CHAPTER 5

DON IHDE

MODELS, MODELS EVERYWHERE

The newest technological toy, the 'computer,' has given us a complexity machine with which ever higher degrees of complex phenomena can be computed, manipulated, and produced in a variety of imaging forms: charts, graphs, simulations, and images. Indeed, it may be or be becoming the twenty-first century's *epistemology engine.*

I call an epistemology engine, some technology which then is used to model the process of knowledge production. Previously I have argued that the *camera obscura* precisely served that role in *early* modern philosophy. It was explicitly used as a model of knowledge by both René Descartes in the *Dioptrics,* and even more explicitly by John Locke in the *Essay on Human Understanding.* While I shall not retrace that analysis here, I tried to show how the subject/object; external/internal; and knowledge as representational all follow from the way the *camera obscura* worked according to seventeenth century understanding. Whether or not one should ever take a technological model for knowledge production or human understanding aside, I have tried to show that the *camera* model is now outdated since it no longer models the kind of practices which produce contemporary styles of knowledge.

By very *late* modernity, a few philosophers have partially identified computation devices and processes as such an epistemology engine, but no one to my knowledge has done so with as much positivity as Descartes and Locke did with the earlier toy. Hilary Putnam has flirted with the idea that the computer serves this role today, and a loose fit borders on more than the metaphorical amongst 'computational models of mind' analytic philosophers. These philosophers do think that there is more than a brain-computer metaphor, as indicated by the wide use of "brains-in-vats" by Daniel Dennett in his *Brainstorms* (1978). But this engine has not yet stuck as fully as the 'theatre of the mind' camera.

So, before deciding how suggestive computational devices may be for epistemology, let us look at some of the main features which the 'computer' as a complexity device can do:

- First, computation can perform massive computations at speed; calculations which would take hundreds of mathematicians decades of time, can now be done

J. Lenhard, G. Küppers, and T. Shinn (eds.), Simulation: Pragmatic Construction of Reality, 79–86.

in manageable, finite periods of time. As a speedy calculation device, able to handle very complex calculations, computation gives us a new amplification of one human capacity never before possible.

- Moreover, the computations possible can deal with many multi-variables, which, in turn, can then be graphed. In turn, modeling via graph frequently reveals unsuspected patterns – for example, a multi-variable graphing process some years ago was applied to the levels of lead in the atmosphere, correlated with human activities from antiquity to the present. The result is one which clearly depicts the role of homogenic activity upon atmospheric phenomena.

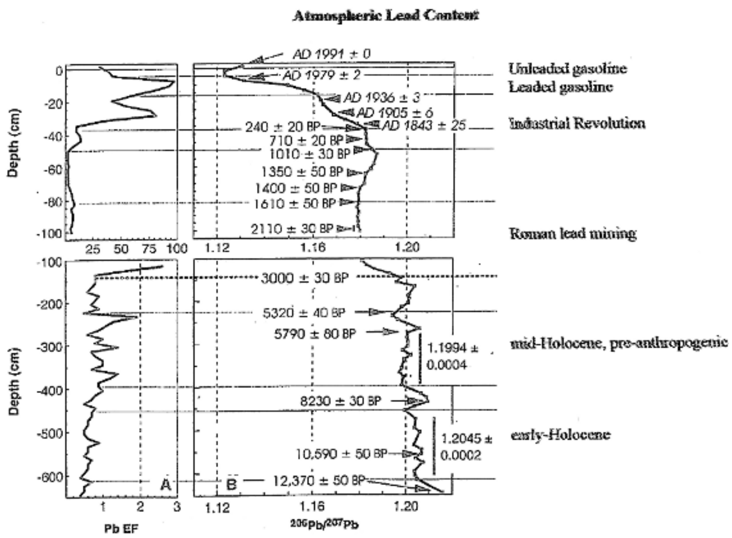

*Figure 1. Atmospheric Lead Content. (Reprinted with permission from Shotyk et al., Science **281**: 1635–1640, 11 September 1998. Copyright 1998 AAAS.)*

- Better still, computer modeling can move from data-to-image-to-data. By using algorithms, one can produce images which are 'readable' at a glance, or, one can reduce images to data for analytic purposes. Peter Galison's *Image and Logic* (1997) showed how this capacity in physics simulations, tended to give the edge to imaging processes in late twentieth century physics. The *Brookhaven National Laboratory*, in producing a poster advertising its heavy ion accelerator, shows both data-graph (logic) and simulation image (image) detectors.

