

## 4

## The 'Theory-Loading' of Facts and Perceptions

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In Chapter 2 we looked at how facts present themselves in history, and in social sciences generally. In Chapter 3 we examined the problem of the Whig history of science. Behind the last two Chapters has been our need to get a critical perspective on the myth of the availability to humans of *simply given objective facts*: The idea that the facts are just waiting out there to be uncovered by privileged humans. This idea is at the basis of those tales and stories that protect science from scrutiny. The story about grasping *given, nuggety, objective facts* is at the bottom of the story of *method*, which we will hear more about in Chapter 9. Belief in simply grasping given nuggety objective facts is also at the bottom of the story of *progress* and it is also the basis of the story of *scientific autonomy* -- the idea that scientists have to be free of social and political biases, in order to inspect the given objective facts. We have looked only at history and history writing, but we found out a few things that are eventually going to be true of scientific facts. So, let's recall Chapter 2, because we shall be making use of these ideas here.

First of all, facts are never naked eye observations. We had the Western journalist standing side by side with the Chinese security agent in Tiananmen Square. They had the same scene striking their retinas, but constructed very different 'basic facts' of the situation. Facts, we found out, are verbal/symbolic reports. Facts are not little nuggets of things, which are out there in the world, they are verbal or symbolic reports uttered or written down and circulated amongst people. These reports (facts) are shaped by the language in which they are reported, and are shaped by the beliefs, values, and aims of the reporter. So when I say the *facts* I mean the journalist's and Chinese agent's reports; these *facts* are shaped by the beliefs, values and aims of the reporter and the agent; and, in each case the resulting 'fact' or report includes those beliefs, values and aims (fig 1). I do not mean that there was some little nugget or kernel of fact, surrounded by a chaff of belief, value and aims, as though we could extract real, neutral nuggets of fact from the human beliefs, values and aims which they always in fact (!) contain. Recall our failure in Chapter 2 to formulate meaningful, neutral facts. To repeat, facts are verbal/symbolic reports and when you make these reports, there is no way to separate the shaping and the construction of reports by the beliefs, values and aims from some supposed kernels of real fact that reside inside them.

A fact is very much like a text. Indeed facts, I would say, are texts, and texts certainly are human constructs--they can be revised, altered, deconstructed, and they have interesting (non-Whiggish) histories. It may at first seem to you very odd that facts have gone from being *things* to being *texts*. However, I'm afraid we will not get anywhere understanding what any of the modern disciplines, scientific or social scientific, are about until we see facts are verbal/symbolic reports. That is to say, facts are texts, and moreover, these texts circulate and are negotiated, interpreted and re-shaped by their relevant community of 'experts', fact-makers and fact-breakers. The experts negotiate, twist each others arms, give jobs, withhold jobs, promote, demote, in cycles of interaction which create and stabilise or destabilise facts or reports. Moreover, *little facts*, basic facts, take on their meanings when *big facts* are asserted - big descriptions/reports. All descriptions, whether they are big facts or little facts are partly explanations. You can't completely separate description from explanation because every report buys into beliefs, values and aims which are partly an explanation for what's given in the report. That's as far as we came in Chapter 2.

In this Chapter we will look at everybody's facts, not just the facts of historians', who have such *weak facts* to work with. Everybody's facts, even the physicist's or the biologist's facts, are ultimately nothing different from those described in Chapter 2. Facts in science are produced in slightly different ways than in history or social science; and they circulate in slightly different ways; but ultimately facts in science have those same properties of being loaded with beliefs, theories, values and aims, and of being renegotiable, reinterpretible texts. We raised these points at the end of Chapter 2 when we pointed out that a lot of what we learned about historians' facts carry over to facts in science. This Chapter addresses the issue of the constructedness and textuality of everybody's facts by turning first to the nature of perception, and second to language.

