Essay Review

The insidiously enchanted forrest.
Essay review of 'Scientific Representation' by Bas C. van Fraassen

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A R T I C L E   I N F O

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Scientific Representation: Paradoxes of Perspective, B. C. van Fraassen, Oxford: Clarendon Press, 2008, 408 + xiv pp., index, ISBN 978-0-19-927822-0, cloth, price: 30 pound sterling.

Scientific Representation: *Paradoxes of Perspective* (henceforth: *Representation*), B. C. van Fraassen's most recent, 400pp. contribution to the philosophy of science, is contemporary, varied, systematic, historical, exciting, provocative, empiricist, pragmatist, profound, sketchy and accessible. We ground these judgments subsequently whilst treating most of the topics of *Representation* in more detail.

Contemporary, Varied. A new book by Van Fraassen! What is it? Another massive attack on realism in the philosophy of science, as in *The Scientific Image* (1980)? A new acerbic treatment of analytic metaphysics, as in *Laws and Symmetry* (1989) and in *The Empirical Stance* (2002)? The long-awaited treatise on voluntaristic epistemology, as outlined in *Laws and Symmetry*? Further historical explorations of philosophical traditions, as in *The Empirical Stance*? Back to logic without existential import, as in *Derivation and Counterexample* (1972)? Forget it all.

Representation is a contribution to the discourse on topics that have entered the stage of attention quite recently, as there are: the concept of representation in science, the role and philosophy of

experiment and technology, of instruments and artefacts, and then the issues of measurement, structuralism and perspective. These topics are scattered over no less than 13 Chapters, grouped together in four parts:

  I. Representation
 II. Windows, Engines and Measurements
III. Structure and Perspective
IV. Appearance and Reality

Besides novel topics there are also familiar topics, such as Carnap's *Aufbau*, Putnam's model argument, Russell's structuralism and Newman's objection, the Poincaré-Reichenbach problem of co-ordination and the microscope—an instrument that keeps haunting Van Fraassen, ever since Ian Hacking started hitting him on the head with it. The topic of Part IV, appearance and reality, is a topic as old as philosophy itself and still a topic in the philosophy of perception; but it was, until now, not a topic in the philosophy of science. The reason that it is addressed is that it presents itself rather forcefully after the ways in which Van Fraassen has treated representation and measurement, and has distinguished phenomena and appearances. And, of course, this time-honored topic of appearance and reality adds to the variety of topics that *Representation* harbors.

Systematic, Historical. Representation is first and foremost a systematic inquiry rather than a historical treatise. Having said this, it is striking what parade of philosophers (and scientists) from the past is marching through the hundreds of pages of this contemporary inquiry. The parade is far from cosmetic. Passages

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of Plato, Aristotle, Copernicus, Descartes, Galilei (who is, as always, mentioned by his first name 'Galileo' for reasons that continue to elude this reviewer), Bacon, Leibniz, Kant, Fourier, Hertz, Boltzmann, Maxwell, Duhem, Kelvin, Helmholtz, Planck, Poincaré, Einstein, Russell, Wittgenstein, Carnap, Weyl, Bradley, Tolman, Reichenbach and Goodman are invariably spot-on. Sometimes Van Fraassen draws attention to unusual aspects of these usual suspects. For example, Wittgenstein's picture theory of meaning of his *Tractatus* can be seen as the ultimate general-isation of how measurement-outcomes are Duhemian locations in 'the logical space of a theory' (p. 164). Weyl's description of co-ordinate systems as "the unavoidable residuum of the ego's annihilation" (p. 71) is taken as pointing to the self-location of anyone in the logical space of a theory, which is, according to Van Fraassen, a necessity for using a theory. Kant is not quoted on transcendental deductions, necessary conditions for the possibility of *X* or the elusive *Ding an sich*, but as stating a "precise and perfect analogy between theory, model and map" and pointing out "the inevitable indexicality of application" (p. 80). There you go.

Exciting, Provocative. As early as 1994, in his contribution to Jan Hilgevoord's *Physics and our View of the World*, Van Fraassen extended Nelson Goodman's distinction between *representation-of* and *representation-as* — drawn in his seminal *Languages of Art* (1968)—from art to science, and then went on to argue that all representation in science is representation-as. We represent the solar system *as* a Newtonian gravitational system of point-particles; we represent a Helium molecule *as* a quantum-mechanical electro-statically bound system; we represent an atomic nucleus *as* a drop of liquid having very special properties, such as an extremely high density; etc. In Part I of *Representation*, he explores the parallels between representation in art and in science in depth.

