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METAPHORS AND MODELS IN MEDICINE

ABSTRACT. This paper aims to show how medical scientists may use metaphor in ways closely parallel to poets. Those who believe metaphor has any role at all in science may describe its use in various ways. Associationists think metaphors are based upon likenesses, and collapse the notions of model and metaphor together. But, as an example from the work of Louis Pasteur suggests, metaphor need not be based upon likenesses. Rather it may play a role in making possible a model's explanatory significance. Models may presuppose metaphors. The Pasteur example also suggests metaphor may play a part in creating likenesses through its role in classification and reclassification. It is in these ways that the use of metaphor in medical science most closely parallels that in poetry.

KEY WORDS: imagination, metaphor, model, likeness, medical science, medical scientist, poetry, poet, vaccination, Pasteur

INTRODUCTION

Both poetry and medical science are imaginative, and may be imaginative in a closely parallel way. The aim of this paper is to show one way in which imagination may appear in medical science. That is in the use of metaphor. Imaginative metaphor may make and remake the objects of medical science. It may do so through models whose application it may be said to underlie.

That scientists and poets are imaginative in a closely parallel way may seem a strange claim. True, a number of poets have been interested in science.^a However when being a scientist the poet might be presumed to hold back her more fanciful or imaginative leaps. Metaphor, being such a vivid example of such leaps, would seem especially in need of restraint. Poetically the lion is the 'king of the beasts'. But we do not make some metaphorical animal social hierarchy the basis of a taxonomy in zoology.

METAPHORS IN SCIENCE

Two schools of thought exist about the role of metaphor in science. One, the anti-metaphor school, holds that metaphor has no role in science. The other, the pro-metaphor school, holds that it does.



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Those who hold that metaphor has no role in science argue that metaphors are deceptive, false, and good only for linguistic decoration.^b Metaphor, for these writers, involves the application of terms and distinctions which are quite appropriate in one place to another place where they are quite inappropriate. The metaphor 'man is a wolf' means what it literally says. However, man is not a member of the dog family, and does not hunt his food in packs. Nor do wolves have ruthless political or economic motives. In a poem or a speech a point can be carried by means of the shock-tactics of metaphor. Science, however, is not a matter of rhetoric or persuasion but of demonstration and truth.

In contrast, the pro-metaphor school holds that metaphors can play an important role in science.^c They see metaphor playing a part in generating hypotheses, extending explanation, stimulating original thought, and so forth.

It is difficult to see how to resolve the issue between the anti- and pro-metaphor schools without attempting too much. The validity of metaphor within science may vary with the account of science which one takes to be correct. However, deciding which account of science is correct is certainly beyond the scope of this paper. Moreover, the nature of metaphor is itself philosophically controversial. This is not reflected only in the broad disagreement between the anti- and pro- schools. The pro-school is itself divided on how exactly metaphor is to be understood. It is not possible for this paper to adjudicate on all the philosophical issues surrounding metaphor. However, it is possible, and will be useful, to say more about the wider debates on the nature of science and metaphor. My position should be seen in their context. I will start by considering debates about the nature of science, and then move on to consider debates about the nature of metaphor.

The Nature of Science and of Metaphor

Some philosophers of science claim that all we can know in science is what appears to us through our senses. This is a view which reflects a broadly empiricist perspective in philosophy, underpins the logical positivist position, and at its extremes leads to phenomenalism (¹¹, pp. 68ff; ¹², 506–550). Other philosophers of science believe that we can have knowledge of what underlies appearances, reflecting a realist commitment also to be found in philosophy more generally. These are differences on the grand scale which have consequences for the role of metaphor in science.

Suppose a logical positivist position is taken. The positivist believes that in science we can know only the things we can see or otherwise sense, and hence has little truck with speculation about why or how things are

the way they are. Faced with a certain pattern of experience, a positivist inclined doctor may use notions such as Chronic Fatigue Syndrome (CFS). She will not believe in a disease entity (Myalgic Encephalomyelitis; ME) which 'explains' this pattern. In eschewing such explanations a positivist account of science eschews the mechanism of metaphor by which such explanations might be produced. Positivism tends to eschew metaphor.