We are inclined to identify our perceptions with facts in the old dictionary sense of the term 'fact'. Presumably, accurate perceptions reveal the facts that really are given, that really are out there. There is a common belief which identifies facts with clear unbiased perception. Most of us tend to think that the perceptions we have are some kind of revelations of the way the world really is; of the facts that are really out there. But if we all agree that perceptions are states of our minds, our brains, then it is doubtful that perceptions can be facts at all. Perceptions are too private to be facts. They are mental events, obviously physically and chemically mediated events in the privacy of our own nervous systems and brains. Moreover, we are going to argue that perceptions are shaped not only by what's out in the world, but also by what's in your mind beforehand, by your prior beliefs, your prior knowledge, your prior values and your prior aims. In addition, facts are publicly circulated and accepted symbolic/verbal reports, which perceptions certainly are not.

There is a traditional story that has circulated amongst ordinary people and amongst Western philosophers since the Greeks. It's a story that tries to tell us how we can get in touch with reality through our perceptions, and I call it the naive man's story of perceiving facts. This is the story (fig. 2):

Here is the world, the material world. It's a systematic collection of facts--facts in the everyday use of the term facts. Over against the world, the object, is the perceiving subject with his or her visual and cognitive apparatus. Assuming the subject, the observer, is unbiased, free from social and cultural prejudices, he/she will get true perceptions of reality -- external facts."

The story in effect states that under good conditions of observation, facts in the world, or information about facts in the world will be conveyed to the sense organs, in this case by light. The information goes through the eye and registers on the retina (never mind that we think that most things in the world are three dimensional but the retinal image is two-dimensional and upside down). The information comes through your eye, it goes through the optic nerve into your brain where you privately enjoy a perception, a perception of a fact. On this story 'Truth' therefore consists of the correspondence between perceptions and facts, a true representation of the fact--a little 'mirror of nature' in your head.

This theory is a story of a simple causal chain:

**World>Fact>Sense Organ>Nervous System>Brain>True Perception of Fact**

According to the story this simple causal chain works when everything is in good order, for example, when your eye is not damaged, the viewing conditions are adequate, you are not drunk, you are not insane, you are not stoned; and also when you are not politically religiously or socially biased. Bias would get in the way, for it would be internal static or 'noise' which would disrupt the clear perceiving of facts; it would disrupt the causal chain. So, if everything is in good order and goes nicely, we can perceive the facts. Nice 'honest', 'healthy' people have nice 'honest', 'healthy' perceptions of the facts. That's another way of saying that if someone doesn't perceive the facts correctly, they are not nice or not healthy or not honest.

We can start to chip away at this naive theory of perception by looking at some examples of so called *gestalt figures*. (figs. 3-4) Gestalt is German for form or shape. These sorts of diagrams have been the subject matter of much investigation in cognitive and developmental psychology in this century. Consider figure 3. Perhaps you having a gestalt experience, in which you perceive something, then at the next moment you perceive something completely different, with your perception oscillating or snapping from one perception to the other. You will be perceiving, say, a duck and a rabbit, or you might see an antelope and a duck; or, you might see an 'alien' and a duck, because we've been treated to twenty-five or thirty years of the occasional science fiction movie, where it just so happens that the 'aliens' took some form that we, the viewers, somehow recognise. It doesn't matter which two things you see as long as you have two different oscillating perceptions. Some people, for example, have trouble seeing the two images in figure 4. If you can't see one or the other there, perhaps you can be 'taught' to see them. It's a very interesting idea that you can be taught to see something by members of a certain culture. (Maybe scientists as members of a sub-culture are taught to see things -- the objects of scientific inquiry! )

Let's return to the issue of the naive theory of perception. We now have got a problem because we must admit that as represented in figure 5, we perceive one image and then something else. Presumably the paper is not changing; the air and the light are not changing; our retinal images are not changing, but it appears something is changing in our brains because we are getting two different perceptions. You are getting a perception of fact which is a duck, and you are getting a perception of fact which is an antelope.

How can this be? Obviously, we are going to have to fix up this naive theory of the perception of facts. And, there is a very easy way to fix it up, but the remedy has far-ranging consequences. (fig 6) At the moment we've got one set of causes, which is the incoming information from the world. The same incoming information gives two different perceptions. Behaving in a scientific manner the easiest way to make repairs is to add another set of causes. That will explain why we get two sets of perceptions under these circumstances. So let's call the incoming information from the world 'Cause 1'. And, let's introduce another set of factors ('Cause 2') which we will call *prior belief*, including beliefs, aims, values, knowledges; in short, whatever you know or believe before you look at the gestalt figure.

