The Place of Function in a World of Mechanisms

Peter Godfrey-Smith, *Complexity and the Function of Mind in Nature*. Cambridge/New York: Cambridge University Press, 1996. Pp. xiii + 311. A$80 HB.

Author's Outline

ENVIRONMENTAL *Complexity and Cognition:* The main topic of my book (whose title I will abbreviate CFMN) is a single idea concerning the place of mind within nature. This idea is the Environmental Complexity Thesis: "The function of cognition is to enable the agent to deal with environmental complexity". The book discusses various versions of this idea, both old and new, and it also defends one version. Nearly everyone will agree that dealing with environmental complexity is *one* thing that cognition does for agents like ourselves. The harder question is whether this activity is important enough to be viewed as 'the function' of cognition. My view is that the answer may well be 'yes', so long as 'function', 'cognition' and 'environmental complexity' are understood in the right ways.

Here is the central hypothesis of the book spelt out in more detail. A core set of cognitive capacities, including the capacities for perception, internal representation of the world, memory and decision-making, has the function of making possible complex patterns of behaviour which enable organisms to deal effectively with complex patterns and situations in their environments. This core set of cognitive capacities is one we share with various non-human animals; my aim is understanding the role played by cognition in possums as well as people. In fact, the environmental complexity thesis can be understood in an even more general way. Patterns of behaviour, and some aspects of the cognitive capacities which make this behaviour possible, constitute one important type of organic complexity. So the environmental complexity thesis might possibly be viewed as part of a more general theory which links

certain kinds of organic complexity to environmental complexity. Dealing with complex problems by means of cognition and action can be seen as a special case of a more general phenomenon: dealing with complexity by means of flexibility.

Much hinges on how the term 'complexity' is understood. I use a very simple concept of complexity: complexity is *heterogeneity*. It is variety, doing a lot of different things or having the capacity to occupy a lot of different states. This concept of complexity can be applied to organisms as well as to environments: organic complexity is heterogeneity in structure or function, and environmental complexity is heterogeneity in environmental conditions and processes. The environmental complexity thesis does not use or require a single overall measure of complexity for environments. Any environment will be simple or homogeneous in some respects, and complex or heterogeneous in others. So will organisms. It is a mistake for a general theory of complexity to seek a single ladder or ranking. All complexity is heterogeneity, but there are many varieties of heterogeneity. In any given context, some complexity properties will be more important than others, and different types of environmental complexity will be relevant to different types of organisms.

Another key term in the discussion is 'function'. I see this term, when applied in biological contexts, as ambiguous, so the environmental complexity thesis can be understood in two ways. In the first *teleonomic* sense of the thesis, something's function is, roughly, the thing it does which explains its having been selected for. In the *instrumental* sense of the thesis, a function is a contribution made to the capacities of a larger system which contains the functionally characterised structure, and where this capacity of the larger system is valuable or adaptive for some reason.

When understood teleonomically, the environmental complexity thesis is an adaptationist hypothesis about evolutionary history. In CFMN this hypothesis is mostly explored and clarified, and only cautiously defended. The instrumental version of the environmental complexity thesis is shown to be false in its original, strong form. So the instrumental version of the thesis is defended only in a weakened form: dealing with complexity is one instrumental function of cognition, but not the only one.

Externalism and Internalism: The environmental complexity thesis attempts to understand cognition in terms of its connections to the environment; it seeks to understand the inner in terms of the outer. Thus it is a member of a large family of explanations which I call 'externalist'. An externalist explanation, in my sense, is any explanation which seeks to explain the internal properties of an organic system in terms of properties of the organic system's environment. An 'organic system' can be an individual organism, a population, or even a social structure; I leave the term deliberately vague. One aim of CFMN is to gain a better general understanding of externalist patterns of

explanation, and the debates that surround attempts to explain insides in terms of outsides.

Externalist patterns of explanation are encountered in a great variety of fields. The two examples which I focus on are *adaptationism* in biology and *empiricism* in philosophical theories of mind and knowledge. Adaptationists seek to explain key aspects of the biological world in terms of adaptive response to environmental conditions. Empiricists—or rather, some forms of empiricist—seek to understand the contents and processes of thought in terms of response to experience. Empiricism's ally in psychology has often been *associationism*, and here we see the same pattern of explanation again. Associationists explain learning in terms of patterns in experience, whether these patterns are in sensations (*circa* 1850), in schedules of reinforcement (*circa* 1950), or in training sets and error signals (*circa* 1990).

Certain common patterns of debate around externalist ideas can also be seen across different fields. An 'internalist' explanation, in my terminology, is any explanation which explains one set of internal properties of an organic system in terms of other internal or intrinsic properties of that system. One form of internalism in biology asserts that evolutionary change is strongly constrained by properties of the developmental programmes that take organisms from egg to adult. The search for general, non-environmental principles of biological order and organisation is another internalist programme. I view some lines of argument in population genetics as internalist also, as they stress the evolutionary role played by the internal peculiarities of genetic systems and oppose the attempt to tell the story of evolution simply in terms of selection pressures. Within epistemology the *rationalist* tradition stresses the importance of the intrinsic structure of the mind, and opposes the attempt to tell the story of cognitive and theoretical growth simply in terms of the impact of experience. In psycholinguistics we find one of the purest internalist views I know of, and a definite cousin of rationalism, in the 'mentalism' of Noam Chomsky. Chomsky not only opposes empiricist explanations of the individual acquisition of grammar, in favour of a 'nativist' alternative, but is also sceptical about the possibility of an environmental, selectionist explanation of how the human species acquired its linguistic abilities during its evolutionary history.

When categorising explanations in this way, how do we determine where the 'inside' of a system ends and the 'outside' starts? In some cases there is an obvious boundary. Despite what some have claimed, the skin is an obvious boundary which is important for many theoretical and practical projects. But of course, in many fields the location and existence of a relevant boundary is one of the issues debated and contested.

Spencer and Dewey: The environmental complexity thesis has a history, some of which I discuss in CFMN. In particular, I discuss in detail the role

played by versions of the environmental complexity thesis in two very different philosophical pictures of the world, due to Herbert Spencer and John Dewey. Spencer is a neglected figure today, not without some reason. But he did have some interesting things to say about the relations between environmental complexity, evolution, life and mind. He was also an extreme externalist in his approach to the biological world. He fused two externalist programmes—adaptationism in biology and associationism in psychology—into a unified theory of biological and mental complexity.

