she goes on: "[B]ut it is a mistake to infer from this that the reason that motivates me to act is my believing that p; rather the reason that motivates me is that p, which I believe" (133). So, her position seems to be that the psychological attitude of believing is a background condition for someone to be motivated by what she believes; but what actually motivates him is the latter, not the former. I am a bit uneasy about this sharp distinction. If we accept it, the following advice looks reasonable: "In acting, abstract from your *believing* that p and act only on the basis of p". But this is not a reasonable advice, for belief comes in degrees, and having these degrees into account is certainly important in deciding how to act. It would also be unreasonable to act on the basis of p and abstract from the attitude (belief, suspicion, hope, etc.) towards p. I therefore tend to think that what motivates is the union of the attitude *and* its content. It seems to me that believing is not merely a background condition for the proposition believed to motivate the agent; it rather looks like a constitutive part of the motivation itself. It is true that quite often we give reasons explanations of the form "S A-ed because p", instead of "S A-ed because she believed that p", but it seems that, even in the former case, we assume belief. For consider the following statement, where the assumption is cancelled: "He left the theatre because the concert had finished, but he did not believe that it had finished". Maybe we can imagine some rather special circumstances in which this strange explanation makes sense. But even if we could it would not be a reasons explanation. That the concert had finished could not be his *reason* for leaving if he did not *believe* that it had. Believing seems then to be a constitutive part of the motivating reason, not a mere background condition thereof.

The preceding critical remarks do not detract from my overall highly positive assessment of this book, which nobody seriously interested in the philosophy of action should ignore. It certainly merits a longer and more detailed treatment than I can afford to devote to it in this short review.

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H. W. DE REGT, S. LEONELLI & K. EIGNER, eds. 2009. *Scientific Understanding: Philosophical Perspectives.* Pittsburgh: University of Pittsburgh Press.

"Understanding scientific understanding" is the declared aim of this edited volume, which derives from a conference held at VU University of Amsterdam in 2005. The editors and contributors have made an admirable effort in interlinking the essays and providing them with an overall narrative, which is not always present in collective books. This results in a strongly cohesive and comprehensive approach to what scientists mean by understanding the phenomena on which they work. The three parts in which the volume is divided address a) the relationship between understanding, explanation and intelligibility; b) the role of mathematical and computational models in understanding, and c) how distinct disciplinary settings affect understanding in a particular scientific field. The authors share a strong philosophical perspective on the topic,

illustrating their arguments with historical and contemporary case studies. This contributes towards the coherence and depth of their arguments, despite making the volume difficult for a general readership, even within Science and Technology Studies (STS).

The general outline and underlying leitmotiv of the book is set in Chapter 1. The three editors challenge the objectivist and empiricist tradition which considers understanding as irrelevant for the philosophy of science. According to this tradition, represented by C. Hempel and J.D. Trout among others, understanding is "a psychological by-product of scientific activity", which is better characterised by theories and explanations. Given its subjective nature, understanding has not an epistemic impact on the practice and outcomes of science (p. 4). The editors, by contrast, highlight the importance of a philosophical approach to understanding, in order to properly address the conditions under which scientists accept a particular theory or explanation as plausible. Understanding, this way conceived, emerges as a consequence of the agency of the scientist and the circumstances under which he or she works. The essays in the volume, accordingly, portray understanding as a context-mediated cognitive achievement, which "is not entirely dependent on the truth value of the knowledge used to understand". Understanding rather "incorporates the values, experiences, and skills of the individuals and communities attempting to carve nature at its joints" (p. 16).

Part I of the volume, entitled "Understanding, explanation, and intelligibility" opens with an essay of one of the editors, H.W. de Regt (Ch.2). He argues for the subjective and pragmatic dimension of understanding, distinguishing it from the more objective category of explanation. According to de Regt, understanding depends on the intelligibility of a theory, which explains to a scientist certain phenomena. Such intelligibility requires particular skills by the scientist and is only achievable under certain conditions. P. Lipton (Ch.3) builds on this differentiation between understanding and explanation by describing a number of instances in which the former can be achieved without the latter. The manipulation of entities, the practice of thought experiments and the resource to exemplars or false explanations may lead a scientist to understand a phenomenon without being able to explain it to fellows. The volume is dedicated to Lipton's memory, who passed away unexpectedly shortly after the submission of his contribution.

Intelligibility, the other key element for understanding, is the object of H. Chang's essay (Ch.3). He defines it as an epistemic virtue which does not necessarily have a connection with scientific truth. Intelligibility rather depends on the harmony between a particular epistemic activity – an explanation, the formulation of a theory or a model – and the ontological principles that the scientist takes for granted at a given time and in a given context. The independence of intelligibility from truth leads S.R. Grimm and P. Ylikoski to distinguish between understanding and the sense of understanding in the last two chapters of Part I (Chs.4 and 5). For the former, the feeling of having understood a phenomenon should be considered as positive and given "conditional reliability", irrespective of this understanding then proving incorrect. Ylikoski, by contrast, argues that scientists should carefully revise the practices behind the production

of understanding – often blackboxed – since their activity is usually based on an illusory sense of truth.