So the final theory is that perceptions are caused or produced by the joint action of two kinds of causes. One kind of cause is the information in the world, and obviously that information in the world is not a little picture of a fact. Let's suppose here it's just some pattern of electromagnetic disturbance. The other cause, which is conjointly necessary, is some bit or other of your prior knowledge, or prior belief, or prior theory. My thesis is that you cannot have a perception without having both of those causes acting to shape and manufacture the perception. You need an external input of electromagnetic

disturbance and you need some prior knowledge to fuse with it, or shape it into a perception. Depending on which bit of prior knowledge gets fused with the information, your brain produces one perception or another -- perception of a duck, then perception of an antelope.

This suggests that in the vast array of your prior knowledge or prior belief, which is encoded in your brain, those of you who alternately perceive 'duck' and 'antelope' certainly have two bits of theory which run as follows:

Bit of theory number 1:

"In the world there are antelope-like things". The theory probably goes on and asserts certain properties and characteristics about antelopes. You might say that you have a concept about antelopes or you have a **concept** of *antelopiness*. You obviously have a little space or node or bit of prior theory or prior belief or prior concept which concerns antelopes.

Bit of theory number 2:

"In the world there are ducks", and you have a kind of **concept** of *duckiness*. You obviously have a little space or node or bit of prior theory or prior belief or prior concept which concerns ducks.

Now when you perceived the duck, your brain was processing the information through the 'duckiness' bit of your knowledge framework, and so your brain produced a perception of duck. Your brain didn't have a perception of duck before you looked at the figure, it only had a conception of (prior knowledge about), a theory of ducks in general; and it only **made a perception** of duck when it took the incoming information, and moulded it that way, through your duck theory. But, in this gestalt situation, the brain was having a little trouble in this situation knowing which bit of prior knowledge to apply, and knowing which perception to construct. Unable to 'decide' which perception to make, your brain alternated with one, and then the other one: the two different perceptions coming from your brain, as it were, squeezing and kneading and moulding the incoming information through two different pieces of your prior knowledge, which your *antelopiness* concept/theory and your *duckiness* concept/theory. Let's call this shaping of perceptions by prior knowledge, belief, values and aims: 'The Theory-Loading of Perception'.

Here is a metaphor that helps us make sense of this. Let's take the brain out of figure 6 and put in a grid work - a network (fig. 7). These grids are a kind of a metaphor for the network of theories, beliefs and concepts that you hold. You've got a grid of prior knowledge, prior belief, as well as values and aims. So we can say one of these little nodes or spaces in the grid is probably your concept or theory of *antelopiness* and one of these little nodes or spaces in the grid is your concept or theory of *duckiness*. Your brain is processing the 'sausage meat' of externally derived information through the antelope node and making a perception of an antelope in the one case; or, not being sure which perception to make, and processing the sausage meat of information through another little bit of the grid which is the duck concept and making a perception of a duck. This is very interesting because what it really means is that it makes the actual contents of the external world a bit of a question mark. (fig 7) The world is a question mark because we ultimately do not directly know which things it itself is divided into. The world exists but we don't know which facts it is divided into, because we only have access to facts, to start with, through our perceptions, and the perceptions are shaped by our grids.

It's reasonable to assume that ever since we were children, we have psychologically projected our grids back onto Nature, and assumed that Nature is divided into those facts that our grid divides things up into. As many philosophers, anthropologists, psychologists and linguists in this century have told us, people chop up the world according to their prior beliefs and theories. They view the world as being inhabited by various kinds of things depending on the categories set in their grids by belief, theory and language. This doesn't mean that there's no world out there, rather that the world only gets shaped for us, for our perceptions, and our reports (facts), by our grids. And grids can vary to a greater or lesser extent from society to society, from one historical period to another, and with different groups within a society. The study of the history of human knowledge and belief is therefore the study of grids and of the factors--social, economic, political and cultural--that preserve or alter grids. In this respect the history of science is no different than the history of theology or any other cultural expression!