John Dewey did not have many points of agreement with Spencer, but (in his later naturalistic work) he did advocate a version of the environmental complexity thesis. For Dewey, intelligent organisms experience environments which display a mixture of two types of properties. Environments contain a mixture of variable and uncertain conditions on the one hand, and stable and reliable features on the other. It is the variable or uncertain conditions that tend to pose *problems* for living organisms; the function of cognition is to make use of reliable features of the world in order to respond effectively to perils and uncertainties.

It is also central to Dewey's view to insist that the story does not stop there. Cognition is not just responsive to environmental features, it is also instrumental in *transforming* the environment. Cognition and problem-solving are not just directed at producing internal adjustments to problems posed from without; intelligence guides action in such a way that the conditions which posed the problem are changed. So thought, as the guide to intelligent action, tends to produce a certain pattern of change in the world. The environmental complexity thesis need not be a view in which mind is seen as passively responding to an environment which calls all the shots and develops in an autonomous way (Spencer's view tended towards this pattern). Thought can be seen simultaneously as generating specific types of environmental change.

The view I defend concurs with Dewey on this point—Dewey more than any other single writer provides the raw materials for my version of the environmental complexity thesis. These raw materials do, however, receive a fair amount of reworking and clarification.

Construction and Correspondence: I described externalism and internalism as two ways of approaching the explanation of internal properties of organic systems. But claims of these kinds are often part of larger explanatory pictures which also include claims about the other direction of dependence—claims about whether and how organisms affect, determine or construct their environments. Thus, debates about 'outside-in' explanations often connect to debates about 'inside-out' patterns of explanation. Further, above I noted that Dewey was prepared to explain some features of cognition in an externalist way, but only as part of a view which includes the impact that agents have on

their environments—especially on the problematic situations that prompt the deployment of intelligence. So it is important to the project of CFMN to clarify what is involved in the idea that thought acts in the construction or reconstruction of environments.

In some debates about organism/environment relations a choice is posed between two apparently exclusive alternatives. One option is to conceive of organic action as a *response* to environmental structure, and hence as determined by it. The other option is to conceive of organic action as creating or constructing the environment, and hence as determining it. This dichotomy suggests that an emphasis on construction of environments is antithetical to the environmental complexity thesis.

This is a false dichotomy. Both directions of dependence should be recognised in particular cases, and this requires that we avoid construals of adaptation and construction that are so broad or so narrow that one category swallows all the cases. In particular, we should insist on a narrow and restricted conception of what it is for an organic system to 'construct' or 'transform' its environment. The organic construction of environments only occurs when an organic system changes or determines the *intrinsic* properties of objects external to it.

We can then incorporate constructive relationships between cognition and the rest of the world into a view of mind based upon the environmental complexity thesis. This is done by viewing the constructive activity of mind as a special case of the more general phenomenon of organic construction of environments. Cognition is an adaptive response to environmental complexity, but it is also true that one role cognition has within nature is making changes to it; intelligence is an agent in the transformation and reconstruction of external conditions. At least, sometimes it is. When thought is expressed in action, that action can make changes to the environments of intelligent agents. It does this in the ordinary physical, causal sense. When the thought does not result in action, and nothing outside the head has its intrinsic properties changed, that is a quite different phenomenon. Then however useful, worthwhile or novel the thought is, it has not played a real role in the construction or transformation of the world beyond itself. So the environmental complexity thesis can be developed as part of a symmetrical, or 'interactionist', view of the relations between thought and external conditions.

Another concept which generates heated debate concerning inside/outside relations is *correspondence,* of the kind seen (for example) in modern correspondence theories of truth. The concept of correspondence might have an important role to play in a picture of mind based upon the environmental complexity thesis. Both common sense and some philosophical theories make use of the idea that when our beliefs correspond to the world—when they

represent it accurately—actions based upon these beliefs are more likely than otherwise to generate practical success. If this idea is right, it certainly fits with the environmental complexity thesis: cognition helps us deal with environmental complexity, and it does so by furnishing us with accurate representations of the world as a basis for action. Although this idea is attractive, it is hard to make it fit with contemporary naturalistic theories of what the correspondence relation is, as the link between truth and success tends to be trivialised by many of these theories. This issue is not resolved in CFMN; a question-mark remains over the concept of correspondence.

The second part of the book, which I will not discuss here, augments the philosophical discussion mathematically. These chapters outline a range of models of adaptive plasticity, decision-making and information use, mostly derived from the biological literature. So CFMN outlines, and cautiously endorses, a view of mind based upon three central components: properties of environmental *complexity*, which make mind worth having, *reliability* properties, which give thought its purchase on the world, and a naturalistic *interactionist* view of the causal traffic between mind and the rest of nature.

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GODFREY-SMITH'S book covers a wide range of topics. Amongst them are the philosophies of Herbert Spencer and John Dewey, the ability of teleosemantic accounts of mental content to retain the idea of correspondence truth, and the structure of several specific models in evolutionary theory. But the core of the book is an extended discussion and evaluation of the 'Environmental Complexity Thesis' (ECT). The ECT claims that the function of the mind is to enable the agent to deal with environmental complexity (p. 3).

Discussions of biological function have settled down of late, with many authors accepting that there are two senses of 'function' that play a real role in modern biology. The first is the etiological sense of 'function', popularised in Australasia by Karen Neander, in which something's functions are those effects in virtue of which it has been favoured by natural selection. Most talk of function in evolutionary biology is about etiological functions, as Ernst

Mayr and Konrad Lorenz argued many years ago. Godfrey-Smith intends the ECT to be understood in the etiological sense of function. The ECT asserts that the mind has evolved by natural selection to deal with environmental complexity. The second sense of 'function' which is widely accepted today refers simply to the contribution(s) that some part makes to the activity of a complex system. When anatomists and physiologists discuss the functions of the homeobox genes they are not concerned with which of these complex and ramifying effects have been naturally selected. The ECT could be interpreted using this second sense of 'function' to assert that, as a matter of fact, the mind allows agents to cope with environmental complexity, but this reading is of little philosophical interest.