A philosopher of science can, however, believe that science seeks for knowledge in and of that which underlies and explains the phenomena we perceive. It does not follow that these philosophers will be members of the pro-metaphor group. However, a philosopher of science for whom explanations are central may at least allow room for metaphors where they help create these. Metaphor may help explain Chronic Fatigue Syndrome on the model of a viral disorder such as glandular fever, or schizophrenia on the model of essential hypertension.¹³ More broadly, diseases in general may be explained in functional terms.

How metaphor may do this leads us to the second debate concerning the nature of metaphor. On this the main members of the pro-metaphor group split. Some give a causal explanation, others a non-causal, associative, explanation. For the causalists, metaphors do have a meaning. 'Man is a wolf' means just what is asserted, that man is a wolf; 'no man is an island' again just means that people are not islands. The associationists think that metaphors refer to likenesses among the associations of the two ideas in question. 'Man is like a wolf' invites us to think of people in terms of the ideas associated with wolves. The idea that the body is a functioning machine could be construed in either way.

Applied to science, the causalists see metaphor working like an unexpected noise, or a bang on the head, producing pictures in the mind perhaps. Pictures are pictures, not alternatives to further true or false verbal ideas or content. Hearing the metaphor 'light wave' the scientist sees superimpositions of bright objects and ocean waves. How the scientist's thought might then go on is not determined by that picture. 'The body is a machine' may bring to mind images of clocks, pumps, car engines, and so forth. The associationists on the other hand speak of applying the explanans (i.e., what does the explaining) to the domain of the explanandum (i.e., that which is to be explained). Take the notion of sound waves. The associationist believes that we take things we associate with waves in water, and apply it to sound. We may then speak of wave lengths of sounds. The body is a machine enables us to speak of the functioning of specific organs.

In what follows I shall suggest an account of how metaphors may work in science which is not either precisely causalist or precisely associationist. Let me start with an example.

METAPHOR IN MEDICAL SCIENCE: AN EXAMPLE

Consider this example, taken from a popular book on the life and work of Louis Pasteur by René Dubos:

Pasteur had begun experiments on chicken cholera in the spring in 1879, but an unexpected difficulty interrupted the work after the summer vacation. The cultures of the chicken cholera bacillus that had been kept in the laboratory during the summer failed to produce disease when inoculated into chickens in early autumn. A new, virulent culture was obtained from a natural outbreak, and it was inoculated into new animals, as well as into the chickens which had resisted the old cultures. The new animals, just brought from the market, succumbed to the infection in the customary length of time, thus showing that the fresh culture was very active. But to everyone's astonishment, and the astonishment of Pasteur himself, almost all the other chickens survived the infection. According to accounts left by one of his collaborators, Pasteur remained silent for a minute, then exclaimed as if he had seen a vision, "Don't you see that these animals have been *vaccinated!*" (¹⁴, pp. 113–114, Dubos' italics)

Dubos comments:

To the modern reader, there is nothing remarkable in the use of the word "vaccination," which has become part of the everyday language. But this was nearly a century ago. Then the word vaccination was used only to refer to the special case of injection of cowpox material for inducing protection against smallpox. (¹⁴, p. 114)

There is nothing remarkable to our ears in Pasteur's words, but to the ears of Pasteur's contemporaries, there would have seemed something remarkable in what Pasteur said. Dubos draws our attention to the unusual use Pasteur makes of the word 'vaccination'. There is something of the incongruity of metaphor in Pasteur's use of this word. Assuming this is an example of the use of metaphor, what might be going on here?

In using the term 'vaccinated' with this reference, Pasteur is both changing it, and not changing it.

He is changing it in the following sense. Up to that time, it had referred to protection against smallpox by the inoculation of cowpox (recognized by Edward Jenner in the late eighteenth century). Pasteur uses it to refer here to the inoculation against virulent chicken cholera by non-virulent chicken cholera. In doing this he makes the application of 'vaccination' to vaccination against smallpox a special case of something which can also refer to inoculation against chicken cholera by the use of chicken cholera.