Obviously grids are very complicated. We wouldn't begin to know how to map one completely or how to take one apart. We only get intimations that they exist, partial maps of them perhaps, through the work of anthropologists, linguists, sociologists and historians. But we can say certain things about grids:

First of all, its pretty clear that different species of animals certainly have different grids at the level of *hardware*. Some animals have grids that only allow them to perceive interesting prey, especially when the prey is in interestingly vulnerable positions. One supposes certain kinds of flies and spiders and frogs are wired up that way. The main purpose of their grids is to give them a perception of what's good to eat, and what is in a position to be eaten. Well, as human beings, we have the same hardware as each other. It's the software that makes the differences, and the most important software programme constituting our different grids is the particular language we speak. One can argue from history, anthropology and linguistics that different languages will, as it were, shape the world differently to a greater or lesser extent for the people who live within, and speak a particular language.

We can articulate a bit more the metaphor of hardware and software with the idea that presumably our *hardwares* are all the same, since we are all *homo sapiens*. But, culture and learning and development within a culture, learning a language 'programmes' us with slightly different softwares. Then, within a language community, there might be different cultural/social categories. For example, we all speak English, so we have largely the same broad language software; but, maybe we're not all the same religion, political ideology, or social class. Presumably experience and participation in different cultural/social settings gives us, at least at the margin, slightly different grids.

Moreover, we could all be the same social class and still have differences. There might be different special activities; for example, we might all be middle class academics, of Catholic background. But, some of us might be professional economists and some of us might be professional historians or philosophers of science. We, therefore, by virtue of these differences would have slightly different grids. We might make out slightly different reports consisting of slightly different facts in certain given situations.

And, of course, even if we were all middle class academic economists of Catholic background we might have different theories within that specialty. I might be a right wing economist of Milton Freedman type, and you might be a left wing economist. So all these differences up and down the line can be registered as subtle differences in grid-

-subtle differences, therefore, in the kinds of facts that people make out, even under the same circumstances. In Chapter 2 our Western journalist and Chinese intelligence officer not only had different language grids, but different cultural, ideological and professional ones as well, and that helps explain their different grids of belief, value and aim and hence their different reports -- their different basic facts of the situation they were observing.

In sumation we can say that the kinds of facts you are capable of perceiving/reporting depend upon the nature of your conceptual grid.

There are no little pictures of objective facts flying about and entering our eyes--those perceptions are manufactured in human minds, using prior cultural material and beliefs.

Change your grid slightly and the possibility of some facts disappears, and the possibility of other facts comes into being. Knowledge of the outside world does not lead us to this situation--our focus is on people and their perceptual/belief commitments--their grids.

Facts of nature do not determine grids--grids determine the ranges of possible facts within a given cultural group or sub-group.

You may think that this is not very important, because in everyday life these situations do not happen very often. I admit our concepts are well entrenched and our usual array of electro-magnetic cues are well established and so our brains, through education and socialisation, give us a fairly stable, unambiguous array of perceptions.

But what about at the frontiers of science--or anywhere facts and beliefs are contested and in conflict? At the frontier of scientific research, for example, new things are seen and proven to exist or not exist. Perhaps something a lot like a Gestalt switch goes on as facts are ruled right or wrong at the research front, as researchers argue about what is being seen and what is not being seen.

Yet we must ask ourselves where do these conceptual grids come from? From human socialisation and language as indicated certainly, but that does not explain the existence of new or changed ideas, and hence new or changed facts. Concepts don't change because nature imprints a new correct concept, but because we manipulate concepts in the grid by analogy, metaphor, associating, at the margin. Much of the historical material treated in this book illustrates this point.

So much for the dissection of grids. Let's now turn to the second key aspect of theory-loading, the issue of the role of **language**. We shall see that languages shape 'facts' for their speakers and that languages contain implicit theories which do that shaping. The argument here would be that different languages shape the world of facts differently. It's not a question of some people making errors, because their language 'gets reality wrong' and someone else having a language that gets everything right; that is, reflects 'the world as it really is'. Languages do not get the facts of nature right or wrong--instead different languages shape the facts that are taken to exist in slightly different ways. I suppose that in the nineteenth century Europeans believed that their languages reported the world correctly, but that the languages of native peoples reported the world incorrectly. As we said, this today becomes simply a question of different languages chopping up the world differently. Different languages embody different theories of what things exist and the things that exist interact.