In discussing the ECT Godfrey-Smith contrasts three explanatory strategies: Externalism, Internalism and Constructionism. Externalism explains the structure of an object in terms of the structure of its environment. Internalism explains the structure of an object in terms of the object's own, preexisting structure. Constructionism explains the structure of an object's environment in terms of that object's own, preexisting structure. I am entirely in agreement with Godfrey-Smith that the contrast between internalist and externalist modes of explanation is characteristic of many debates in the life and social sciences. In evolutionary biology this shows up in the opposition between selection and developmental constraint. The very fact that there are regularities to be found in the development of organisms becomes a 'problem' for the theory of natural selection. In psychology dichotomous thinking shows up as the nature/nurture debate, essentially a debate over apportioning causal responsibility to inner and outer causes. The idea that this opposition has been overcome by the conventional formula of 'gene-environment interaction' is demolished by the fierce current debates over the 'genetic' nature of sexual orientation, male aggression and criminal behaviour. Internalists and externalists dance the same barren dance with one another over whether there are 'inner' mental representations and whether children develop by possessing a succession of theories. The same oppositions, the same rhetorical devices, the same dialectical moves recur again and again. However, Godfrey-Smith has a more positive attitude to the internalist/externalism dichotomy than I. He has diagnosed the condition, but has no very strong desire to cure it. He even suggests that it would be productive to dance more precisely in step with the nature/nurture debate or the selectionist/developmentist debate, in discussions between 'internalist' and 'externalist' views in the philosophy of science. On an analogy with these two older cases, he suggests, 'internalist' factors of evidence and argument and some 'externalist' factors, like laboratory politics, should both be regarded as 'inside' science and contrasted with an 'environment' of broader social factors.

In my view the proper response to what Susan Oyama has called "dichotomous thinking" is to try and find new and more productive ways to approach the topics concerned. Godfrey-Smith's discussion of Oyama's work is disappointing, in that he fails to grasp that Oyama's rejection of debates between 'internalist' and 'externalist' is not yet another call for compromise, or for a more complex account including both kinds of factors, but a rejection of the lines between 'inside' and 'outside' across which the dance is conducted. Oyama is well-known for her rejection of both sides of the debate between nature and nurture, genes and environment, in her book *The Ontogeny of Information* (Cambridge, 1985). According to Oyama, both sides of the debate localise biological form (or 'information') in one set of developmental resources, in an almost preformationist manner, so that other resources which make an equal causal contribution to form can be pushed into the background. Godfrey-Smith treats the dichotomous theories rejected by Oyama as opposing empirical bets on the adequacy of models that deliberately omit some relevant factors in the interests of tractability. Strong environmentalists bet that a model that treats genes, cytoplasmic traces and so forth as a mere standard background will be largely adequate. Biological determinists bet that a model focusing almost exclusively on these factors and backgrounding the environment will be adequate. Godfrey-Smith interprets Oyama as arguing that both sides lose their bets. Only a more complex model including both factors can be adequate. In my view this misses a central aspect of Oyama's critique, which is that the place in which the line between internal and external is drawn is unsatisfactory. By excluding bets which straddle this line (ignoring factors from both sides, in the interests of tractability) we narrow our theoretical options unnecessarily. Strategic research decisions to 'bet' on one set of factors are essential to practical science, but should be driven by local considerations, not by some global metaphorical conception of 'inner' and 'outer'.

The third explanatory strategy—constructionism—is the subject of heated debate in many fields. In biology it appears as the thesis that organisms do not evolve to 'fit' their environment, but instead shape the environment so that its and their evolutions are aspects of a single process. In epistemology it appears as the thesis that the world we know is not independent of the process by which we know it. Godfrey-Smith argues that much of the heat in debates between constructionist and externalist modes of explanation is unnecessary. Constructionists mistakenly take externalists to be committed to asymmetric externalism. Asymmetric externalism says that internal structure is shaped by the external and that external structure is not shaped by the internal. In reality externalists need not, and often do not, assert the second conjunct. They can accept, for example, that the structure of the environment depends in some ways on the structure of the organism. Many biolo-

gists embrace a co-evolutionary view of organism and environment without rejecting the externalist idea of natural selection.

Some of the heat in debates between constructionists and their opponents is generated, according to Godfrey-Smith, by sloppy use of the notion of 'construction'. He develops a taxonomy of different senses of 'construction' based on Richard Lewontin's discussions of the organism's construction of its environment. In essence, Godfrey-Smith argues that it is only legitimate to talk of the construction of the environment when an organism changes the intrinsic properties of the objects around it. Digging a burrow is construction of the environment, but walking in the shade is not. In the latter case the organism merely changes its relation to the environment. Distinctions similar to that between constructing the world and changing one's relation to the world can be found in other recent theorists, as Godfrey-Smith documents. Russell Gray has distinguished the co-construction of organism and environment from their co-definition. Robert Brandon and his collaborators have distinguished diachronic (causal) and synchronic (roughly, definitional) senses in which an organism affects its environment. A similar distinction underlies Richard Boyd's principle of the "metaphysical innocence" of theorising. If creating a theory changes the world it must do so because the activity of theorising makes a causal difference to the physical world. When the World Bank adopts a new theory, for example, it really does change the policy mix that makes for economic success in developing nations. NASA, on the other hand, cannot mould the planets to its will. Economists, but not Kuhn's astronomers, engage in world-making.

I sympathise with Godfrey-Smith's desire to restrict 'construction' to substantial processes as opposed to definitional tricks, but fear that his rejection of relational properties will prove unsustainable. On a philosophical level, it requires some principled distinction between intrinsic and relational properties. "We have not that science yet perfect", as John Aubrey lamented of astrology, "it is one of the desiderata". On an empirical level Klaus Immelmann cites some studies which illustrate the evolutionary importance of relations ("Ecological significance of imprinting and early learning", *Annual Review of Ecology & Systematics*, *6*, 1975). The expansion of the European mistle-thrush's range from forest to parkland in France and Germany was shown to proceed, not by the spread of several local populations, but by the spread of a single population which had become habitat imprinted on parkland rather than forest. The fate of different thrush lineages will depend on their interaction with the particular habitat with which they are reliably associated, and the fate of that habitat. The habitat is something they have acquired through evolution, as much as any other element of the phenotype. Yet no intrinsic difference in cognitive mechanism between the two lineages is needed to sustain their association with two very different habitats. In another example,

cuckoo-style parasitic viduine finches have developed morphological subspecies and species on the basis of historic associations with different parasitised species. These associations are sustained by host-imprinting. It is highly plausible that having a historical relationship with a successful host species, and one that has not developed anti-parasitic adaptations, is a critical factor in success for the parasitic species. In both these cases the evolutionarily significant 'construction of the environment' is a matter of changing relations to the environment rather than changing the intrinsic nature of the environment. This is the 'construction' of walking in the shade rather than the 'construction' of digging a burrow.

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By Huw Price

EVEN more than most areas of contemporary philosophy, the philosophy of mind is constrained, for most of us, by the recognition that humans minds are part and product of the biological world. Philosophers of mind differ in how seriously they take this constraint, of course. For some it is nothing more than a kind of reality check: if it turns out that one's *a priori* model of the mind could not be realised in flesh and blood, it's time to try again. Many philosophers take the constraint much more seriously, however. They take the view that problems of the nature of mind and cognition are, essentially, problems in biology.