The Renaissance theory of geometrical perspective made it possible for artists to learn how to suggest 3 spatial dimensions in pictures on a 2-dimensional flat surface (the paper of the drawer, the plate of the etcher, the canvas of the painter); this theory put a number of hallmarks of perspective center-stage: occlusion, marginal distortion, grain and angle. Van Fraassen argues that precisely these hallmarks have their parallels in scientific representations, which thus is supposed to provide the ground for claiming that *all representation in science is necessarily perspectival*, just like every drawing, etching and painting provides what is seen by a pair of eyes at a particular location in space, that is, from some particular geometrical perspective. The parallels are not invariably drawn with shining success, e.g. occlusion and distortion do not seem to have an obvious parallel in measurement.

Then there is an elaboration on Van Fraassen's view of measuring instruments in science as *creators of phenomena* that were not there (Chapter 4). Microscopes are notoriously included; they are unlike windows and glasses, through which we see *what there is*. Van Fraassen does not believe (but does not disbelieve either) in the existence of blood cells, not even when seen through a microscope, as a consequence of his doxastic policy to believe only those propositions of established science that are about observables only and to remain neutral with regard to the rest. One posits the existence of unobservable blood cells in order to explain, for instance, the kind of phenomena created by micro-scopes we call *images*; the inference from the existence of images to the existence of blood cells is abductive, which is however veiled by the elliptical phrase of 'seeing blood cells'. Since such inferences do not guarantee that conclusions are true whenever their premises are, one can coherently suspend belief in the existence of blood cells whilst believing in the existence of

images. The moral is that we do not literally *see* through a microscope. This is a hard counter-intuitive nut to swallow. Yet it is consistent to swallow it. Constructive empiricists are forced to swallow it and are thereby destined to walk around permanently with a sore throat.

In response to criticism of Paul Teller (who has taken over hitting Van Fraassen on the head with a microscope from Hacking), Van Fraassen draws further distinctions. The sort of image that a microscope creates is (i) a *public hallucination*, which stands in contradistinction to (ii) a *private hallucination* (broadly construed, e.g. dreams included). Public hallucinations subdivide further into (i.a) images *of objects*, to which images produced by microscopes and projectors belong, as well as reflections, holograms and shadows, and (i.b) images that are not images of anything, such as rainbows and mirages. (i) Public hallucinations can be recorded by camera and displayed on screen, in contra-distinction to private ones. Public hallucinations are not *delusions*, in that they do not suggest that some object is there that there is not. The point is now that (i) public hallucinations, in contrast to (ii) private ones, need to be saved by science, because they are observable events, i.e. *phenomena*, and according to Van Fraassen to save the phenomena is the aim of science. The ray theory of light and the laws of optics provide a description of the rainbow as well as of microscope and projector images; thus they save these phenomena.

But must we not assume, then, in cases of images where we speak of (i.a) images-of-something, that there is something, something very real, that is responsible for the occurrence of these real images? We can but we must not, Van Fraassen submits, in case this alleged real something is *unobservable*. The observable events do not compel anyone to believe in the existence of unobservable objects, such as for instance blood cells. Van Fraassen does mention the possibility to welcome that we do see through the microscope and believe what we see is amongst what there is, but he does not endorse this possibili-ty—for if he were to endorse it, the flood gates of unobservables would be wide open and the constructive empiricist would face the risk of drowning.

In the mean time we have landed in the realism debate and we shall stay there for a few Chapters.

Empiricist, Pragmatist. Although the empiricist spirit is not omnipresent in *Representation* as it is in *The Scientific Image* and *Laws and Symmetry*, it is far from absent either, as the discussion above on images and microscopes already testifies. The full frontal attack against realism takes place in Part III; *structural realism* in particular is here the main target. In its strongest form, first propounded (and perhaps qualified) by Russell and Carnap, it reads that all we can know about the world is the *kinds* of structures there are, *their* properties and *their* interrelations, somehow inferred from the phenomena. Modern day versions of structural realism assert that all we can know about the world is its structure (epstemic variety), or that structure *is* all there is (ontic variety), or that structure *determines* all there is (Dubrovnik variety).