This 'creates' a new referent – a new thing (albeit an abstract thing) for the word to refer to. That is the general concept of 'inoculation by disease against disease' of which Jenner's vaccination and the chicken cholera inoculation are both examples. The idea is that Pasteur recognises that 'vaccination' is not the name of a particular process (the protection of humans against smallpox by the inoculation of cowpox) but is rather the name of something more general. It is not clear (at the time the word is first used in this way) how many other examples may be discovered, or created, or annexed to this concept. Now we vaccinate against polio, whooping cough, TB, and so on.

There is also a sense in which Pasteur does not change the term (for everyone or immediately or, importantly, permanently). For it is the 'wrongness' of the application by the existing criteria which expresses his vision. If it wasn't 'wrong', 'odd' or 'incongruous', Pasteur's colleagues would not have noticed anything in his words. Pasteur would simply have been using the word 'vaccination' as it was supposed to be used, and nothing unusual would have been expressed in its being used to refer to the survival of some of the chickens. However, according to one of his collaborators, something visionary seemed to have been expressed, and the verbal surprise experienced at the time at the very least marks that.

The view that Pasteur is misusing the term 'vaccinate' can, however, be challenged. It might be argued that Pasteur was expressing an unusual capacity for observation.^d He has noticed something, something which could have been seen (and perhaps, no sooner had he said it, was seen) by his colleagues. This allows for an apparently unusual use of the word, without necessarily committing us to the idea that it was a misuse, a metaphor. Scientists typically claim to have seen things which are 'odd' or 'remarkable'. Galileo saw moon-mountains. These, on contemporary beliefs, should not have been there, for it was axiomatic that the moon was a 'perfect' body, not subject to earth-like imperfections (for a brief account see ¹⁵). Galileo's claim 'there are mountains on the moon' may, then, have sounded very odd, on first hearing, rather like a metaphor. However, the oddness turned out to be in the heavenly bodies. It was, if you like, an observed oddness, not a logical (verbal) one.

Applying this to Pasteur, what might he have observed? The most obvious parallel would appear to be the survival of the chickens. This, like the moon-mountains, was a quite unexpected feature of the observable world. However, this is not what we are trying to account for. It is Pasteur's exclamation that what he and his colleagues were seeing was 'vaccination' which we want to explain. The Pasteur example is not then merely an example of being surprised at what the world may throw up.

It may instead be suggested that what Pasteur and only Pasteur saw was the connection between the survival of the chickens and their earlier having been given another dose of chicken cholera. However, this won't do either. Undoubtedly Pasteur did recognise that the chickens that survived were the ones that had earlier been inoculated with another strain of chicken cholera. But even if Pasteur was the only one there to notice that, his ejaculation clearly refers to something more. If which chickens survived was what was at stake, Pasteur could have exclaimed 'Don't you see? It's the chickens we inoculated in the summer that have survived, and not the others!' In exclaiming that they had been vaccinated, Pasteur is doing more than reporting which chickens had survived.

If Pasteur did observe something, then, what could it have been? The strongest candidate seems to be likenesses between inoculation by weak chicken cholera against chicken cholera and 'vaccination' (as understood by Jenner). The idea is that these likenesses are what were noticed by Pasteur, and that they explain his outburst, and his way of putting things. The verbal usage would have sounded odd because only Pasteur noticed the likenesses. Because initially only he noticed these, only he was able to make the extension of the category of 'vaccination' which follows from seeing the similarities.

The problem with this claim is that, though there may be likenesses to observe between Jenner's 'vaccination' and what Pasteur saw happen to the chickens, there are also a number of differences. Chicken cholera inoculation involves 'vaccination' with a disease against *itself*, whereas what Jenner had observed among milk maids was protection against one disease by contracting another. And there are more obvious differences; in Pasteur's case we are dealing with chickens, not people, with chicken cholera and not cow or smallpox.