Godfrey-Smith's sympathies lie in this latter direction, but his book is no narrowly focused contribution to the biologically construed project of understanding the mind. Much of the book is devoted to a much more wide-ranging discussion of the methodological and philosophical presuppositions of the project. Godfrey-Smith is interested in different possible patterns of explanation of minds and other 'internal' aspects of organic systems. He contrasts 'externalist' approaches, which seek to explain features of the internal in terms of relations to external things, with 'internalist' explanations, which seek to explain features of the internal in terms of other internal features. Generally speaking, he seeks to defend the externalist approach, especially for the case of cognition and the mind.

In seeking to combine serious discussion of issues of this second-order generality with a detailed consideration of some first-order proposals, the book is thus very ambitious indeed, by contemporary philosophical stand-

ards. And it succeeds remarkably well. Godfrey-Smith moves between the levels with an impressive command of a wide range of historical and contemporary material, and an engaging clarity and lightness of touch. I enjoyed the book a great deal, and learned a lot from it. All the same, there is one respect in which Godfrey-Smith's discussion of the general methodological issues seemed to me to be significantly incomplete—one major part of the relevant philosophical landscape to which he seemed blind. This would not be a failing in a less ambitious book, of course. We would simply take for granted that certain things were presupposed. But Godfrey-Smith does aim to give us the big picture, and hence may fairly be taken to task for leaving out a significant portion of the relevant contemporary landscape. In the remainder of this review I discuss this failing (as it seems to me), but the usual caution applies. The negative tone of what follows does not imply that I don't admire the book as a whole.

Here's a crude version of the picture in terms of which Godfrey-Smith frames his internalist/externalist distinction. There are two components in the picture: the internal component, comprising various features of organic systems; and the external component, comprising things external to the organic systems in question. The basic task is to explain aspects of the internal component, and in any particular case, internalists and externalists divide as to whether this is better done in terms of internal or external things. Mind figures in this picture as part of the explanandum. Less obviously, it is also implicit in another role, namely that of the would-be explainer. As human enquirers, we are being invited to view the problem posed by the existence of human minds in a particular way—from a sideways-on or God's eye view perspective, from which we may 'survey' the various ingredients of the world, internal and external. The importance of this lies in the fact that one strong tradition in metaphysics—a tradition which arguably includes some of the figures Godfrey-Smith sees himself as opposing—turns precisely on denying the legitimacy of any such perspective. Indeed, debates between Internalists and Externalists in metaphysics, in a common sense of these terms, turn on exactly this issue. (I'll use these capitalised terms to distinguish this metaphysical use of these terms from Godfrey-Smith's.) By these lights, then, Godfrey-Smith's starting point is resolutely Externalist, and it is natural to wonder whether the implausibility he finds in some of the positions he calls internalist is in part an artefact of the viewpoint.

Given Externalism, for example, idealism and certain forms of constructivism seem necessarily to amount to the bizarre view that the external world is ontologically dependent on mental world—that to the extent that Matter exists at all, it is constructed by minds, or composed of mental ingredients. There are idealists of this kind in the philosophical tradition, of course—Berkeley is the obvious example—but their view is a far cry from that of an

Internalist who holds (i) that our view of the world is necessarily mind-dependent, being ineliminably coloured by aspects of our own constitution, and (ii) that in virtue of Internalism, no other viewpoint is available or intelligible. Arguably, Kant is a fine example of such an Internalist, at least if we set aside the Externalism of his transcendental perspective. And it is not difficult to find related views in modern writers such as Carnap, Quine, Sellars, Davidson, Putnam and Rorty, for example—however reluctant some of these philosophers might be to describe their own views in these terms! 'Idealism' and 'constructivism' may not be good terms for these Internalist views—they tend to be used more by opponents than by the advocates of such positions—but there is enough point to their use to make it true that any contemporary critic of idealism and constructivism who ignores Internalism has probably attacked a straw man.

How relevant is this to Godfrey-Smith's project? Not very relevant, in one sense, given that his reference to idealism and (bad) constructivism is largely by way of illustration of the internalist/externalist distinction. Somewhat more relevant, in a second sense, given that Godfrey-Smith wants to apply themes from Pragmatism—from Dewey, especially—to the project of explaining the mind, and that Internalism is such an important theme in the work of philosophers influenced by Pragmatism in the second half of this past century. And really quite important, in a connected third sense, as I'll now try to explain.

Putnam once suggested that we think of Kant as someone who argues that all properties are secondary properties—someone for whom there is no talk of the world which is not coloured by the influence of our own perspective. It is important to realise that this need not be a non-naturalistic view. There is nothing to stop us investigating the ways in which our conceptual categories depend on the contingencies of our position in the natural world, even if we recognise that we cannot step outside these categories. Moreover, the perspective here may well be externalist and biological, in Godfrey-Smith's sense. After all, we are interested in explaining our use of various conceptual categories, and good explanations may well appeal to the role of these categories in allowing us to negotiate our environment, as well as to features of our internal constitution. But note the nature of the explanandum. Applied to one of the hard problems of the philosophy of mind, for example, the question would be why we humans *use* the conceptual categories associated with the intentional stance—concepts such as representation, truth, and the like. The question is what these concepts *do for us*, not what these things *are*. This is certainly an internal question, in Godfrey-Smith's sense. (Indeed, issues from elsewhere in metaphysics become internalised in the same way—not 'What is causation?' but 'What is the function of the notion of the causation in the lives of natural creatures such as ourselves?' for example.) But it is

not the internal question which biologically-inclined philosophers of mind normally take themselves to be addressing.

Godfrey-Smith devotes a chapter to "The Question of Correspondence"—in other words, to the issue as to whether an externalist account (in his sense) has a use for a significant relation of correspondence between thought and the world. He concludes by describing the possibility of a negative answer:

> In the case of correspondence we may find ourselves ... with the facts of practical success ... and a multiplicity of explanations for why particular belief patterns and cognitive strategies turned out to be effective, but no general and explanatory relation lying behind all or most of these cases of success. If this turns out to be the outcome ... there would be little reason to keep using the notion of correspondence. If it has no real role to play, and can be no more than an antiquated honorific with dubious habits of thought hanging off it, we would probably be better off without it. (p. 195)

What seems to be overlooked is the possibility that the notion of truth may have quite a different role to play. Perhaps the concept of truth has a useful function in human life which simply does not depend on the existence of a substantial notion of correspondence, of the sort to which Godfrey-Smith here refers. There are at least two proposals already on offer in the literature which would fit the bill. One is the well-known disquotational or pro-sentential theory, according to which the truth predicate has a useful grammatical function. Another is my own account (in *Facts and the Function of Truth*, Blackwell, 1988), according to which the normativity of the notions of truth and falsity serves a useful role in encouraging argument, with long-run benefits to the linguistic communities concerned.