Now, let me give you the verbal/symbolic report. -- "The pen I am holding is blue" -- a perfectly reasonable **fact**. My verbal/symbolic report, my stated fact, is a text in an Indo-European language - Standard English. Now I don't deny that is a fact, especially as this is a *widely accepted report* within a certain language community, and that it is a fact for that community; doing useful work in their everyday activities and communications. So, I do not deny that fact - "the pen is blue" - but I do wonder whether there are any theories implied in that statement; I wonder whether my language pumps certain theories about the world and its organisation into this seemingly banal, and factual, statement.

Are there any theories about the world involved in saying something as seemingly simple as the 'pen is blue? -- 'It **is** blue. This statement seems to run along a line of theoretical cleavage in which 'blueness, or 'being blue is a state that things have or they don't have. The same holds with any other colours when we discourse about them in English. For example, 'The tape recorder which I use to record my lectures **is black**'. This implies that it possesses blackness. Blackness is something it has in it. There is a very strong implication here that white, black and other colours are kinds of things or substances and that they are spread around the universe and that some things possess colours and other things do not. All of this seems to follow from the way in which an Indo-European language like English formulates the relation of subjects and predicate adjectives around the simple verb "to be". It is implied that subjects of sentences possess other things, particularly the qualities named in the predicate. The language implies the universe is stocked with things, subjects in sentences, which may or may not possess various other things--the different qualities and properties which can be predicated of them, using the verb 'to be'.

But, is this the only way to speak about pen and its presumed colours? It is not. There is, for example, the language of physics as it has developed since the seventeenth century, since Newton really, but more especially the during the twentieth century. In this language colours are not properties in the world possessed or not possessed by objects. I'll give you an example of how this other language works to divide up the world into things and their relations, but I'll give it to you in a very bad translation because I'll give it to you in English, whereas it should be stated mainly in mathematics. Here then is the English translation of physics language on this issue:

*Everything is made out of atoms and molecules; each type of atom or molecule has a characteristic way of absorbing and then re-emitting certain parts of the electromagnetic spectrum. The surface layer of this pen is made of molecules which have the characteristic of absorbing certain bits of the spectrum, but re-emitting mainly electromagnetic radiation in that part of the spectrum which, when it strikes our nervous system, makes us apply the term 'blue. In other words there is no blue, there are only interactions of electromagnetic radiation and molecules. And in a very real sense, the pen isn't blue, the pen blues.*

This carries the implication, the theoretical cleavage, that the blueness in our minds is the result of the interaction between us, the pen, and whatever else there is in the universe. It is not that 'the grass is green', rather in physics we are closer to saying 'the grass *greens*'.

The world according to ordinary English and the world according to the language of modern physics are two rather different worlds. In one world there are the colours that float around and attach themselves to things and in this other world there really are no

colours, only relationships between atoms, molecules and energy. The two worlds are the creations of, and are expressed in, two different languages. The two different languages carry with them two different ways of giving reports, so that the two different languages divide up our reports and hence our worlds into two different sets of facts. Different languages--different facts; different theories--different facts. We call this The Theory-Loading of Facts--and it is very important for our understanding of how science really works and has developed.

Thus far we have been dissecting the key assumption in the myth--what we might call the cult of fact: The idea that there exists a world, a system, a set of given objective facts. They are just there and they are waiting for the good guys to arrive; the good guys who have the method in hand. If the good guys have the method and are unobstructed, they will be able to use the method to uncover and test the facts and turn them into knowledge. What I suggested to you was that facts are not really so hard: They're not really that given; they're not just given out there ready to be uncovered (discovered), that facts are much more constructed than given.

After all, facts do not equal what strikes our eyes--electromagnetic disturbance; facts are not even as simple as our private perceptions--and we've seen that perceptions are the joint product of inside grids and outside information. We concluded that facts are communicable, discussible reports--verbal or symbolic reports which may relate back to our perceptions; but are also heavily shaped by the languages and theories or systems of communications in which we can utter or form the reports.