In a brief chapter on Bertrand Russell's intellectual develop-ment as a structural realist, on Newman's well-known objection (displaying an insight that Felix Klein and Hermann Helmholtz had before) and on Russell's repair, Van Fraassen concludes that one important aspect was lost in Russell's repair, that could never return in any variety of structural realism ever after, "when our direct acquaintance with certain entities separates *what science is about* from what logical gerrymandering concocts" (p. 223). Good old knowledge by acquaintance comes to the rescue, but only to the rescue of an empiricist. Here Van Fraassen navigates towards an *empiricist structuralism*. This turns out to be what has been part

and parcel of constructive empiricism since it was born (p. 238, slightly reformulated):

I. The aim of science is to represent the phenomena as embeddable in certain abstract structures (theory-models).
II. Those abstract structures are describable only up to isomorphism.

Every instance of a data structure representing some phenomenon being embedded in a theory-structure counts as a success of science. Here and only here is the scientific locus of *objective truth*: "this data structure is embeddable in that theory-structure" is true or false, *tertium non datur*, independent of our activities, purposes, hopes, desires, beliefs, perspectives and the whole holy lot.

In the subsequent Chapter, there is a clear and succinct presentation of Putnam's model-argument against metaphysical realism. For Putnam this argument was sufficiently convincing to kiss metaphysical realism goodbye. Van Fraassen congratulates Putnam and follows him in his Wittgensteinian dissolution of the issue, which emerges as soon as we realise our logo-centric human condition: we are suspended in *our own language in use*. In this language 'There is a cat on the mat' means that *there is cat on the mat*, and not something else. The possibility of another language that takes it to mean that *there is a cherry at the tree* does not belong to our language in use but is logical gerrymandering. We can and must locate ourselves in the world in terms of our language in use and this location is an empirical matter; in the context of science, we can and must locate ourselves in the world in terms of our theories under consideration—which are formulated in our language in use—because otherwise our theories would be as useless as a city map without knowing where you are in terms of the map. You locate yourself on a city map by finding out empirically where you are. Recognising buildings and reading street names in our language are exactly like measurement results that we express in terms of our theory.

This *indexicality* is a recurrent theme in *Representation* and enters the analysis of representation too, to which we turn next.

Van Fraassen's *Hauptsatz* about representation reads (p. 23):

There is no representation except in the sense that some things are used, made or taken to represent some things as thus-and-so.

Thank goodness there are examples in *Representation* to put some flesh on this skeleton-sentence, which borders on the edge of triviality if not obscurity. Ultimately the fundamental concept of representation is expressed by a hexadic predicate:

$$\text{Repr}(S, V, A, \alpha, F, P),$$

which reads: subject or scientist S is V-ing artefact A to represent α as an F for purpose P. The most naive idea about representation, expressed by the dyadic predicate 'A represents α', is then made respectable by obtaining it from the fundamental hexadic predicate by a sequence of existential quantifications:

$$\text{Repr}(A, \alpha) \text{ iff } \exists S, \exists V, \exists F, \exists P : \text{Repr}(S, V, A, \alpha, F, P)$$

A few examples will give one the hang of it. In 1926, Schrödinger (S) constructed (V) a mathematical object (A) to represent a Hydrogen atom (α) as a wave-mechanical structure (F) to calculate the frequency of its spectral lines (P). In 1953, Watson and Crick (S) built (V) a table-top artefact of pieces of metal screwed together (A) to represent a DNA-molecule (α) as a helix (F) in order to display its spatial structure (P). In 1964, Streater and Wightman (S) used (V) a mathematical object (A) to represent a quantum-field (α) as an operator-valued distribution on space–time (F) in order to have a rigorous axiomatisation of quantum field

theory that prevents infinities from arising at space–time points (P).

The presence of subject S who is V-ing for purpose P makes representation a manifestation of human agency; it becomes an *intentional* and therefore also an *intensional* concept. There is nothing in some mathematical structure $\mathfrak{S}$ that tells us, all by itself, what $\mathfrak{S}$ represents. A human agent is needed to turn $\mathfrak{S}$ into something that represents something else as a particular kind of structure—a kind captured by predicate F, such that $F(\mathfrak{S})$. Van Fraassen here joins company with Ronald Giere, Nancy Cartwright, Mauricio Suárez and others, but honesty requires to mention that this idea was almost half a century ago already propounded by Peter Achinstein in his 'Theoretical Models':

To propose something as a *model* of X is to suggest it as way of representing X which provides at least some approximation of the actual situation; moreover, *it is to admit the possibility of alternative representations useful for different purposes* (Achinstein, 1965).

