

idea of a mechanical balance, described the volume of exchange of various aggregated commodities, weighted by their price, balanced against the quantity of money in the economy, weighted by the money's rate of circulation. Another family of models addressed issues about the gold standard and bimetallism by thinking of quantities of gold and silver as liquids in different connected reservoirs representing, alternatively, bullion and minted coin, and the way the liquids/metal/currency in one reservoir will flow into others if the level in one becomes higher than in another. Morgan sets out the ways in which Fischer developed these models in response to both theoretical and practical issues of the day. In the process we see how the activity of building models can address relations which are very imperfectly understood, revealing previously unappreciated causal interconnections. For example, Gresham's law is revealed as just one facet of a much more complex network of interconnected variables, and the models help to make clear the conditions under which this law does and does not apply. Also illustrated are ways in which such models can be illuminating about the underlying mechanisms even though the models in question involve extreme idealizations and are extremely limited in practical application because they require parameters which cannot be independently measured. In this respect these examples provide cases in which models would appear to facilitate theory development and articulation more than mediation between preexisting theory and the world.

Different readers, because they will be looking for different things, will themselves offer widely different evaluations of these essays, individually and collectively. In my own evaluation this collection provides a wonderful resource of much needed detail for use in the effort of all interpreters of science to move beyond past problematic oversimplifications. Accounts such as the positivist and semantic descriptions of theories can themselves be seen as highly idealized models, and as such do indeed bring out important features of the ways in which we theorize about the world. However, as the material in this collection demonstrates, such accounts provide only the smallest fragment of a much, much richer picture.

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Science Without Laws

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There are two themes dear to Giere's philosophical heart: naturalism and realism. These are clearly compatible with each other, so the prima facie problem with any naturalistic realism is to show that the combined view can withstand the pressures that beset its two

components, taken individually. *Science Without Laws* is an attempt to defend some form of naturalism alongside some form of realism and to blend the two into a substantive philosophical programme. The book contains already published papers which span a period of 14 years, although most of them are fairly recent and one of them (Chapter 4: “Naturalism and Realism”) is brand new. Their appearance in this volume is very welcome since Giere takes the opportunity to weave the several threads that tie them together. Put in a nutshell, the main slogan of the book is that realism should be perspectival and naturalism should be methodological. The realist part of the slogan is unpacked in terms of the semantic view of theories (which Giere prefers to call “model-based view of theories”, p. 122), while the naturalist part is unravelled in terms of an instrumental approach to normativity and rationality. *Science Without Laws* is a wonderful book by an eminent philosopher of science who has reflected for many years on the issues he writes on. So, one can see in it mature thoughts and arguments, vision as well as detailed scholarship.

The book falls roughly into two parts (although the division I am going to suggest does not reflect the organization of the actual parts and chapters of the book): one is diagnostic, while the other is therapeutic. Giere the diagnostician aims to offer an appraisal of the post-positivist state-of-play in Science Studies. There are, on the one hand, the “enlightenment rationalists” (pp. 1, 57) who take science to be a distinctively rational and progressive enterprise, aiming to discover truths about the world (or, equally, Giere thinks, to uncover the true laws of nature) by means of the scientific method. But there are, on the other hand, those “social constructivists” who take science to be just one among the many historically contingent social institutions with no privileged cognitive status, nor special claims to rationality and truth. Giere has been for years a participant in these debates. So, his exegesis and diagnosis are rich in content. There are a number of sections in the book which discuss in detail the legacy of Logical Empiricism (with a historically juicy Chapter 11 focusing on the Empiricists’ domination of the philosophical scene in the States), the Kuhnian historicist turn, the “methodological foundationalism” of Carnap and Popper, the turn to metamethodology by Lakatos and Laudan and finally the sociological turn of the Edinburgh school and the recent social constructivism of Pickering, Woolgar and Latour. All this is useful recounting for the knowledgeable readers and excellent introduction for the uninitiated. His diagnosis is sharp: despite their vast differences, the “warring camps” are both products of the “internaliz(ation) (of) the Enlightenment view of science” (p. 5). For the Social Constructivists, to challenge the Enlightenment view of Science is “to challenge science itself” and for the rationalists “to defend science is to defend it in its Enlightenment form” (p. 5).

Giere the therapist thinks that the stalemate of the recent “Science Wars” is due to the fact that the “warring camps” have not seen that there is space for a middle position which allows for both the existence of “much genuine scientific knowledge” which is “knowledge of the world” (p. 3) and the failure of “the attempt to separate the content and methods of science from psychological and social reality” (p. 44). The development of this middle way is the main therapeutic task of the book. So, how does Giere’s middle way differ from the Enlightenment view of science? Let us first see what Giere urges us to abandon. The “deliberately provocative” (p. 6) title “Science Without Laws”, suggests just one thing we should leave behind: the search for universal laws of nature. But, for Giere, there is more to abandon: truth and rationality (cf. p. 6). We are then urged to endorse “naturalistic realism” (p. 60) which (a) “downplays the idea that there might be universal natural laws encoded in true statements”; and (b) “denies that there are universal principles of rationality which could sanction belief in the correctness of any particular

model" (pp. 60–61). Abandoning all these may be too high a price to pay for any theory of science which does not become simply descriptive. So, Giere offers substitutes for the abandoned concepts.

