the *Metaphysics* which opens section I, as well as for his helpful comments and discussion, and Jill Sigman for extended discussions of representation and her critical comments on my ideas about that perennially difficult subject.

1 It is a more familiar point that the teleology in Aristotle's science was rejected in modern times. My point is that the rejection encompasses much more; and remarkably, the organic unity of nature which in Aristotle's worldpicture was teleological is found in modern physics though ungrounded in teleology.

2 *The Works of Aristotle Translated into English*, 12 vols, ed. W. D. Ross (Oxford: Clarendon Press, 1908–1952).

3 Here and elsewhere I use, *Poetics*, trans. R. Janko (Indianapolis: Hackett, 1987).

4 The kind of learning Aristotle points to is simply figuring out what the image, or various parts of the image represent—as in "that is Icarus, you can just see his legs." But the point is general.

5 Here and elsewhere I use, *Physics*. Translated by R. Hope (Lincoln: University of Nebraska Press, 1961).

6 We cannot develop this here, but I have a subversive suggestion, contrary to the tradition that identifies catharsis as the aim of tragedy (as opposed to a means to achieve that aim). If we imagine that the plan of the *Poetics* was basically the same as that of the *Physics*, what would we conclude? We would look for a deduction of the structure of tragedy from its aim or end. In fact, we do find something surprisingly like such a deduction, but not from the stated end of catharsis. Rather, it is a deduction based on the question: if a tragedy is to represent universal, necessary, pervasive aspects of the human condition, in those situations that we take as tragic, what must its structure be? This question is answered quite explicitly, with the answers based on a certain view of human affairs as well as on the ontology behind their description, most specifically implying a certain causal structure similar to that found in the description of nature in general in the *Physics*. So we do have a putative deduction of the structure of a good tragedy from something classifiable as an aim or end.

7 Cf. also Deborah Roberts, "Outside the Drama: The Limits of Tragedy in Aristotle's Poetics," in *Essays on Aristotle's Poetics*, ed. Amélie Oksenberg Rorty (Princeton: Princeton University Press, 1992), 133–154.

8 As Dorothea Frede points out, Aristotle allows himself quite a lot of leeway with respect to necessity in different contexts, not all as strict as appear in the *Posterior Analytics*. While he insists on omnitemporal validity especially in his discussion of the first premises of scientific demonstration in the *Posterior Analytics* and at other places where he discusses the ideal of science (cf. *Met.* E.2), in his dealings with nature and the natural in the sublunary sphere he entertains often a much more relaxed and diversified conception of necessity" (D. Frede, "Necessity, Chance, and 'What Happens for the Most Part' in Aristotle's Poetics," in *Essays on Aristotle's Poetics,* op. cit., 201).

9 It is actually not so easy for us now to deal with this gambit if we regard extant science as probably only approximately accurate—as many scientific realists in fact do too. But we can reject the gambit through a more thorough exploration of the structure of science. See further my "Science, Materialism, and Bad Faith," in *Warrant in Contemporary Epistemology: Essays in Honor of Alvin Plantinga's Theory of Knowledge*, ed. J. Kvanvig (New York: Rowman and Littlefield, 1996), 149–181.

10 Hilary Putnam, *Meaning and the Moral Sciences* (London: Routledge and Kegan Paul, 1978), 123.

11 There is a considerable recent literature on this. Perhaps Nelson Goodman made this point the most salient and drew the most radical consequences. See N. Goodman, *Languages of Art: An Approach to a Theory of Symbols* (Indianapolis: Hackett, 1976); D. Arrell, "What Goodman Should have Said about Representation," *Journal of Aesthetics and Art Criticism* 46 (1987–8): 41-49 with N. Goodman's, reply ["On What Should not be Said about Representation," *Journal of Aesthetics and Art Criticism* 46 (1987–8): 419]; C. Files, "Goodman's Rejection of Resemblance," *British Journal of Aesthetics* 36 (1996): 398–412; D. Lopes, *Understanding Pictures* (Oxford: Oxford University Press, 1996).