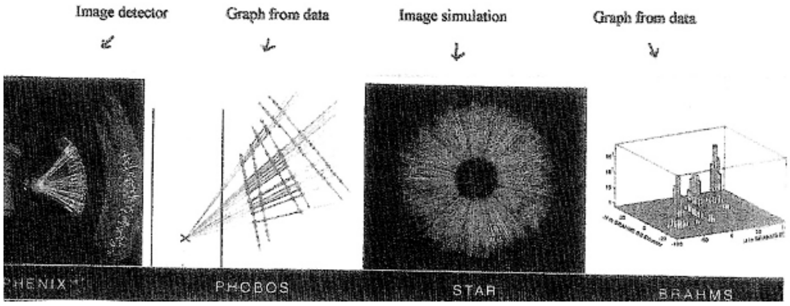

Figure 2. Relativistic Heavy Ion Collider Detectors

- The data-image reversibility has also allowed for modeling of long term processes not previously manageable. My colleagues, Pat Grim and Gary Mar, in *The Philosophical Computer* (1998), were able to model semantic paradoxes in three-dimensional projections in such a way that interesting differences were shown to obtain between different types of paradoxes.

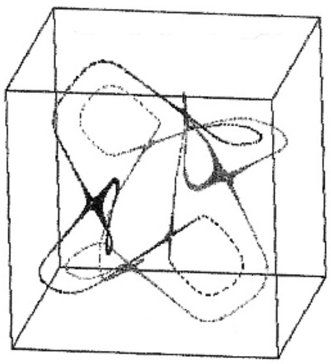

Figure 3. Strange attractor semantic paradox. (Permission by Patrick Grim.)

- One result of this – contrary to what is sometimes thought of as a computational move toward 'disembodiment' – is a return of critical interpretive activity to the humanly *perceivable* through images. Images produced by computations thus produce what can be seen at a glance, thus engaging the visual gestalt capacities of embodied humans.

Those of us familiar with the models which such processes produce recognize that images are, in effect, mediations. Here, I shall concentrate upon the imaging processes employed in models, but with a particular concern. Early modern epistemology was an epistemology centered in *representations.* In their simplest forms, representations were what I call *isomorphic images,* that is, images which are 'like' that to which the images refer. The actual optical model, employed by both Descartes and Locke, was the *camera obscura,* for which the images – which stood for the impressions or sensations in the mind – to be 'true' had to be isomorphic.

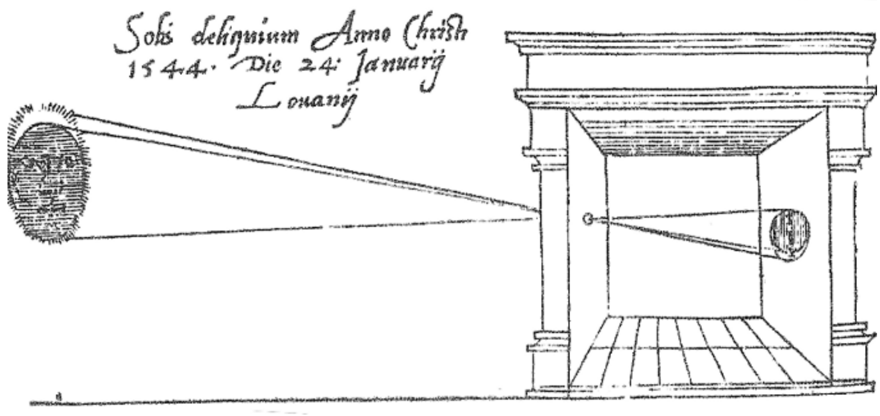

Figure 4. Sixteenth century camera obscura

Thus, the imaged Sun projected upon the back wall of the camera is 'like' the external Sun in shape, configuration, and so forth. Except it is not! The imaged Sun is flat or two-dimensioned; it is inverted or upside down; and in any actual *camera obscura,* does not even approximate the intensity of light of the external Sun. In short, the *camera obscura* radically transforms the Sun into the imaged Sun. Similarly, in a later modification of the *camera,* that is the nineteenth century *photographic camera,* the process of producing the image is one which 'fixes' the image of the Sun, yet another transformation.