Some prefer to express the occurrence of human agency by saying that representation has a 'pragmatic dimension'. From the bird's eye point of view, Van Fraassen's view seems synthesis of sorts between empiricism and pragmatism, which would make him a truly American philosopher—Quine propounded a different synthesis of the same philosophical traditions.

Representation generally is *imagery*: a matter of selective resemblance between represented and representor. Besides (i) perspectival imagery, which we have addressed above, and is also called *picturing*, there is (ii) kinematical and (iii) mathematical imagery. Perspectival imagery subdivides in (i.a) measurements and (i.b) visual imagery, notably perspectival drawing. In science one encounters every species of representation in this taxonomy. Van Fraassen emphasises that *scientific* representation is always representation *of phenomena*, so that variable 'α' ranges over all and only observable events, processes, objects and structures:

$$\text{ScRepr}(S, V, A, \alpha, F, P) \quad \text{iff } \text{Repr}(S, V, A, \alpha, F, P) \wedge \text{Phen}(\alpha).$$

The realist will protest. The realist will want to take a more encompassing domain for variable 'α', including unobservable events, processes, objects and structures. But for Van Fraassen this is simply not on, or at least not needed to make sense of science. Representation in science runs via measurements, which in turn represent phenomena (this is the core of Van Fraassen's representation theory of measurement—*lege infra*). A consequence of this restriction of scientific representation is that empiricist and realist part ways *ab initio*. By empiricist lights, someone who talks about the representation of this DNA-molecule or that Hydrogen atom is not talking about *scientific* representation, because these are not phenomena: variable 'α' has assumed illegitimate values here. It's nonsense. How do you like them apples?

Profound, Sketchy. The relation between the word and the world, which in science becomes the relation between the actual concrete beings that science is about and the theories and models that science constructs, arguably is the leading theme in 20th-century philosophy. Van Fraassen breaks this relation in two pieces:

(A) the relation between phenomenon and data structure;
(B) the relation between data structure and the theoretical structure (model).

Relation (B) is one between two mathematical structures and is an embeddability-relation (see Principle I above of Empiricist Structuralism). Relation (B) breaks in turn in at least two embeddability relations:

(B.1) the data structure gives rise to a *surface structure*; and
(B.2) this surface structure gets embedded in a theory-model (mathematical structure).

About half a century ago, Patrick Suppes already argued there is in general a hierarchy between, on the ground floor, raw measurement data and, at the roof top, the mathematical structures that constitute the theory (theory-models): (B.1), (B.2), ..., (B.n). Curious that Van Fraassen does not use the Suppes hierarchy but chooses to make due with a one-story version of this own (with surface structures living on the 1st floor).

Relation (A), between phenomena and measurement data, is *the problem of co-ordination*, to which Chapter 5 is devoted (one of the highlights of *Representation*). Solving this problem means to answer the following two questions:

(A.1) How do we know that we are measuring Q when we are measuring? What counts as a measurement of Q?
(A.2) What is Q? What is the meaning of 'Q'?

These questions bring Van Fraassen back to the works of Henri Poincaré, Ernst Mach and Hans Reichenbach, who were the first to address these problems systematically. To answer these questions, the first thing to do is to acknowledge that both questions are intertwined and that thereby we enter what Umberto Eco has called *the hermeneutic circle*—a topic that Van Fraassen already addressed in *The Scientific Image* (pp. 56–59). The unavoidability of this circle resides in the fact that two plausible answers to questions (A.1) and (A.2) have undesirable consequences. We forego expounding these two answers for spatio-temporal reasons, but we mention that one answer to (A.1) and (A.2) leads to the impossibility of empirical confirmation and disconfirmation, whilst the other answer needs some grand inauguration event in the distant past, where everything concerning Q was somehow settled once and for all. Van Fraassen's answer consists in a spiral along which science moves upwards, driven by better theories that tell us what is measured and that justify our measurement procedures, and by the theories becoming better and only becoming better by the development of better measurement procedures and the invention of better measurement technology, leading to better measurement results, of course provided the measurement results keep confirming these theories. This spiral is not a circle because the interplay between the development of theories and the practice of measurement is subjected to coherence conditions that keep driving the spiral upward and thereby guarantee scientific progress. Images of Neurath's boat, Popper's swamp and Magritte's castle obtrude. Van Fraassen illustrates this with two case studies: the measurement of temperature (Mach) and of time (Poincaré). In passing Van Fraassen points to the historical fact that frequently certain *choices* were made that were not enforced by facts, thus illustrating that *voluntarist* epistemology is the best epistemology for science.