It is tempting, perhaps, to respond that this exactly picks out what made Pasteur a notable scientist and made his use of the word 'vaccination' seem odd at the time. The differences are perhaps what struck his collaborators, if, indeed, they even thought of 'vaccination' at all at that moment. It was, however, the likenesses which struck Pasteur. The scientist seeks, among other things, to find generalisations, to explain the many by the few, as it were. As an original scientific thinker, we would expect Pasteur to observe similarities where they had not before been noticed. In the example, Pasteur notices the similarities and concludes that one explanation will do for both events.

However, this leaves something to be explained. The scientist does not seek just any generalisation abstracted from just any likeness, but has to distinguish between what is significantly shared and what is trivially or

irrelevantly shared, and between what is significantly different and what is trivially or irrelevantly different. Suppose that Pasteur remembered that Jenner had first reported his findings on the very date that he (Pasteur) was brought face to face with the surprising chickens. This is a similarity, but I imagine few would regard it as significant. Equally, the fact that the events Jenner and Pasteur observed took place in different countries is a difference, but an entirely irrelevant difference.

In trying to show that it was in his powers of observation that Pasteur's genius lay, we cannot drop the notion of relevance: if we do, we do not seem to have explained Pasteur's 'vision' at all. All we would be left with would be the recognition of the *existence* of certain similarities. (Though, as I will later suggest, this claim may contain something more interesting.) What is wanted is more than an account of Pasteur observing similarities, for it needs to be added that he seemed to see too what they meant – that the survival of the chickens was owing to their having been 'vaccinated'.

Now, this significance or meaning of the similarities between Jenner's vaccination and Pasteur's chicken cholera inoculation cannot be explained merely in terms of the existence of those similarities. That is to say, similarities of the kind considered here do not speak for themselves. Indeed, it is quite impossible for similarities simply to determine which things are of which kind. Given the multiplicity of our engagements with the world, all things can be seen to be multiply similar to other things, but not all things are thereby placed in 'kinds' identified by these similarities. There is not, in a general sense, a 'kind' of round red things, although there are many things which are more or less round and more or less red.

It may be suggested that, in some cases, we can move from similarities of features to sameness of kind by adding further observations as to the pattern and frequency of similarities. Where similarities co-occur in individuals at above chance rates in a large enough and non-selected population, we may speak of them as pointing to the existence of kinds (see ¹⁶ particularly Chapter 1). However, this suggestion is more or less irrelevant to our case. Even if its account were well and good where large numbers of cases are involved, Pasteur's exclamation is clearly not based on a large sample population, nor on the careful quantification of co-occurrences.

If Pasteur saw similarities, what could have made him think they implied that the chickens had been vaccinated? It is natural to think that if both vaccination (as Jenner understood it) and chicken cholera inoculation against chicken cholera are the same kind of thing then the similarities will tend to be of significance, while the differences will be less so. It would not matter that in one case it was chickens and in the other humans, in one less

and more virulent strains of one disease and in the other two quite different diseases. If the two are of the same kind the similarities seem to stand out. But this does not help us move from the observation of similarities to the recognition that vaccination and chicken cholera inoculation are of the same kind. For in what I've just said the significance appears in the light of the fact that the two are of the same kind rather than the likeness of kind appearing in the light of the similarities.

Where the significance of the similarities appears only in the light of the sameness of kind, similarities have no role to play in deciding what kind of thing Pasteur saw at all. This is not a point about the temporal order in which we may suppose things happened. I'm not suggesting that Pasteur had the idea that the chickens had been vaccinated, but had to wait for the proof. Mine is a point about the logic of the role of likeness in attributions of kind. Since likenesses are observed (logically) afterwards; they can have no role in the attribution of kind.

It would surely be wrong to conclude from this that likenesses among things lack all significance. A question then arises as to whether likenesses can, on their own, press upon us forms of significance other than that of identity of kind. Could there be an explanatory significance in certain likenesses, such as those hypothesised between sound and waves or between the human body and machines? The answer I think is there can be, and this is where the notion of models comes in.