Of course, views of this kind are normally regarded as anti-realist, but even if this description were appropriate, it is not clear that it would constitute any sort of reason for a biology-aware philosopher to discount such approaches. For one thing, the view is not anti-realist about what it sees as the appropriate explanandum, namely the ordinary *use* of the concept of truth. Surely the project of explaining this use is respectable, from this biological perspective? For another, the view need not be eliminativist about the concept of truth. If the concept serves a purpose which does not require that it itself 'corresponds' to anything in reality, how could anti-realism touch the issue as to whether we should keep it?

In any case, it is far from clear that the label 'anti-realist' is justified here. First, because in many contemporary mouths the terms 'realism' and 'anti-realism' are associated with metaphysical Externalism, and are not obviously well defined from the Internalist perspective here contemplated. And second, more specifically, because the concepts in terms of which realism and

anti-realism are naturally analysed include those—truth, for example—whose function in human life is the very question at issue in an account of this kind. It is far from clear that the upshot of this circularity need be anything other than 'realist', in the only sense now available: if truth ascriptions are themselves properly described as true and false, on this view, what more is there to say?

Of course, there are some familiar examples of the application of this functional, 'explain the use' approach in contemporary philosophy of mind. Dennett's account of the role of the intentional stance is a notable example. But these accounts are commonly dismissed on what amount to metaphysical grounds. Dennett is said to be insufficiently realist about beliefs and desires, for example. However, if the metaphysical presuppositions involved in such criticisms (and perhaps, to be fair, in some of Dennett's own attempts to characterise his view) amount to a crude and unexamined Externalism—in particular, if they take for granted notions of truth and existence which are not themselves subject to the kind of scrutiny involved in asking 'What do we do with these notions? Where do they come from?'—then it may be that the critics are not playing the game by their own professed rules. Given a biological starting point, in other words, Internalism may be preferable to Externalism in metaphysics, on the grounds that it avoids such presuppositions.

These are difficult issues, of course, and no one in contemporary philosophy seems to have explored them very far. Progress requires the ability to step back from the day-to-day debates, and to think about subtle matters concerning the relation between first-order issues and the second-order metaphysical framework. Godfrey-Smith's book provides ample proof that he has the necessary skills, and isn't afraid of the big picture. All the more reason, then, to regret that he seems as blind as most other writers at the biological end of philosophy of mind to these interesting parts of the contemporary philosophical landscape.

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By Werner Callebaut [1] and Karola Stotz[2]

LIFE originated from inorganic matter and energy, and it enabled the further emergence of mind. Materialists such as Herbert Spencer and Konrad Lorenz held that life and mind display a common abstract

pattern. Informed as he is by latter-day reliabilist sophistication as to how humans exploit the resources offered by correlations and connections in the world to generate epistemically interesting internal states, Godfrey-Smith (hereafter G-S) makes the more cautious methodological suggestion not to try to understand mind without taking into account its role within a 'whole organism' context (unlike traditional AI and philosophies of mind that hedge themselves by appealing to 'supervenience').

To the extent that human beings individually and collectively learn something about their external environments, it must be through *causal interactions*, whether direct (cf. 'instruction') or indirect (cf. 'selection'), with their immediate or more distant surroundings. Naturalism, old and new, posits essential *explanatory continuity* across all human cognitive endeavours. These include science, philosophy, and the rich and varied belief and value systems found in all human cultures, which may be viewed as so many more or less risky attempts to come to grips with life on this planet (cf. Hooker 1987, 1995). The naturalness of all our knowledge and beliefs at once suggests a principled *fallibilism* at all levels, including the level of scientific methodology. If certainty is not to be had from science, one should not expect it from 'first philosophy' either! The extravagant claims of some of its advocates (e.g., Wuketits 1990) notwithstanding, mainstream evolutionary epistemology has actually had little that is conclusive or specific to say about the nature and incidence of the beliefs, true or false, that guide living systems' attempts to survive and thrive in more or less hostile environments (Sober 1994; cf. Godfrey-Smith 1989, 1992). What is uncontroversial, however, is that our pre-human ancestors must have begun their cognitive quest from a state of ignorance, without benefit of revelation. Presuming that human beings are pretty successful at 'the knowledge game', the challenge for evolutionary epistemology is to explain in consistently naturalised terms how it is that 'we got from there to here'.

G-S's own brand of evolutionary naturalism sets out to marry Dewey-style pragmatism's insistence on the embeddedness of cognition in behaviour and action with reliabilist epistemology *à la* Alvin Goldman and, more specifically, the 'indicator' or information-based approach of Fred Dretske, Jerry Fodor, and others. One appealing feature of G-S's book is that he tackles—or so it looks at first sight—the notoriously tricky cluster of issues surrounding the origin and functions (past and current) of mind by the roundabout of the currently fashionable notion of *complexity*. According to the Environmental Complexity Thesis (ECT) he centrally promotes, the "function" of cognition is simply "to enable the agent to deal with environmental complexity" (p. 3). G-S probes his ECT in two major contexts, "externalist explanation" in general, and a subcategory of externalist explanation he dubs "c-externalist explanation". In both cases he claims his aim is

"understanding rather than promotion", as both categories of explanation have had substantial impact in both science and philosophy (p. 4). Yet he also admits that the framework he uses in some of his theorising (Ch. 1) and modelling (Chs 7 and 8) is "adaptationist".