But this is not the end of philosophical inquiry into measurements yet. For questions (A.1) and (A.2) presuppose and answer to the following question, or are intertwined with the following one, thus complicating the hermeneutic circle even more:

(a) What is a measurement? What sort of process is it?

Answer: a measurement is a physical interaction between some physical object and another one we call a piece of measurement apparatus, which generically is an artefact, designed and constructed by us in order to measure Q. This answer leads immediately to the questions that will occupy Van Fraassen two Chapters (6 and 7):

(a.1) Which kind of physical interactions qualify as measurements?
(a.2) Which conditions do we impose on physical interactions such that they yield what suits the scientific purposes we have for measurements?

Question (a.1) inquires into what Van Fraassen calls "the physical correlate" of measurements (Chapter 6), whereas (a.2) inquires into a "representation criterion", which tells us when a measurement outcome represents the measured physical object in a certain fashion (Chapter 7).

Question (a.1) brings us to that realm of philosophical inquiry known as 'quantum-mechanical measurement theory'. Again quantum mechanics turns out to be a gold mine for philosophers. The notorious measurement problem of quantum mechanics has given rise to quite elaborate theories of measurement interactions of a generality that encompasses, of course, quantum mechanics, but also all other branches of natural science. Perhaps better therefore to speak of *physical measurement theory*—'physical' then refers to Van Fraassen's physical correlate and not to physics. In spite of the presence of such an impressive amount of rigorous literature, Van Fraassen's own account of measurement is rather sophomoric.

Question (a.2) brings us into what is confusingly also known as 'measurement theory' (call it *representation measurement theory*, in order to distinguish it from physical measurement theory), a programme in the philosophy of science launched in full splendor by Suppes—with a variety of historical progenitors (Helmholtz, Campbell, Stevens). In representational measurement theory, one investigates which qualitative arrangements, when suitably characterised, permit quantitative representation; and under which symmetries what is left invariant—called 'representation theorems'. Exactly here begins Van Fraassen's chain of reasoning to defend his view that *all measurement in science is representation of phenomena*, rather than revealing what is there. (Van Fraassen's view on microscopes we discussed above is a corollary of this view on measurement generally, thus contributing to the overall coherence of his view.) This leads to the conclusion that measurement also is a manifestation of human agency, which makes it too an intentional and therefore an intensional concept. Those who concentrate on physical measurement theory (see previous paragraph) tend to leave out the intentional side of measurement.

Finally we must return to issue (A), the relation between phenomenon and data structure, which Van Fraassen develops in a fictional dialogue with a metaphysician (Chapter 11). The metaphysician asks Bas how he knows that the presented graph through the measurement outcomes (the data structure) represents the phenomenon under consideration, rather than some other phenomenon or even something else altogether. Bas responds by explaining how he obtained his data structure, which measurement procedures he followed. The metaphysician responds by saying that she does neither question the careful execution of the measurement procedure nor its legitimacy. She wants to know about the relation between the word and the world, not about embeddability relations between mathematical structures. Van Fraassen repeats that all relations involved in going from theoretical structure via surface structure to data structure are expressible unambiguously in mathematical terms, which is as clear as anything can be, but then goes on to acknowledge, as he must, that there is no *such* relation between

(A) phenomenon and data structure. When we restrict ourselves to the mathematical embeddability relations, the sequence ends at the data structure, and this data structure represents the phenomenon but is not identical to it. The metaphysician complains that ending there means losing the world! Was not science supposed to be about the world?

Van Fraassen calls this 'the loss of reality objection' and wants to countenance it (p. 259):

> The empiricist reply must be, in effect, the step that leaves the entire game of metaphysics behind, and frees us forever from its illusionary charm and glamour. But just because it is the step out of that so insidiously enchanted forrest into realistic common sense, it will have to be a very simple one.