MODELS AND METAPHORS OF THE BODY

The associationist group hold that a whole explanatory structure may be applied away from its original domain to another superficially different domain. This seems to collapse the notion of metaphor into the notion of a model. In this section I shall oppose the associationists by considering metaphors and models as distinct though related notions.

*Gray's Anatomy*¹⁷ starts from the proposition that the body is a functioning machine. I quote from the introduction:

...all functions occur in structures and the basic medical discipline, anatomy, necessarily provides a basis for all functional studies. But the anatomist may, and often does, stop the machine, describing it, even ad nauseam, without appeal to its function. This policy, though fortunately not often nowadays pursued to the ultimate, deprives the subject of its content of rationality. It is difficult to imagine investigation of a structure without a concomitant desire to elucidate function, development or any other aspects of structure. Long ago Descartes described man as a complex of machinery – biochemical, micro- and macro-anatomical – and machines work; all *living* structures are constantly changing at one level or another. (¹⁷, p. 3)^e

There are, at least on the surface of it, no verbal surprises here. The ideas are at least familiar. Someone may say that describing man as a ‘complex of machinery’ is merely a useful way of conceptualising the body. A likeness is implied between the body and material things generally, which has in some cases an explanatory utility, but no identity of kind can be inferred. Moreover, it may be said that the utility of this way of thinking is restricted. This is but one way or level of looking at the body (it could usefully be thought to be like several other things). The ‘functioning structure’ model is only one of these, and a fairly basic one at that [cf. ⁹]. The associationist might well hold that this makes the metaphor ‘the body is a complex of machinery’ a model.

However, in its more detailed anatomical description, *Gray’s* use of models seems to be based on something deeper.

As in most musical instruments, the mechanism of speech consists of three essentials: a source of energy, structures capable of periodic and aperiodic oscillations and a resonator. Energy is derived from the velocity of the expired air, oscillation primarily from the vocal folds and resonance from the multiform ‘column’ of air extending from the folds to the lips and nostrils. (¹⁷, p. 1257)

The description continues in yet greater detail in the same vein.

What we see here is how deep the idea that the body is a machine goes. Initially, the musical instrument is presented as a model of the human vocal organs and the way they work. It is effective and explanatory, however, because we already see the body in terms hospitable to such a model. That is, we see the body as a machine (in a general sense; not as any particular machine). We may infer from the second passage from *Gray’s* that: ‘The human vocal organs, like a musical instrument, are a machine’.

Let me put that in a little more detail. The human vocal organs and musical instrument have certain features in common. These shared features are, first, non-trivial. They help to explain or understand the workings of both the relevant kind of musical instruments and the human vocal organs. The shared features are, also, extensive. They cover a substantial part of the ‘domain of the explanandum’ – the range of important features of the thing which is to be explained or understood. In this particular case, it can be said that the features mentioned in *Gray’s* are what really matter to any anatomical description of the human vocal organs (just as they are what chiefly matter in any description of the workings of musical instruments). Moreover, the shared explanatory features of musical instruments and the human vocal organs are mechanistic.

But lying behind the significance of these likenesses is the assertion (which logically precedes the significance of these likenesses) that the two things are of the same type. It is because of this likeness of kind

that what is, for example, explanatorily significant in one will be explanatorily significant in the other. This claimed likeness of kind is not itself based upon, extrapolated or generalised from these significant likenesses. The application of explanatory (particular machine) models in medicine is based upon a prior metaphor, that is, the simple assertion that the body is a machine.

Models should not be equated with metaphors, contrary to what the associationist group suggests. Nevertheless, models and metaphors are connected. The associations and likenesses which give machine models of the bodily organs their explanatory force presuppose that the body is mechanical. The presupposition is expressed in the metaphor 'the body is a machine'.

METAPHOR AND SCIENTIFIC RATIONALITY

I have suggested that models used in medical science may be based on metaphorical assertions of identity. Models are based upon metaphors, but metaphors need not be based upon likenesses or other observable phenomena. In this respect they seem groundless. This may seem somewhat threatening to science as a rational enterprise. In this section I shall consider this threat.