This means that facts are social constructs: contending groups and individuals struggle to construct and impose certain facts on others in science and in society at large. It means that facts are historically variable, the facts are different for different people at different points of time; and different for different individuals and groups at the same time. The facts are therefore negotiable and revisable rather than eternal. Most importantly, it means that when facts change and are altered--we don't look to see which good guys finally saw nature correctly and objectively--we ask which group won, why certain groups constructed their facts the way they did, and what political, social, intellectual and historical factors shaped and affected the way the facts were made and unmade by the contending parties. To explain scientific change we don't invoke a mythical method, we ask sociological, historical, political and economic questions about the players.

In the next Chapter we're going to start talking about the world-view, *the vision of the world*, produced by the dominant Natural Philosophy (science) of the Middle Ages. That world-view or Natural Philosophy was largely the product of an ancient Greek philosopher named Aristotle who was, until the seventeenth century, probably the most influential and persuasive Natural Philosopher or scientist who had ever existed in the Western tradition. As it happens, his Natural Philosophy was overthrown and replaced in the Scientific Revolution of the 16th and 17th centuries. This is the main change we examine in this book.

The really interesting thing about Aristotle is that his theory of Natural Philosophy is largely based on taking ordinary language seriously as a guide to what facts exist. So for Aristotle the pen is blue. *Blueness* is a thing. The pen has got it, and the *blueness* permeates the optical media around the pen, affects your eyes, and somehow gets into your souls, because you do have souls according to Aristotle, and this produces a perception of *blueness* in your soul. So the blueness in the pen corresponds to the blueness in your soul and therefore you have a true perception of blueness in the world.

Does that story remind you of anything? The original story in figure 1 derives largely from Aristotle. There's blueness out here in the world. There's perception of blueness in here in the mind. Clearly Aristotle was very happy to accept the theories that are implicit in ordinary language.

Here is another example of Aristotle's scientific theories being conditioned by the way ordinary language loads facts. Aristotle's whole cosmology is based on the following sort of 'factual statement' - "Heavy things fall down." Ask any child, 'What happens if you drop a heavy thing?' 'It falls straight down', a child or anybody who is not a physicist will say. What does such language assume? What is the theory involved in that statement? Certainly that there are **heavy** things. By implication there might be things that don't fall down, but instead go **up**: like air bubbles in water, or flames from a fire. But, hold on, if **heavy** things go **down** -- the things that go '**up**' must be '**light**'. This certainly entails that in reality there is a 'down' and an 'up' etched into the nature of reality. All of a sudden we are in the middle of a vast conceptual grid: With a bit more systematisation and argument Aristotle can conclude that the cosmos is a large sphere, at its centre sits the motionless earth, around which go the moon, sun, planets and stars. Heavy things fall down, toward the centre of the earth and centre of the cosmos; light things move up, radially away from the centre. The heavenly bodies? Well, it's obvious from observation that they move in circles around the earth; so they must be neither heavy or light, and hence must be made of some special heavenly substance.

Aristotle, you might say, elaborated and systematised the kinds of theoretical assumptions inherent in everyday language, which seemed to be a perfectly reasonable and rational thing to do in fifth century BC. Greece, especially if you do an expert job as he did. In the next Chapter we will look a little more closely at his cosmology as based on these kinds of ideas.

Now, presumably nobody reading this really believes that there are heavy objects (from the standpoint of the language of post-17th century physics!) Didn't Newton show that there are no any heavy bodies; that bodies don't naturally have weight or heaviness? They just have mass. Weight is a relational property. It has to do with how bodies attract each other, and certainly nobody at present believes there's a 'down'. According to Newton, and Einstein, and any cosmologist since the seventeenth century, there is no 'down'. We are in an infinite universe (you can argue about the sense in which it's infinite). The infinite universe of Newton is a different from the infinite universe of twentieth century cosmology, but if it is infinite; it has no up it has no down.

All this permits us to begin to see the point of my talking about the problem of Whig history in Chapter 3. Were Aristotle, and the people who followed Aristotle, just stupid, or were they just not seeing the true *facts* of reality because they were biased? Did they have some bias which prevented them seeing what we take as reality, that there are no *heavy things*; that there is no *lightness*, that there is no *up and down*. Or is it that they had a very good basis for their perceptions and their facts in their own historical context--in their own time and place and in their own fact-forming language and theories? Indeed there was every reason to take seriously the idea that 'chalk is white' and that 'heavy bodies fall down'. The real trick was to elaborate those commonly believed facts into a coherent theory, which is what Aristotle did as a Natural Philosopher. So, the Whig view of Aristotle is wrong; he was not a fool; but actually a very smart fellow. We cannot explain the content of his theory by his making a

mistake, being biased, or foolish; and the collapse of his theories was not due to smart guys like Copernicus suddenly clearly seeing the true facts.

