Preface

Depth advances a theory of explanation, the kairetic account, on which explanatory relevance is primarily a matter of causal relevance. It is centered around a conception of causal difference-making (originally presented in Strevens (2004) and further developed in chapter three) that allows properties that are extremely abstract to be causally, and thus explanatorily, relevant to the phenomena that science seeks to explain. To this end, I formulate a recipe that extracts from any detailed description of a causal process a higher level, abstract description that specifies only difference-making properties of the process. The resulting causal-explanatory abstraction is, I contend, responsible for a number of striking features of our explanatory practice: the appearance of absences or omissions in causal explanation, the possibility of causal equilibrium explanations that are silent about the particular causal pathway taken to the event to be explained, the explanatory value of robustness, the utility of idealization in explanation, the importance of probabilistic explanation in deterministic systems, and more.

In later chapters, I introduce a non-causal variety of explanatory relevance that has at its core the notion of *entanglement*, a kind of local modal dependence between properties (section 7.3). A property becomes relevant to an explanandum in this second way not by being entangled with the explanandum but by having its instances entangled with instances of another property that plays a part in causing the explanandum. The explanatory relevance that issues from entanglement is, compared to causal relevance, subsidiary; yet it too helps

to make sense of a range of features of scientific explanatory practice, such as the relevance constraints on properties that explain (and feature in) many high level laws, and the nature of covering law explanation. It also supplies missing parts of the answers to the above questions about equilibrium explanation, robustness, and the probabilistic explanation of deterministically produced events.

A property may figure in an explanation, then, by bearing either of the two kinds of explanatory relevance relations—the causal and the entanglement relations—to other relevant properties. There is in addition a third rationale for a property's appearance in an explanatory model, a rationale that does not require the property to be explanatorily relevant at all, indeed, one that neutralizes any relevance it has: the property may belong to, or it may be a placeholder for something that belongs to, the *explanatory framework*, a construct similar to Mackie's causal field (section 5.3). As entanglement is less important to scientific explanation than causal relevance, so the explanatory framework is much less important still. But it has a role to play, especially in understanding first, the practical side of the organization of explanatory inquiry in science (section 5.4), and second, causal-explanatory claims in everyday discourse (of which I claim all causal claims of the form *c was a cause of e* are instances; see chapter six). The three criteria for entrance to explanatory models may be seen at work side by side in section 12.2.

No particular view of the metaphysics of causation is assumed in *Depth*. I do, however, make certain assumptions as to how the correct metaphysics will turn out. In particular, I claim that the raw metaphysical material from which the relation of causal-explanatory relevance is to be fashioned can be found entirely in the causal structure uncovered by fundamental physics. It is not especially controversial, outside perhaps of certain corners of the philosophy of physics, to hold that the right kind of causal material is to be found in physics— many, perhaps all, well-known accounts of the metaphysics of causation imply as much (section 1.4). It is far more controversial to claim that this physical

level causal influence will suffice for the purposes of causal explanation in biology, psychology, economics, and so on. In advancing this thesis, I do not assert that biological phenomena can be explained in the same way as physical phenomena. I assert only that the raw causal ingredient is the same in biology as in physics; when prepared according to the recipe provided here, explanations of different kinds of phenomena and at different levels may take quite different forms. My position does, nevertheless, commit me to a certain species of explanatory reductionism or physicalism: everything that can be explained, I hold, can be explained in terms that are reducible to physical terms.

That said, I accept the modern view that many terms put to explanatory use in the higher level sciences cannot be translated into physical language; my position is that other, physically reducible terms are capable of reproducing their explanatory functions. The non-physical properties, though convenient, are therefore explanatorily dispensable (section 12.4).

Depth does not discuss every major topic in the philosophy of explanation; I have in particular avoided, or treated only very briefly, issues for which the kairetic account has no especially novel consequences. Some of the omissions: there is no discussion of functional explanation in biology and the social sciences, that is, explanation in which the presence of a trait or practice is explained by the (typically beneficial) role that it plays in the system to which it belongs; I have nothing to say about how-possibly explanation; there is no treatment of the interesting, although recently virtually abandoned, question of explanation in history; I have not mentioned work, some of it my own, on the explanatory role of representations outside of belief/desire psychology, for example in developmental biology and cognitive ethology.

Further, there are a number of problems in explanation proper to the higher level sciences—biology, psychology, sociology and anthropology, economics—that I would have liked to have discussed further, if my hard drive were not already sagging under the weight of the manuscript. You will find hints here and there as to how I would proceed, as well as a short chapter in which some

initial moves are sketched (chapter twelve).

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Chapter one of *Depth* lays some ground rules and selectively surveys approaches to understanding explanation. A minimalist causal account is constructed. Chapter two critiques this minimalism and launches the project of augmenting minimalism with a criterion for causal difference-making; various such criteria are considered and rejected.

Chapter three presents the kairetic criterion for difference-making. In chapter four, I show how to assemble from various facts about difference-making what I call a standalone explanation; for any given event, there are many such explanations, each taking up the causal story at a different point. All standalone explanations for an event are in their own way self-contained, but some are better than others; the respects in which standalone explanations can be ranked are discussed. The kairetic account of explanation is then extended in various ways in chapter five: among other things, I define a measure of explanatory weight, I give accounts of contrastive and what I call aggregative explanation, I introduce the notion of an explanatory framework, and I interpret explanation that makes use of "black boxes". Chapter six examines some particular problems concerning event explanation, such as cases of "preemption", familiar more from the literature on causation than the literature on explanation, and pursues a kairetic understanding of each.

In chapter seven, I turn to the question of the explanation of laws and other regularities. I approve of the general approach taken to such explanations in the literature on causal explanation, but I suggest that much more should be said about the explanatory role of basing generalizations, that is, statements of the matters of physically contingent fact—as opposed to the fundamental laws—on which so many scientifically important generalizations depend. One consequence is a sketch of a metaphysics of high level deterministic laws, to be extended in chapter ten to the statistical case. Chapter eight focuses on the question of the explanatory value of idealization and other abstracting

techniques in regularity explanation.

Chapters nine, ten, and eleven together provide an account of probabilistic explanation, principally in deterministic systems. Chapter nine surveys the major issues. Chapter ten tackles the question of the explanation of frequencies and other statistics, both by probabilities proper and by qualitative analogs that I call quasiprobabilities (as when an event is explained by pointing to the fact that it was "very likely"). Chapter eleven turns to the explanation of single outcomes.

Two short concluding chapters examine, first, the kairetic account's application to several topics in the higher level sciences, and second, the role of the aesthetic sense in explanation.

I have tried to give *Depth* as modular a structure as possible. Let me briefly mention some of the principal interdependencies. Everything depends on the account of difference-making presented in chapter three. The account of probabilistic explanation depends also on the notion of a basing generalization developed in chapter seven; it relies much less heavily on the material in chapters four and five. The account of explanatory idealization, although focused on the explanation of regularities and laws, calls upon just the preliminary discussion of such explanation in sections 7.1 and 7.2 and of course on chapter three's criterion for difference-making. The discussion of preemption in chapter six also depends principally on chapter three only; the treatments of causal absences and transitivity, however, make considerable use of chapter five.