The concern for the rational scientist is that non-associationist notions of metaphor make science too much like poetry. The existence of assertions of identity of kind which is groundless with respect to similarities among objects seems to invite into science the anarchy welcomed in poetry. Surely the difference between poetry and science is represented by the presence, and indeed fertility of such anarchy in poetry contrasted with its absence in science.

Now, rationality is not absent from poetry. The poet, or critic, can say things about a choice of words in a poem, and, of course, a poet can revise and reword her poem as she works on it. In making such changes, a poet may be able to give reasons for choosing one word rather than another. Moreover, a scientist does not necessarily justify everything she holds. The fundamental assumptions of Newtonian physics went unchallenged for many generations. When they were challenged, they could not be justified. The idea that the body can be described mechanically may be so deeply embedded within a doctor's thought that it is never questioned, let alone justified. That is not to say that it cannot be questioned. However, in both cases, scientists proceed quite rationally upon the basis of ideas which are not rationally held.

In the idea that scientists proceed or go forward upon the basis of their assumptions, however, we do seem to have a distinction to hand. A poet who uses the metaphor 'green thought' (²⁰, p. 101) need not believe that thoughts are coloured, nor act upon that. A scientist would tend to believe that the body is a machine, and would act upon that. That is to say that these metaphors enter the poet's life and the scientist's life in very different ways. The words of the poet do not go to the bar of belief about the world; the scientist's do.

This difference between poetry and science, however, does not apply to metaphor in science in quite the simple way it may seem to. Pasteur wants to call what happened to the chickens 'vaccination'. What would it be to take this claim to the bar of belief about the world? We may observe that there is a sense in which Pasteur's 'claim' makes certain facts significant or emphasises them: *viz.* the fact that both chicken cholera inoculation and vaccination (as then understood) are examples of protection against a disease by inoculation of a disease. But what facts might be brought in to bear witness against the identification which Pasteur has made, in order to test it? I have already canvassed the differences between what Pasteur witnessed and what vaccination then referred to, but these differences did not count against the identification of the two. The identification was made despite them.

We may make a similar point with the idea that the body is a complex of machinery. This way of looking at the body enables someone to make a specific mechanical analogy (musical instrument to human vocal organ). It makes sense to question a specific analogy of machine to organ or system of the body. Perhaps the vocal organs are more like a musical instrument than they are like a bicycle pump. But, how is the identification of the body as a machine to be tested? If the vocal organs are not much like a bicycle pump, nothing follows for the general identification of the body with machinery.

To challenge that, someone may produce an alternative identification. Perhaps the body is a society of elements rather than a machine.^f In the light of this, the idea that the vocal organs are like a musical instrument, in so far as the musical instrument is a machine, will certainly be rejected. But if the body is a society no facts about the body will seem to bear any particular machine analogy out any longer. The facts now appealed to have, as it were, occupied the whole body, while the previous set of facts about the body have been evicted, lock, stock and barrel. The facts which occupy the space of the body come with the general way of looking at the body. But then, they do not help mediate between different ways of looking at the body, or test them in any way.

To test Pasteur's claim or the idea that the body is a machine against the world seems to be impossible. Metaphors, whether in science or in poetry, resist such tests. This of course leaves us with questions. What makes us choose between ways of looking at things such as the human body? It also suggests a way of distinguishing between metaphors and hypotheses. Metaphors would be those claims of identity which could not be tested; hypotheses would be those claims of similarity which could be tested. When Harvey suggested that the heart was like a pump circulating the blood, he hypothesised that there must be vessels which completed the circulatory system. These vessels, the capillaries, which he never observed himself, were later discovered. His hypothesis was tested and proved correct (see ¹¹, p. 93; ²¹, p. 122; and ²², pp. 152–169 and pp. 209–213, for an account of these events and sources).

However, we cannot test whether the body is a machine by reference to facts about the body. This is not a hypothesis, but a metaphor.