Most of G-S's book makes for delightful reading. It is divided in two self-contained parts of uneven length. The long Part I, "Foundations", contains the essence of the author's message, and will be our major focus. The "Models" in Part II elaborate certain features and ramifications of ECT, such as adaptive plasticity, the reliability of the environmental cues organisms use, and complexity at the population level as contrasted to the level of the individual organism, with which the bulk of the book is concerned. G-S captures the reader's attention by his novel and often fruitful way of intermingling issues in the philosophy of mind and post-Hempelian accounts of explanation. He "generally assume(s)" the causal view, articulated by Salmon, Wimsatt and others, according to which "an explanation is a factor causally relevant to the event explained", as well as "a realist view of causation" (pp. 17-8). He does not always seem to be aware of the high demands such a stance puts on explananda, such as historicity (causal processes take time) and 'nuts and bolts' concreteness, that is, the articulation of actual mechanisms (see, e.g., Callebaut 1993, Ch. 4), a point to which we shall return below. G-S's ambitious juxtaposition of systematic philosophical exposition (Chs 1, 2, 5, 6, and parts of Ch. 8) and a historical excursion into the roots of evolutionary naturalism in Spencer and Dewey (Chs 3, 4, and many of the notes to Ch. 6) is quite convincing. The author is unabashedly Whiggish—he himself prefers the term "phenetic" as opposed to the "cladistic" approach to categorisation in historical disciplines—in his treatment of 'Bad Guy' Spencer, who is thus timely saved from oblivion; the late Don Campbell would have liked this. (On the other hand, Campbell would probably have deplored the fact that the author does not refer to Tolman and Brunswik's epochal 1935 paper on "The organism and the causal texture of the environment". Nor does he seem to realise the importance of Simon's "Rational Choice and the Structure of the Environment" for his ECT.) He also does us a great service by dextrously countering Richard Rorty's recent postmodernist vindication of 'Good Guy' Dewey by a *genuinely* naturalistic aggiornamento. All this sits well with the sober style and the general, yet relevant level of exposition G-S has chosen. He almost never loses his readers as he skilfully avoids both getting lost in the nitty-gritty of unexciting technicalities and the aimless speculation that makes much epistemological literature so boring. This sort of approach is not without its own inconveniences, however. Some of these we will discuss toward the end of this review.

G-S's attempt to explain mind in terms of (external) complexity requires the continuous trespassing of disciplinary boundaries, as he is building on

insights from behavioural ecology, complexity theory, cybernetics, historical and contemporary epistemology, philosophy of biology, and philosophy of mind. This invites the question: what kind of 'glue' ensures the coherence of his project? (Incidentally, the book's index, an important tool under the circumstances, has disappointingly few entries and what is worse, these are incomplete.) Before turning to a discussion of three of G-S's more specific views—externalist explanation, complexity, and the internal/external distinction, respectively—we want to take a closer look at the author's variety of evolutionary naturalism, which provides the background, if not the backbone, for his overall argument, although he never discusses it explicitly in more than casual ways. As we already intimated, naturalism in epistemology and philosophy of science aims to further *explanatory continuity* with respect to the various parts and levels of the one physical world we inhabit. It must commit itself neither to 'greedy reductionism' nor even to materialism, although it has often done so (see Callebaut 1993). It is probably fair to say that varieties of more or less 'evolutionary' naturalism are currently being advocated by the overwhelming majority of philosophers of biology, that some more cautious sort of naturalism may also well be on its way to become the dominant position in general epistemology, but that naturalism remains very controversial in philosophy of mind.

This divided state of affairs may not be irrelevant to the question of the intended audience for G-S's book. With respect to philosophy of mind, the very phrasing of the book's topic, "the function of cognition in nature", excludes from being taken seriously positions that might be considered *plausible* (notice that we did not say we think they *are* plausible!) *even on the naturalist's own account*. Current resistance to naturalistic approaches to mind or cognition typically takes the form, not of alternative ontological positions such as substantialist or interactionist varieties of dualism, but of what one could call 'sceptical defeat'. Thus, according to one of G-S's mentors, evolutionary geneticist Richard Lewontin (1989, p. 229), "we know essentially nothing about the evolution of our cognitive capabilities and there is a strong possibility that we will never know much about it". Tom Nagel (1986, p. 81) went even further when he proposed to "take the development of the human intellect as a probable counterexample to the law that natural selection explains everything [sic], instead of forcing it under the law with improbable speculations unsupported by evidence". These or similar criticisms of the project G-S takes to heart cannot always be dismissed out of hand, *even if one insists on playing the game according to the naturalist's own rules.*

The main reason is that naturalism itself often provides grist to the sceptic's mill. We mention two examples: (i) There are good grounds to be wary of invoking functional arguments to explain 'one-shot' events, especially in the social sciences, which do not normally operate under the 'umbrella' of

evolution by natural selection (cf. Elster 1983). To the extent that adaptationism is not the last word, and, more generally, to the extent that evolutionary theory is to be understood as history rather than science (Gould's point, which is now being endorsed by neo-Darwinian hardliners such as Maynard Smith and George C. Williams as well), it is difficult to see how Elster's 'obstacle' could *not* be relevant to G-S's endeavour. His discussions of the (degree of) generality of features of the external world that are pertinent to epistemology and of the 'unity' or 'plurality' of cognition are pertinent to our problem, but too inconclusive to dissipate our worries. (ii) A plausible case can be made against the very possibility of a social 'science' in the sense of a discipline reaching generalisations of nomic import (Rosenberg 1980; cf. Lewontin 1995). To the extent that one believes—as we strongly do—that the evolution of sociality will prove to be far more important to a deeper understanding of human cognition than most epistemologists and cognitive scientists have realised hitherto, arguments such as Rosenberg's may have to be taken very seriously. (In this particular case, some solace may be found in current attempts to articulate social theories that allow comparisons across species.)

A minor quibble concerns the contrast between the *evolutionary foundationalism* that is typical of much of the epistemological work G-S refers to (cf. Quine's "there is some guidance in Darwin"; Wimsatt in unpublished work more generally talks about the possibility of articulating a "dynamical foundationalism" in terms of a hierarchical view of generative structures) and the straightforward *antifoundationalism* of much contemporary naturalised philosophy of science. An antifoundationalist or reflexive theory of knowledge is, roughly, a theory that allows the results of inquiry to influence the conditions of knowledge. G-S, who is more epistemologist than philosopher of science, argues at some length—correctly—that theories of science such as Kuhn's, or Callon and Latour's actor-network approach, offer internalist explanations of their subject matter (although not necessarily for the reasons they would consider themselves). He does not seem to realise that their internalism (in his sense) follows logically from the reflexivity (*would-be* reflexivity, really, in Kuhn's case) of their accounts, which does not allow 'going beyond' them.

The first major issue we will look at in detail is *externalist explanation*, which G-S understands as one basic explanatory form linking certain internal properties of the (minded) organism to properties of its external environment. The two major large-scale externalist programmes he discusses critically but sympathetically are *empiricism* in epistemology and *adaptationism* in biology, which today typically takes the form of pan-selectionism. In adaptationism "the externalist pattern of explanation is displayed more clearly than it is anywhere else" (p. 32). On the reading of empiricism G-S prefers, this comprises only a part of a fully externalist account of the mind—the part

dealing with the (patterned) properties of experience—with "another part of the story (the origins of experience in external things) untold and perhaps untellable" (p. 33). G-S does not consider the alternative, *realist* position that claims it can deal competently with "invisibles" beyond the realm of that which can be experienced (e.g., Campbell 1997). Neither does G-S explore the intriguing parallels between the "(essential) role played by mind in transforming the world" (p. 132) and the constructivist varieties of realism (e.g., Giere, Hacking) that rely crucially on human intervention.