Now, so long as that which is imaged is available both to direct perception and the mediated perception provided by the image, one can compare Sun with imaged Sun. And, when this is done, one can also see that in definite and limited senses, the imaged Sun has certain advantages because of the technological transformation entailed. Looking at either an *obscura* or *photographic Sun* will not make you blind! You can also return again and again to the image to take notice of features perhaps not noted at first glance. (But you can also take account of features which make the imaged Sun different from the perceived Sun: size, two-dimensionality, stasis, etc.) But note, all this is possible *only if one has the comparative capacity to differentiate between the image and the object imaged.*

With contemporary imaging of the sort for interest here, that comparative capacity simply does not exist. I shall take as my example what I call 'whole earth measurements' or simulations related to global warming. Here are some recent such simulations produced as images of the whole earth.

In a strict sense, these are not 'images' in the previous sense of simple, isomorphic depictions of a perceptible object. Rather, these are graphic depictions of phenomena which *could not and cannot* be perceived from an embodied and situated perspective, not even one from a satellite perspective. The schema which is depicted

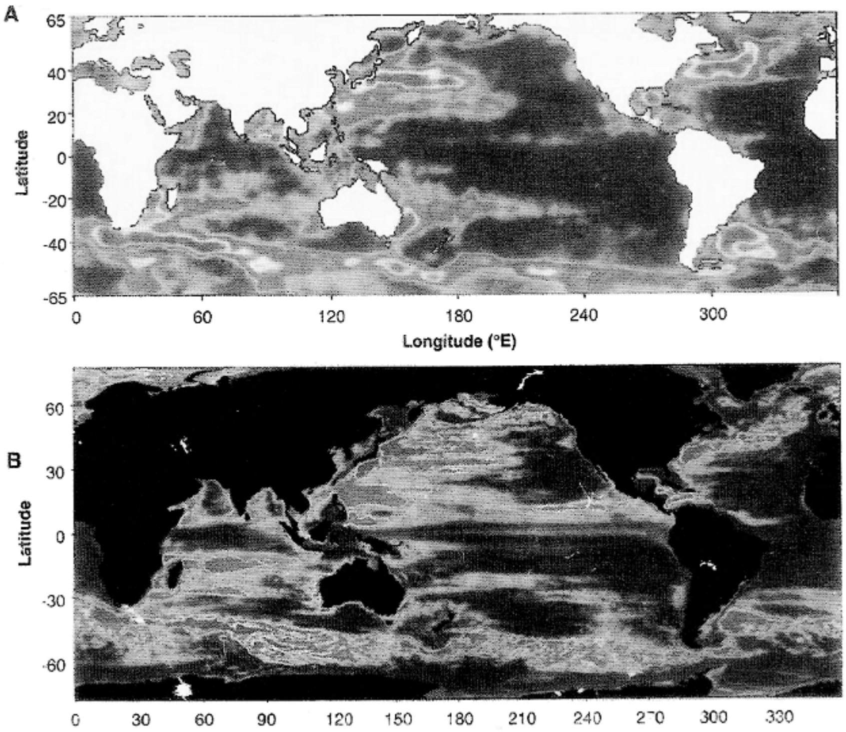

Figure 5. Simulations related to global warming

is a ‘whole earth’ projection, reduced to a single image. It is also depicted with a color convention, in the original, using ‘false color’ to map intensities – and unless one is privy to this convention, it is not even possible to know what is being depicted. In this case it is ocean levels, not, for example, heat ranges which could also be so mapped. It also incorporates an older convention, with the arctic circle at the top; the antarctic at the bottom (a convention which reversed older conventions). In short, this is not really a ‘picture’ or what we might ordinarily think of as an ‘image.’ It is much more like a ‘map’ in a special sense.

It does have vestigial isomorphic features, one is familiar with the very high perspective which produces continental shapes (illustration from satellite view of the earth). These could be seen were one on the space station, but here are reduced to a flat projection with its built in distortions, and including a 360 degree sweep. All of this and much more is built into this model. Yet, to the informed perceiver-‘reader’ of this depiction, all of this is available at a glance for an ‘aha’ recognition – “so that’s how much the oceans have risen!” But, however seen or read, one cannot simply compare the ‘knowledge’ produced by the model with ‘reality’ since one has never had the ‘reality’ of the whole global view!