LIKENESSES AND METAPHOR

When, much to everyone's astonishment, Pasteur's chickens survived, Pasteur exclaimed that they had been vaccinated. The grounds for his exclamation could not have been the mere existence of likenesses between what he saw and what vaccination was understood at that time to denote. We have to add something – that two things are of the same kind, for example – in order to grant to likenesses certain meanings. And then, when we do, we find that the meaningfulness is not classificatory. So far the presumption has been that the likenesses are observable. It is their role which has been reassessed, not their existence

However my argument can be extended to their very existence. Consider the similarities in the case of Pasteur's chickens. One of them was that, in both cases, we have prevention of disease by inoculation with disease. Now, this similarity is an abstraction from the fact that, in one case we have milder strains of a disease preventing death from more virulent strains of itself, and in the other we have one disease preventing death or other serious long term effects from a second disease. Indeed, if we omit such abstractions as 'disease', we are left with even more particular descriptions. 'Disease' is substituted by 'chicken cholera', 'cowpox' and 'smallpox'. At this level of description, the claimed likeness 'prevention of a disease by inoculation of a disease' seems distant and obscured.

Are there any likenesses of the kind suggested to be observed (that is seen, or otherwise 'sensed') here at all? In fact, the two cases have first to be described at a sufficiently abstract level for the likeness to appear.

When they are thus described we find we have also described the kind ('vaccination' broadly speaking as we now understand it). The existence of likenesses between Pasteur's chickens and Jenner's vaccination is not independent of the idea that these two events were of one and the same kind. Likewise with the language of *Gray's Anatomy*. We might say that we see in terms of our understandings, and that we do not come to such understandings because of what we see. The editors of *Gray's* can see only a complex of machinery when they look at the human vocal organs, or the human body generally. They do not derive this way of looking from what they look at.

This links the very existence of similarities and not merely their role to the ways in which we classify things in the world around us. I believe we should embrace this link, at least at the levels I am speaking of in the examples given. We are not here speaking of such similarities as those of colour, or of pitch, and so forth, in short those most clearly sensed. The similarities canvassed here, even if they emerge from our engagements with the world, are much more abstract than these. It is no surprise to find them related to the classes in which humans understand and order the objects and events in the world around them.

CONCLUSION

Models, such as the mechanical model of a musical instrument for the vocal organs, may be based upon metaphors. Metaphors may create the conditions of explanatory models; and this is one role that metaphors may take in medical science. This position may further entail that limits of likeness cannot be set to the explanatory models which science employs. The explanatory likenesses of models explain what they do because both the model and the thing modelled are already identified as being of the same kind. This identification is not grounded upon independently perceived likenesses.

The anti-metaphor group are then wrong to rule metaphor out of science, and the pro-metaphor associationists ignore one possible way in which metaphor may function. The falsity or oddity of identity claims may mark a new way of looking at things around us. These may be seen as the basis of explanatory models employed throughout science. Given the claim that the body is a machine, likenesses between particular machines and parts or systems of the body may appear, or become significant, for instance having explanatory power.

The causalists recognise that metaphor involves leaps of human imagination. They recognise that this imagination may act independently

of the observable likenesses and differences in the world around. It cannot, in any direct sense be tested against the world. Whether it follows that metaphor works like a bang on the head is a moot point. My conclusion is less striking. In some of their most creative and scientifically significant thought, medical scientists may be more like poets than they think.

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NOTES

^a Coleridge wrote on psychological theories¹ attacking the theories of David Hartley,² and Goethe wrote a thesis on optics³ and took a more general interest in science.⁴

^b This position is taken by Thomas Szasz in⁵, pp. 135–169. The position has a considerable pedigree. Cf. Thomas Hobbes *Leviathan*⁶ I, viii, pp. 136–137.

^c This position is taken by Max Black,⁷ Donald Davidson,⁸ Mary Hesse,⁹ and Richard Rorty.¹⁰

^d The argument however need not be tied to his actually being there and seeing the chickens himself. The point could also be made if we imagine Pasteur having the events described to him.

^e The editors of *Gray's* seem wrong to say that Descartes described “man” in these terms; but it is widely agreed that this is how he saw the human body; see¹⁸.

^f I am grateful to one of the reviewers for this suggestion.

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