On the issue of laws, he claims in Chapter 5 (where this theme is taken up in detail): "there are both regularities and necessities in nature, but there are no laws of nature" (p. 86). Here things get perplexed. For many, laws of nature just are universal regularities with modal force. So, Giere's problem is with the universality of laws. In fact, he is happy to allow for "restricted generalisations" which have the form of "conjunction listing [some] systems, or kinds of systems ..." (p. 93). But I don't think there is much at issue here. For, where the Enlightenment view, according to Giere (pp. 90–91), safeguarded the universality of regularities by adding "provisos" and *ceteris paribus* clauses to a universally quantified statement, Giere safeguards the restricted character of the regularities, by—in effect—adding the provisos and the *ceteris paribus* clauses to the theoretical hypothesis that links the model with the world. "Various pairs of objects in the solar system may be represented by a Newtonian two-body gravitational model of a specified type" (p. 93) is a restricted generalization not because a Newtonian two-body gravitational model of a specified type fails to universally apply to any and all two-body systems which exactly satisfy it, but because it is selectively applied to pairs of objects in our solar system.

On the issue of truth, Giere (p. 73) suggests that all that is needed for expressing the relation between the model and the world is the notion of similarity or fit. In particular, he suggests that the truth-predicate can be understood in a purely "redundant fashion". Being a realist, he also believes that this similarity of fit (in various degrees and respects) between the model and the world can be certified. Now, although in this setting the truth-predicate may sound redundant, it seems that, after all, Giere operates with a substantive (realist) notion of truth since he operates with a substantive notion of "fittingness". For, given that models license linguistic descriptions, to say that the model fits the world is to say that the linguistic description licensed by the model is satisfied by (this piece of) the world. But isn't this the main thought behind the realist notion of truth as correspondence?

On the issue of rationality, Giere endorses a means-end conception in place of the categorical conception of the Enlightenment view (pp. 7, 27, 72). But many philosophers have raised apparently legitimate worries as to whether the instrumental approach to rationality can capture all the content of rational judgement. A problem that seems to arise for him is the following. He claims that "irrational" are the people who "employ manifestly inappropriate means to attain their goals" (p. 27). But how are we to judge whether the chosen means are manifestly inappropriate? Judgements of (in)appropriateness may be either categorical or instrumental. If the former, then there must be some categorical notion of rationality (e.g. a judgement is irrational if it fails to connect with the evidence in the appropriate way). If the latter, then we seem to face a regress. Couldn't one just say that the chosen means are inappropriate just in case they fail to achieve their intended aim? This may well be. But note that this answer would presuppose that success is itself elevated to a regulative idea which, as such, has normative import. In fact, Giere does seem to need this notion of success as a regulative idea. For part of his positive views is the thought that although science does not differ in method from other activities, what seems to distinguish it from other activities is that it is "representational" and as such it can be judged in terms of its success "at constructing models that in fact represent various aspects of the world" (pp. 60–61). This notion of representational success as the means for judging science is itself quasi-normative: whether or not a model is representationally successful is a factual question; but that it *should* be

judged against this criterion is not. A related issue crops up when Giere talks of “correct judgements” (p. 51). Here again, this notion of correctness, even if it is taken as a desired goal (pp. 51–52), is categorical and normative in character.

Giere’s naturalism is a “programme”, “a way of approaching a subject” (p. 5). Given the naturalists’ rejection of the a priori, Giere makes abundantly clear that naturalism cannot be defended as a philosophical thesis by a priori arguments (p. 70). So he is left with “methodological naturalism”, that is with “a set of strategies to be employed in seeking to understand the world”. These strategies prioritize scientific explanations of the phenomena. But this means that scientific explanation acquires—correctly in my opinion—a special cognitive status: it is such explanations that set the standards of our opinion of the worldly phenomena. So, naturalism cannot be just methodological. It should also be able to explain and defend this prioritization of scientific explanation. Giere suggests that it should be supplemented by “theoretical naturalism”, the view that the methodological strategy of naturalism is “justified by appeal to past successes at finding naturalistic explanations” (p. 77). Once this is allowed however, the door is open for a substantive engagement with epistemic issues of justification and warrant.

Giere urges us to adopt what he calls “perspectival realism”. Chapter 9, which criticizes van Fraassen’s Constructive Empiricism, outlines a position which Giere first called “constructive realism”. It is realism because the scientific models make contact with the world, but it is constructive because it emphasizes that theories and models are “logical constructs” (p. 150). His more recent “perspectival realism” stresses that theories “provide us only with perspectives on limited aspects of reality”. “Scientific knowledge”, he claims, “is not absolute, but perspectival” (p. 150). This view is put to work at several junctures in the book: in his reply to the argument from the underdetermination of theories by evidence (pp. 240–241); in his account of principles as providing “the perspective within which to understand” models (p. 94); in his account of theories as maps (pp. 81–82). The term “perspectivalism” has tended to be a fancy philosophical word lately, perhaps because it contrasts nicely with the supposed outmoded term “absolutism”. Giere himself takes traditional realism to be absolutist and connects it with the Enlightenment view of science (cf. p. 78). But I think more care should be taken here. More needs to be said about the perspectival aspect of realism. In particular, the notion of different perspectives may suggest the notion of different truths (according to the perspective). Now this may all be OK for realism as long as the different perspectives are reconcilable (or compatible). But what if they are not? Aren’t there any facts-of-the-matter any more? Giere touches this problem briefly (p. 82) and solves it by what he calls the “one world as a methodological rule” hypothesis: if two perspectives overlap but make conflicting claims about the region of overlap, then assuming that there is only one world, try to find models that “eliminate the conflict” (p. 83). But if conflicting perspectives should give way to a single one, then why insist on perspectivalism?

Science Without Laws should be read and re-read. Even if, in the end, we cannot do without laws, truth and rationality, Giere’s book is path-breaking in exploring how far a naturalist–realist can go without these apparently fundamental concepts.

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