But since the 1950's other philosophers of science have taken the model-theoretic paradigm seriously and employed it, for a so-called "non-statement" analysis of empirical theories. Prominent amongst these are the "structuralists" (not to be confused with the homonymous French philosophers) such as Sneed, Stegmüller, and others, and also supporters of the "semantic" view of scientific theories – Beth, Suppes and a number of others. In the course of the last two decades of the twentieth century some philosophers overcame the structuralists' curious denigration of the importance of the linguistic formulation of scientific theories. Now there is a greater appreciation of the rôles of and the interplay between theories as syntactical entities in language, their classes of models as semantical entities in our conceptual and mathematical imagination, and the data empirically extracted from reality to be accommodated within the models.

In this book Emma Ruttkamp demonstrates the power of the full-blown employment of the model-theoretic paradigm in the philosophy of science. Within this paradigm she gives an account of science as process and product. She expounds the "received, statement" and the "non-statement" views of science, and shows how the model-theoretic approach resolves the spurious tension between these views. In this endeavour she also engages the views of a number of contemporary philosophers of science with affinity to model theory. Finally, she defends a sophisticated, referential, model-theoretic *realism* in the philosophy of science as being the appropriate meta-stance most congruent with the model-theoretic view of science as a form of human engagement with the world.

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INTRODUCTION

In this text I shall offer a model-theoretic realist interpretation of the processes and products of science built on recent work in the philosophy of science dedicated to analysing the natural sciences in terms of conceptual (mathematical) models of theories and the various semantic relations between such models, theories, and (aspects of) reality. Although analyses of theory-reality and model-reality links have long been a part of philosophy of science, I shall concentrate on the more recent developments concerning these issues in a *model-theoretic* context. Such analyses touch on core questions of the philosophy of science, such as questions regarding the nature of scientific theories, the usual realist inspired questions about the possibility and character of relations between scientific theories and reality, the notion of scientific truth, and, in general, on the nature of scientific progress.

This book has two themes. In one sense I mean it as an introductory text on formal semantic analyses (especially those making use of model theory) in philosophy of science over the past 70 to 80 years. On the other hand I mean this book as an introductory exposition of my account of model-theoretic realism. I join these themes by setting out and explaining a model-theoretic realist account of science against the background of other developments in formal semantics. Mary Morgan and Margaret Morrison (1999) in their book entitled *Models as mediators* make the point (ibid., pp.12,13) that philosophy of science texts in general offers very little information on how models are built. I think there is also very little on exactly what are taken as "models" by different philosophers, and on what the goals and also the consequences of introducing "models" in philosophy of science really are.

A model-theoretic realism offers, via analyses of the structure of scientific theories and the processes of science, a scientific realism that needs, apart from the ontological assumption that the world exists independently of us, very little else from metaphysics. This particular kind of realism is simple although sophisticated, and, as such, implies that although reality is acknowledged to exist "outside" of human practice, this neither means that reality is unknowable nor, at the other extreme of the scale, that science simply mirrors it. By analysing the structure of scientific theories model-theoretically (Chapter 2), it will be shown (Chapter 5) that a model-theoretic approach to science and its processes and products offers the best kind of scientific realism — i.e. a scientific realism with as little metaphysical content as possible.

First a few words on the notion of "science" as it will be used in this text. In principle, my interpretation of science is applicable to all sciences (natural, behavioural, human, social, economic, and so on). I shall in this book however put the emphasis almost exclusively on the natural sciences, and in particular on physics, for the following reason: all of the three main aspects of my model (or interpretation) of science (namely empirical models, interpretative, conceptual models, and theories) are — mostly — more simple and more clearly delineated in the case of the natural sciences (and in physics in particular) than in the other sciences. However, in Section 1.4 I briefly discuss the use of the notion of "model" in economics, and in Section 2.6 I briefly explore the relations between theories and models in methodological studies of