Let us complicate the scene a little more by introducing dynamics. We can get increasingly sophisticated results about 'real' earth history by making more and more things 'speak' or give us measurements from the past. Greenland ice cores, subject to ion analysis, can take us back several tens of thousands of years; the same for Antarctic cores. Ocean bottom sediments can also reveal patterns which yield ancient temperatures. Put all these together and one gets a piecemeal mapping, not as 'coherent' as our 'image' has it, but perhaps in each piece a bit of accuracy. But, strictly speaking, there remains no way to compare 'real' earth history and the simulated 'history.' Yet, this language continues to pervade much discussion – and much objection to the simulator's claims. This is, however, to assume that simulations are in some sense 'representations.' I do not think they are, although I allow that the vestigial isomorphism suggested by the way the 'scientific' image is presented tempts one to believe that. Rather, I do not think contemporary science imaging is either a 'picture' or a 'text,' although it probably does have map-like features. These, in turn, presume skills of interpretation which map readers must have learned.

The map is never the territory. Borges' fictional Chinese Emperor who needed a paper larger than the territory in order to map the territory is one such absurdity noted. Rather, imaging in the context of simulation and modeling is more analogous to a critical, interpretive *instrument,* through which we see and read. Insofar as a simulation 'images,' it does not do so on the basis of any copies or isomorphic representations since it is nothing like either the optical lens systems of microscopes or telescopes, nor of a *camera obscura* and the progeny therefrom. *There is no original from which to copy.* Yet the end result *is* image-like; it is a gestalted pattern which is recognizable, although it is a *constructed* image.

I want now to examine a few features of what is really a relatively new critical-interpretive instrument. The literature about the uses of models and simulations remains rife with representationalist language. "How closely does the model match the real?" But, we don't have the real separately to tell if there is a match or not. Rather, in one sense, it is the instrument, the model, which gives us the 'real.' Or, at best, if we have a 'real' record of some sub-pattern, perhaps then we can say the model does match a sub-pattern. What we are after, however, is a depiction of a lot of composite features which we may have separately. It strikes me that what we have is an analog to the learning of tool use familiar in much earlier science. As Andrew Pickering points out, there is a lot of tuning and skill to attain before the instrument becomes as transparent as it can be (Pickering 1995). And, we have to learn how to distinguish 'real phenomena' from 'instrumental artifacts.' Double images, 'auras' or 'halos' frequently bugged early telescopy in analogy to many model 'artifacts' in simulations.

Return to my earlier whole earth chart: What the simulation image depicts is a very complex *composite* of multiple measurement instruments. Ocean buoys, satellite readings, deep sea probes, and a wide variety of separate measurements are tomographically combined to make the image shown. If one has enough variables, has tinkered well enough, then one hopes the image is 'adequate.' I previously claimed that this kind of image is more like a map than a picture.

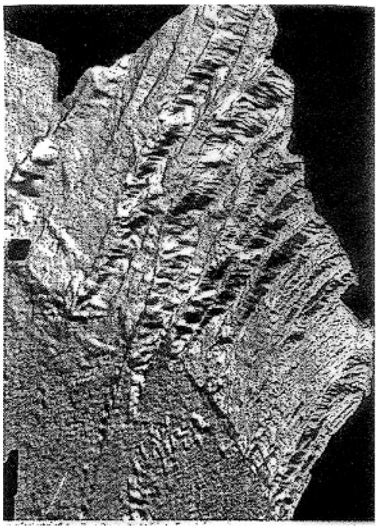

Figure 6. Sea floor image

Here is one recent *map* example which is also constructed and composite. These are recent ocean bottom maps which drew from Cold War techniques originally produced for finding and/or hiding submarines.

The construction process utilizes a series of different technologies:

- Gross features come from averages of many satellite passes which image ocean surfaces, in turn analyzed via gravitational effects to show sea mounts and such;
- then, with multi-side scan radar, more detail emerges;
- and, finally, where fine detail is needed, a photographic and optical scan can be made.

But, once again, it is the tomographical capacity of computation which combines and constructs what in this case is the 3-d projection of ocean bottom map. This example, while showing the constructive and composite features, would for the previous example be only one of an even wider set of variables.

What I have been illustrating is not only a set of some of the most expensive 'pictures' ever produced, but the way in which 'models, models, everywhere' is taking hold. Contemporary imaging is 'constructed' imaging. When compared with early artistic use of the *camera obscura,* for example, the tracing of the inverted image, while 'active,' was drawing-by-the-lines. Photography, as a later adaptation of the *camera,* was in a special sense 'passive' in that the chemical process did the 'drawing.' Today's constructed imaging retains an analogue to art processes, in that the result is well-planned, laid out with results in mind, and thus more active than the seeming 'photo-realism' of earlier forms of science imaging.

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