Van Fraassen compares someone believing that the theory embeds the data structure yet doubting that the theory saves the phenomenon that is represented by the data structure to Moore's Paradox, which is someone saying: "It is raining but I do not believe it." The possibility of doubt here is a mere logical one, just as Moore's Paradox is a mere logical possibility. But it is, in the relevant scientific context, to utter a *pragmatic contradiction*, just as in Moore's Paradox, because for Van Fraassen there is, in this context, no leeway between:

(T𝔇) the theory T embedding the data structure 𝔇; and
(Tφ) the theory T saving the phenomenon ϕ represented by the data structure 𝔇.

Pragmatically speaking, there never is such leeway; there is such leeway only logically speaking. To say that (T𝔇) and (Tφ) are the same is to utter a *pragmatic tautology*—not a logical one. To deny it is to utter a pragmatic contradiction—not a logical one—and this denial is a necessary condition for entering the insidiously enchanted forrest of metaphysics. The realist is therefore committed to denying the equivalence.

Perhaps needless to say, the realist will nevertheless insist on *not* to trivialise the distinction between (T𝔇) and (Tφ), because it amounts to trivialising the relation between the word and the world. To commit this act of trivialisation is to commit a philosophical sin that no act of contrition will make good. If the reason to baptise the identification of (T𝔇) and (Tφ) shrewdly 'pragmatically tautological' is that to distinguish (T𝔇) and (Tφ) makes no difference for the life of science & scientist and therefore ought not to be made, then this is a typically pragmatist justification that will not impress any realist philosopher. The practice of science should not dictate norms in philosophy of science. If the reason is to keep us out of the enchanted forrest, then this will not convince any realist philosopher either, because she already lives in that forrest, she wants to live in that forrest and she needs to live in that forrest.

But there is more. Even when we solemnly renounce any comprehensive distinction between (T𝔇) and (Tφ), or downplay it sufficiently to stay out of the enchanted forrest, we are still not out of the woods yet. For there is another distinction that invites us to enter the forrest, the one between *appearance* and *reality* (Part IV).

Since the Scientific Revolution in Early Modern Europe, science and in particular our most general science, physics, depicts nature markedly different from how it appears to us. In Sellars' illustrious terminology, the difference between the scientific image and the manifest image is large. How can the world possibly be such that it appears to us as it appears to us? Given what science tells us the world is like, how can the existence of the manifest image that we have be explained? With the theories of relativity, quantum mechanics and quantum field theory, the difference seems to have reached the size of the Grand Canyon. What must we do? Galilei made a proposal that has remained alive ever since: physics must *explain* how our appearances are produced in reality. More generally, science must answer the question *why* the scientific image gives rise to the manifest image. If and when science generally succeeds in doing that, we shall lead a happy and healthy epistemic life. Van Fraassen calls this Galilean demand the *Appearance from Reality Criterion*, where it is good to remember that *appearances* are how the phenomena look to us, human beings, they are *the content of* our measurement results and outcomes, they are *representations of* the phenomena, and thus have to be sharply distinguished from the phenomena themselves (previously Van Fraassen used 'phenomena' and 'appearances' interchangeably).

Then he shows that both in the philosophy of mind, which is dominated by supervenience relations, as well as in quantum physics, where it seems sufficient to solve 'the problem of the classical limit' in order to make contact to the manifest image, this Galilean Criterion by-and-large has been rejected. Next he proposes to extrapolate from these two cases to all case, i.e. to science across the board. "It is incumbent on the theory only to predict what its appearances will be like", concludes Van Fraassen severely (p. 308), not to posit unobservable entities in order to explain why the appearances are like what they are like. Foolish realists do that, wise empiricists do not. Take your pick.

Accessible, Since *Representation* is contemporary, varied, exciting, provocative, profound and (sometimes) sketchy (with however lots of references to literature where sketches are turned into rigorous edifices), and since *Representation* is very accessible (the few detailed mathematical considerations are relegated to appendices), it is an ideal book for stirring up discussion in a reading group as well as for introducing students to a host of topics in the philosophy of science that are currently discussed in journals and on conferences. For individual readers (members or non-members of reading groups) who are interested in how constructive empiricism can be expanded coherently so as to harbour views on several of contemporary topics, and who are willing to wrestle with the issues of representation and measurement, *Representation* is a rich and accessible read, independent of whether you are lost in the insidiously enchanted forrest but believe you are trailing the nature of reality, or whether you put wax in your ears in order not to hear the metaphysical siren calling and lose yourself instead in the profusion of appearances and phenomena.

Anyway, do not hesitate. Get it and read it.

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