12 I use here and hereafter B. Jowett's translation (*The Collected Dialogues of Plato,* 4th ed., trans. B. Jowett, Oxford, 1953).

[13] Paul Woodruff, "Aristotle on Mimesis" in *Essays on Aristotle's Poetics*, op. cit.

[14] Thus P. Woodruff (op. cit.), argues that Aristotle's "μίμησις" is mistranslated as "representation," precisely because that word in its current meaning does not have this connotation which requires a context of intentions, functions, and goals. He suggests "a general answer to the problem of defining *μίμησις*. Μίμησις is the art of arranging for one thing to have an effect that properly belongs to another: *M is a μίμημα of O just in case M has an effect that is proper to O*" (91). He adds: "This theory depends on the idea that there is a natural order in which μίμησις can intervene. One reason μίμησις has been hard for modern thinkers to digest is that it belongs to a nest of concepts that are intrinsically teleological. Μίμησις is best understood as a goal-directed activity; specifically, it is an activity that aims at producing effects that are normally produced by other means; but this makes sense to you only if you think of objects and their effects as somehow being designed for each other. Μίμησις breaks the natural order of design and effect. That is why it is wonderful and exciting, and that is why it gives us a safe way to learn things about lions—through pictures—and a pleasant way to develop courageous habits of mind—through music or dance" (92). A very similar suggestion is made by G. Sörbom ["Aristotle on Music as Representation," *Journal of Aesthetics and Art Criticism* 52 (1994): 37–46] as reading for the *Sophist*. How can we say that a moving animal, for example, is real, while its shadow is not real, but an image or appearance of an animal? We can make this distinction if we take teleological distinctions and status for granted, and take the shadow's function or nature to be nothing but *to resemble* the animal in certain respects, to provide a two-dimensional likeness in nature—i.e. that it has no function beyond being similar to the latter object in that respect. This addition of teleological terms is needed precisely because Plato clearly states that resemblance in some respects is not sufficient to make something an image (Sörbom, op. cit., 39).

[15] Again, a topic much discussed in recent times: see e.g. E. H. Gombridge, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (Princeton: Princeton University Press, 1961); K. Walton, "Transparent Pictures: On the Nature of Photographic Realism," *Critical Inquiry* 11 (1984): 246–277; J. Friday, "Transparency and the Photographic Image," *British Journal of Aesthetics* 36 (1996): 30–42; D. Lopes, *Understanding Pictures* op. cit.

[16] The story is probably apocryphal. See D. Park, *The Fire Within the Eye* (Princeton: Princeton University Press, 1997), 267.

[17] I may be faulted here for thinking only of description rather than explanation, and thereby skewing the comparison of realists and empiricists. The former see the removal of wonder, through explanation, as precisely one of the main intellectual tasks of science (thus continuing Aristotle's emphasis on reasoned knowledge). I have argued elsewhere against giving a predominant place to the satisfaction of that "sentiment of rationality" (thus continuing William James' emphasis on the proper status of that desire). Let me go a bit further here and compare the view of science as having explanation as its main aim with a largely discredited, simplistic view of what Aristotle meant by κάθαρσις. I refer to the "therapeutic" reading of the *Poetics*, which interprets κάθαρσις as a literal purging of certain harmful emotional conditions. The objection against the therapeutic interpretation is that it makes the emotionally and intellectually disadvantaged the most appropriate and best audience—the audience in the appropriate condition for receiving the benefits! Parallel for science: the explanation-satisfaction views according to which the real purpose of science is the relief of wonder and of agnosticism (in Isaac Levi's priceless phrase). The therapeutic interpretation of tragedy fits rock concerts rather better than Sophoclean tragedies, crafted for an emotionally mature audience which delights in the representation as representation (i.e. whose delight in representation is something quite different from any delight to be had in perception or living through the represented action). I will leave it to the reader to draw the parallel for science.