In *c-externalist explanation*, properties of internal complexity are explained in terms of environmental complexity, which G-S views as necessary but not sufficient for organic complexity: "Not all environmental complexity will lead to organic complexity—much environmental complexity can simply be ignored—but you will not get organic complexity in any other way" (p. 58). This is how G-S understands "asymmetric externalism". His own position is much more congenial to Dewey's: cognition is useful (only) in environments characterised by a mix of regularity and change. (For the pre-cybernetician Dewey, environmental complexity generated problems because the organism's equilibrium had to be maintained.) G-S sharpens this into a claim that distinguishes between variability in salient distal conditions and regularity or stability in the relations between proximal (observable) and distal (cf. pp. 118, 220). (There is a crucial error p. 220, where G-S writes about the distinction between "regularity"—read: "variability" —in salient distal conditions, and regularity in the relations between proximal and distal.)

What is crucial here is that Dewey's view leaves ample room for constructive activities: "Cognition enables agents to deal with complex environments, but an important aspect of this process is transformation of environmental conditions" (p. 140). Once this much is conceded to the internalist/constructivist (we will return to this distinction below), and once the feedback loops from the partly constructed and thus 'complexified' environment to the organic system are taken into the picture, the externalist stand loses much of the attraction it may originally have had. The author raises this point himself in a somewhat angst-ridden section called "Contesting the Explanandum ", but without reaching a firm conclusion. Matters become even worse if one realises that in many if not all systems that are sufficiently complex, the system/environment boundary is being defined by the system itself (De Mey's 1982 "cognitive stage"), for this may mortgage all attempts at externalist explanation in addition to making the external observer's perspective problematic—an issue of some sensitivity for G-S (cf. his discussion of the objectivity of Cummins functions, p. 17).

G-S distinguishes between a teleonomic and an instrumentalist version of his ECT. As an explanation of why cognition exists in nature, the teleonomic or 'Wright' version (roughly, 'what something is for') must involve some proc-

ess of selection; that is, it may be expected to refer to some actual history, and it is to be understood as the more 'objective' function. As part of an explanation of the role of cognition in the context of a particular system, the instrumentalist variety can describe a further set of ('Cummins') functions ('what something is good for') which must not involve an adaptationist hypothesis. This distinction seems to us problematic. The Wright function of some trait or structure (from a multiplicity of effects) is supposed to reveal its adaptive value 'as such', irrespective of the larger system context. But can there really be functions in the world that do not relate to some higher level of organisation? In the case of the teleonomic version of the function of cognition in nature, G-S claims he "will focus on a small and allegedly fundamental set of mental phenomena" only (p. 22), which he describes as the "teleonomically fundamental ones" (p. 23.). How much does this really differ from the instrumental version G-S describes in terms of the "well-being of the whole organism" (e.g., p. 59)? Eventually, both versions of function are expressed by referring to the whole, viz. the agent. "The language of the modern synthesis [is] entrenched in its emphasis on the individual" (Buss 1987, p. 174). Instead of explaining separate cognitive phenomena—without ascribing any concrete content to them—in terms of environmental properties, should we not first try to understand them in their role for hierarchically higher cognitive properties, and allow for the possibility that their sole function could reside in their integration in a larger cognitive-behavioural complex not itself explainable in terms of ECT? As suggested before, what a special effect is for should actually exist and have evolved. The teleonomic function cannot be time-independent, then. As G-S neither wants to really cope with historical time nor with the "day-to-day operation" of "how" cognition works (p. 126f.), his claims concerning ECT remain on a highly abstract level—too abstract, as far as we are concerned (see, e.g., his discussion of changes in the functional consequences of the effects of different intermediate stages of evolution—"what use is 5 percent of an eye?", p. 214). Gould and Vrba (1982) made the useful distinction between adaptations with respect to current functions and "exaptations", where the current function of something differs from what it was originally selected for. As Wimsatt (in Callebaut 1993, p. 139) points out, pan-functionalism "is the particular disease of functionalist theories—that are not tied down to selection mechanisms operating in specific contexts on specific system—as they become overextrapolated and overextended after the first blush of success".

The second topic to be commented on at length is G-S's view of complexity. At first glance his account may be regarded as a contribution to the current complexity debate that takes place at the Santa Fe Institute and elsewhere. "Complexity" labels an area of science in which large-scale complex adaptive systems, that is, systems with an increasing amount of interacting

components, are the focus. This may be seen as a follow-up to studies of chaos and nonlinear dynamics. Defined as a property of natural processes, "complexity" has two different, almost opposite, meanings. One goes back to Shannon's mathematical theory of communication, which measures the (potential) information of an event in terms of its thermodynamic probability: the higher the positive entropy, the higher the potential information. Defined thus, complexity stands for 'disorder' or 'lack of structure', which seems to be what G-S has in mind when he tries to capture complexity in terms of heterogeneity, changeability, variability, uncertainty and, in the case of organic properties, flexibility or plasticity (which he uses interchangeably). To focus on the sort of complexity of organisms and their environments "that can be understood, and measured" (p. 25), G-S seems to want to avoid a second understanding of complexity which he dubs "biological complexity", although it refers to a definition of complexity we nowadays find in many non-biological disciplines, including chemistry, physics and computational mechanics. This second notion of complexity is tributary to a different conception of information. Information-theoretic analyses of the structural information of natural sequences have shown that they "are regarding the arrangement of their 'letters' on the border between order and chaos, ... they rather display a characteristic mixture of the unexpected and the expected", and thereby present a maximal amount of structural information to living organisms through the mixture of 'novelty' and 'confirmation'.

Natural processes, then, are prone to an increase in entropy and an increase of 'effective complexity', which is used in combination with levels of organisation, structure, and hierarchy—"complexity on the edge of chaos" (cf. Kauffman 1993). The more internal symmetries and layers of order are embedded, the more complex is a process or structure. Human cognition in this sense is complex, referring to the high degree of structure in its neural architecture, the multilevel organisation of its information processing, and the output of complex (social) behaviour. Here we want to ask how useful a concept of complexity can be that "abstract[s] away from the property of organisation as much as possible" (p. 25) in an account of the origin and function of mind. Even if we could find a solution to the measurement problem, and compare the complexity of different natural processes, then this would probably relate only to conditions of well-defined and symmetric relations, let us say between two organisms in their relation to their respective environments. Current complexity approaches, however, emphasise interaction within every level of an organisation's hierarchy by means of self-organisational dynamics. They occupy an intermediate position on a continuum from reduction of emergent properties to the properties of parts, on one hand, to the 'antinaturalistic' explanation of properties of parts in terms of a whole, on the other.