Correspondingly, how do we explain Copernicus and the other people who opposed Aristotle's Natural Philosophy in the 16th and 17th centuries? Do we say they saw the real facts more clearly than the Aristotelians? No, what we say is, they changed their grids, or at least they made bids to change the grid of Natural Philosophy and cosmology. You have to ask, not what were the true facts they saw that made them change the grid, because the facts come after the grid. No, you have to ask why did they want to change the grid? And, how did they succeed? It is not hard to make a change in a grid. It is hard to get changes accepted and embedded in the usages and grids of one's peers and colleagues. So you have to ask historical questions, social questions, religious questions, questions of history and sociology and anthropology and psychology, rather than just saying, in Whiggish style, the good guys saw clearly and the bad guys saw things in the wrong sort of way. And the basic reason for that is that everyone sees through grids, so the history of science is the history of how grids of theory are defended or changed. To repeat, history of science not the Whig history of heroes finding the true facts, it's the social and political history of how and why grids are made and changed, and of what facts are made or changed as a consequence of changes of grid.

This ultimately is the difference between the type of history of science now being written and the old fashioned Whig history of science: the supposedly given and objective facts of nature do not determine the history of science, for the simple reason that we have no access to some direct, given facts of nature. We never have had access, never will, would not know if we did. But we have many scientists arguing throughout history about what grids to use; the ways they argue and why they argue, and why they succeed or why they fail are all historical questions, and that's what we study in the history of science.