Part II of the volume is entitled "Understanding and models", and offers a variety of perspectives on these mediators between scientific theories and practices. M. Morrison (Ch.7) addresses the production of mathematical models in physics and biology, showing that their abstract nature – and apparent disconnection with reality – is beneficial for the epistemic aims of these disciplines. Geneticists and physicists can only understand infinite populations and thermodynamic phase transitions through the resource to models that statistically represent such events. This productive dimension of models is the focus of T. Knuuttila and M. Merz's contribution (Ch. 8). In their essay, they propose an "objectual approach" in which models are not conceived as representations, but as material entities that interact with scientists in a variety of ways. The portray of models as research objects eases the investigation of key elements of scientific understanding. Merz and Knuuttila illustrate these advantages by analysing the practices and skills behind the models produced by two different technologies: event generators in particle physics and parsers which enable computers to understand different programming languages. The last chapter of Part II is also devoted to computational modelling (Ch. 9). In it, J. Lenhard explores the role of computer simulations as producers of understanding without a theoretical grasping of the phenomena they describe – or, as Lipton would put it, as generators of understanding without explanation. Lenhard proposes an "action-oriented" perspective on understanding based on the study of those simulations: the philosopher, instead of looking for theories, can address the production of computer algorithms which allow researchers to control phenomena – such as climate change or friction forces in nanotechnology – in the absence of a full explanatory framework.

Part III of the book addresses "Understanding in scientific practice". The focus of the essays in this last section is upon how the peculiarities of different disciplines shape the scientific understanding they produce. The chapters are devoted to biology (S. Leonelli, Ch. 10); economics (M. Boumans, Ch. 11); physics (D. Dieks, Ch. 12); engineering (M. Boon, Ch. 13); psychology (K. Eigner, Ch. 14); political science (J. van Bouwel, Ch. 15), and history (E. Koster, Ch. 16). All the contributors start with a discussion of de Regt and Dieks' Criterion for Understanding Phenomena (CUP). This Criterion, first published in *Synthese* in 2005, conditions understanding to the intelligibility of a theory in a particular context. Chapters 10 to 16 propose additional elements for the CUP in light of the specific understanding achieved in a particular scientific field. Such elements range from theoretical and performative commitments to judgment and tacit knowledge.

A common conclusion of Part III is that understanding incorporates knowledge and skills which are specific to a community or disciplinary framework. This opens the study of understanding not only to intelligibility and theories, but also to entrenched practices within a particular field. The chapters also distinguish between various types of understanding, which are embodied in the plurality of approaches of every scientific field – top-down and bottom-up in physics, or Marxist vs. Liberal perspectives in international relations. This plurality, which is considered positive by the contributors,

challenges the aspiration to unification in science that philosophers such as M. Friedman or P. Kitcher have long proposed. The volume rejects both the fundamentalist dismissal of a particular scientific approach and the attempt to dilute the plurality of perspectives within a discipline through a so-called integrative theory.

This balance between disciplinary specificity and plurality is probably the main virtue of the volume. The contributors present an array of cognitive practices and skills which are remarkably similar – but not identical – in all the scientific fields. This opens the investigation of understanding to transdisciplinary approaches which seek to break the boundaries between the natural and the social sciences. The resource to mathematical abstraction via the formulation of models may integrate not only physics and biology, but also the philosophical study of those disciplines with that of engineering or economics.

The focus on modelling practices transcends the philosophical approach presented by the contributors and expands the study of understanding towards a more general STS perspective. The investigation of the skills by which scientists make sense of phenomena – as well as their diachronic transformation – necessitates both a historical and sociological frameworks. In this line, most of the essays in the volume present past and contemporary case studies, such as the kinetic theory of gases, the research of R.A. Fisher, the development of neobehaviourism or IBM's Great Deluge Algorithm.

Those case studies, however, are not enough balanced with the arguments presented by the contributors. Given their predominantly philosophical background, the focus of the essays is on the analysis of understanding rather than a detailed discussion of past or current science. This leads the volume to present a robust and amply versatile epistemic model which still needs to be checked against more empirical evidence. In the face of this necessity, historians and sociologists of science may be interested again in the problem of understanding, which as the essays show is not that far from the study of scientific practice.

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ANTONIO DIÉGUEZ. 2011. *La Evolución del Conocimiento: de la mente animal a la mente humana*. Madrid: Biblioteca Nueva.

El tema que el autor coge por los cuernos es algo por lo que todos nos enfrentamos a nuestros peores fantasmas. Es decir, si somos animales, como científicamente en la actualidad no cabe otra tesitura, ¿hasta donde nos lleva esa animalidad? Puede haber dos acercamientos al respecto. O bien se toma cualquier característica humana y, como primera providencia, se naturaliza de un modo u otro, o bien se intenta conectar desde una perspectiva empírico/analítica con características animales que a la postre por evolución, y mayormente por selección natural, están abocadas a desembocar en las dimensiones propiamente humanas que hacen al caso. Esa primera providencia tiene