This takes us to G-S's use of the notions of 'internal' and 'external' and the relationship between parts and whole. His strong distinction between externalist and internalist explanation on one hand and constructivist explanation on the other is reflected in the way these respective discussions are presented (the former in Ch. 2, the latter in Ch. 5 only). This looks like a way to avoid a serious discussion of feedback causation or iterative models of causation. The main problem seems to be G-S's restricted view of the environment as an *explanans* only (e.g., when he holds environmental complexity responsible for the complexity of mind without really considering what causes an environment to become more complex). There are good reasons to have doubts about such a neat division. "Parts and wholes evolve in consequence of their relationship, and the relationship itself evolves. These are the properties of things that we call dialectical: that one thing cannot exist without the other, that one acquires its properties from its relation to the other, that the properties of both evolve as a consequence of their interpenetration" (Levins and Lewontin 1985, p. 3). The problem is not that G-S does not take into account 'interactionist' claims, but that he rests content with countering them with the general remark that internalists as well as externalists make 'explanatory bets' on different models. He is convinced that the real question is that one model will fit the data better than others, and concludes, "I am accepting the dichotomy as real and useful" (p. 53).

What should be the consequences for G-S's internal explanation, that is, "to understand one set of organic properties in terms of other organic properties", of taking 'interactionism' seriously? Instead of viewing an organism as an undifferentiated whole, it has to be described as a system consisting of different, hierarchical levels of organisation; organic properties themselves then become both 'internal' and 'external' with respect to their relation to other organic properties. There is no one-to-one relation between genetic information or complexity and somatic traits or phenotypic complexity. Principles of self-organisation and stochastic tendencies within the developmental system lead from genetic to somatic programmes (cf. Mayr) that can become relatively autonomous through organised anatomy and physiology at higher levels of development. As Leo Buss puts it, the history of life can be understood as a history of different stages of self-replicating units with changed developmental rules. Current evolutionary theory with its focus on the selfishness of separate evolutionary innovations, Buss complains, only describes and identifies given mechanisms by means of "post-hoc summaries", but has little to say about the subsequent evolution because it black-boxes the whole field of channelling interactions. A novel, *hierarchical* view—a kind of new biological 'ontology' or reconceptualisation of the evolutionary process—Buss (1987) regards as a contribution to the "coming synthesis". This should lead to a better understanding of the selfish interests of genes in the

framework of the constraints and conditions generated by higher organisational units and thus to the prediction of the creation of new hierarchical levels through synergisms and conflicts between different units like individuals and cells. Development can be understood as a process in which the "original heritable units became increasingly distanced from direct interaction with the external environment" (Buss 1987, p. 183).

By way of conclusion we would like to comment on G-S's way of arguing. Sometimes we became frustrated because an interesting line of argument is suddenly brought to a halt. The comparison of adaptationism and empiricism provides an example. G-S considers (most) classical empiricists wary of "theorising about specific properties of the external world that might explain particular aspects of thought" (p. 32). He contrasts this cautious stance with the more overt and/or extended externalism displayed in adaptationist explanation. So far, so good; the author is charting ongoing debates, and maybe feels the comparison should not be pushed too far. Yet wouldn't it have been interesting to take one more step and ask: (i) if empiricism can (or could, historically) be formulated consistently and 'work' satisfactorily on the sole basis of a 'thin' account of experience, and; (ii) if, moreover, this version was widely preferred to 'thicker' accounts, wouldn't it be possible and/or preferable to articulate a 'thin' version of adaptationism as well, that is, one that would be deliberately agnostic as to the actual modalities of the correspondence between organism and environment that G-S discusses so neatly in Chapter 6? What we have in mind here is an adaptationist counterpart to epistemologically cautious versions of constructivism. Sometimes the author's decision to end a discussion seems motivated by an (unacknowledged) 'underlabourer of science' view of the role of the philosopher. For instance, with respect to the co-existence of teleonomic and instrumental functions, he writes: "No doubt many will feel a lingering attraction to a more unified analysis ... But the disunity which the present concept of function has is not the product of philosophical difficulty, but a recognition of real differences in the explanatory projects which exist in fields such as biology" (p. 18). One may agree with this or not; playing the devil's advocate, we could render G-S's position as 'science legislates, and philosophy looks on'. The problem with this stance is that we have little or no reason to believe that science as it exists and evolves is optimal in any genuine sense of the word.

At other occasions we would have preferred a firmer stand. More than once we became confused by the proliferation of pros and cons drawn evenhandedly from the vast literature G-S masters, added on to many more straightforward points. These 'self-qualifications' may incline the reader in one direction or another; but the objection remains. In particular, G-S's main thesis—ECT—never becomes really palpable. At one time complexity is understood as heterogeneity, at another time as plasticity, then again as variabil-

ity or diversity; but it is always unclear if this is meant in the sense of 'highly disordered' or, perhaps, as 'a neither randomised nor accidental dynamical pattern of highly interactive components' (cf. Holland 1995). It is still under discussion if selection by itself can produce and maintain emergent patterns of connectivity, for a historical pattern, once it is settled (as a product of selection and an internal process of self-organisation), shows an increasing degree of stability against external pressure.

It is one thing to profess naturalism in matters epistemological, another to get down to the level of specificity where philosophy may be rightly said to have turned into real science. G-S is not to be blamed for having taken only the first step in the right direction; the ways of mechanism are difficult for everyone. But he certainly encourages us to venture to take the next step, and that is no small merit of his book.

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Author's Response

By Peter Godfrey-Smith

REPLY *to Griffiths*: Griffiths criticises several aspects of my handling of the opposition between internalist and externalist programmes of explanation. He also expresses doubts about my narrow construal of when organisms 'construct' their environments. I will address these points in turn.

Griffiths agrees with my characterisation of the role played by the opposition between internalist and externalist programmes of explanation in biology and the social sciences. As he says, we differ about whether the constant appearance of this opposition is, on the whole, a pathological feature of those fields. Griffiths, unlike me, sees the typical pattern of argument between internalists and externalists as a 'barren dance', and hopes the condition can be cured. His description of my version of the internalism/externalism distinction is mostly accurate. One exception is his claim that in my taxonomy, evidence is an internal factor when discussing scientific change. In debates within science studies, evidence-driven views of science are usually described as 'internalist', but not by me. As empiricism is externalist, evidence-driven views of science are externalist too, and I claim in the book that the usual