Figure 1 Two Views of Facts

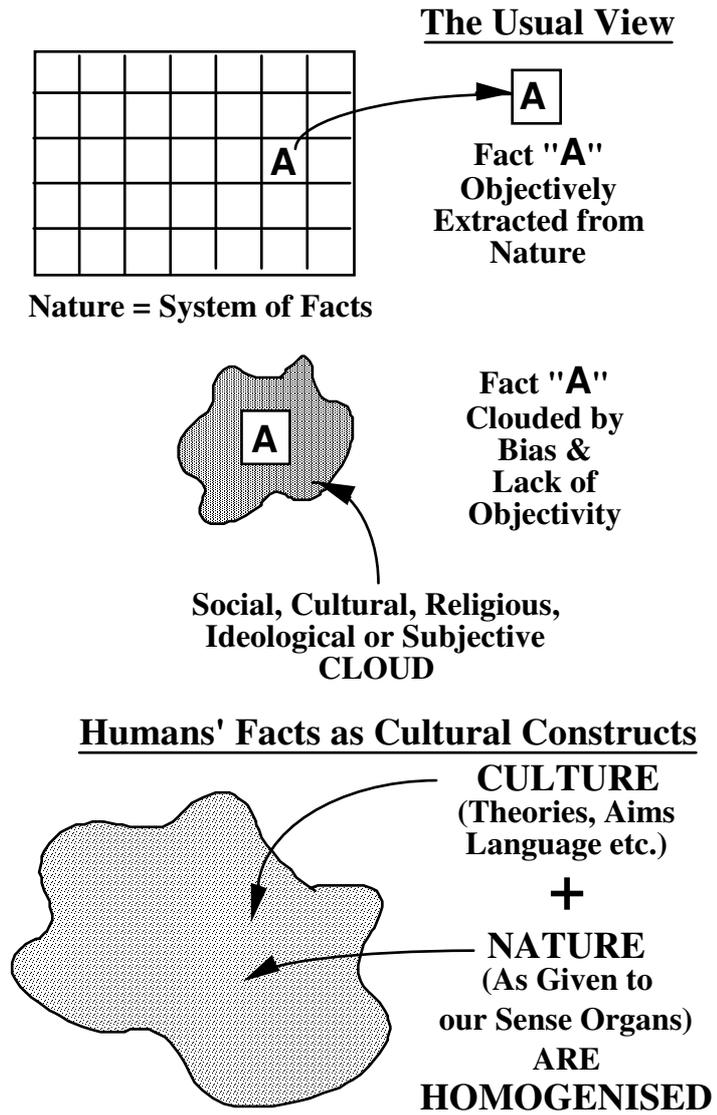


Figure 2 Naive View of Perception

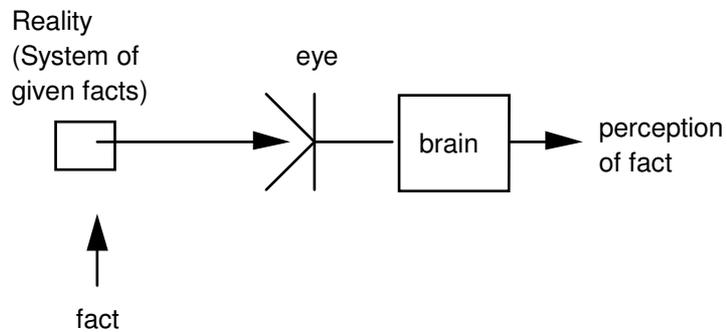


Figure 3

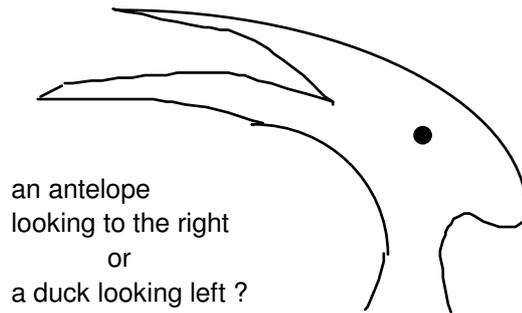


Figure 4

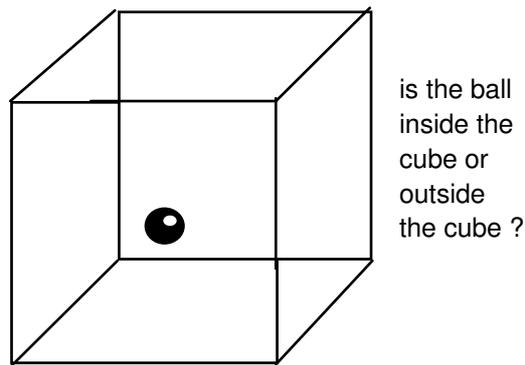


Figure 5

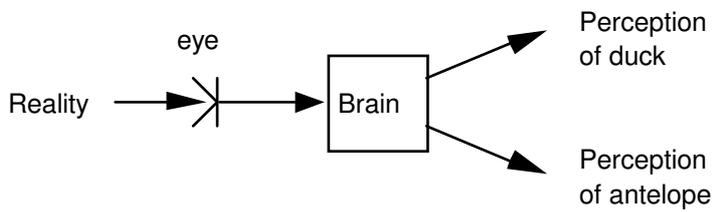


Figure 6

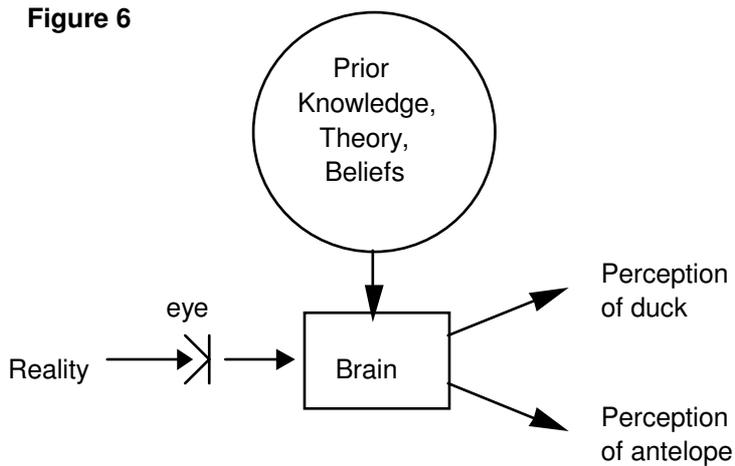


Figure 7

