Peculiarities in Mind; Or, on the Absence of Darwin[1]

Tanya de Villiers-Botha

Department of Philosophy
Stellenbosch University
Private Bag X1
Matieland
7602
South Africa
tdev@sun.ac.za

Abstract

A key failing in contemporary philosophy of mind is the lack of attention paid to evolutionary theory in its research projects. Notably, where evolution is incorporated into the study of mind, the work being done is often described as philosophy of cognitive science rather than philosophy of mind. Even then, whereas possible implications of the evolution of human cognition are taken more seriously within the cognitive sciences and the philosophy of cognitive science, its relevance for cognitive science has only been appreciated relatively recently, and the approach still comes in for some major criticism from prominent theorists within the field. This paper explores some of the reasons for this state of affairs and finds that it might have less to do with due consideration and well-founded scepticism about the relevance of evolutionary theory to these disciplines and more to do with historical accident and faulty assumptions on the part of key theorists in these disciplines. It is also noted that where cognitive scientists are taking evolution into account in their work on the mind, they straying more and more into domains that used to fall exclusively under the purview of philosophy of mind as it is traditionally conceived – qualia, consciousness, perception, intentionality and so forth. The point is made that in ignoring the work being done on the evolution of mind, philosophy of mind runs the risk of becoming obsolete.

1. Introduction

As a topic of academic research, the mind came into its own in the 20th century. Not only did psychology as a discipline burgeon into a fully-fledged science, but 'mind' came to have a distinct philosophical discipline devoted to it. So, while Russell (1962) for example, believed that psychology would now fall under the purview of science and hence did not constitute a philosophical problem anymore, enough aspects of mind were deemed to be of philosophical interest to generate a new school dedicated

1 I would like to thank the anonymous reviewer of an earlier draft of this article for his/her considered and extremely helpful comments and suggestions, which allowed me to make substantial improvements to the paper.

to it within philosophy proper. In the subsequent years, the new disciplines and theories that developed within the sciences and philosophy of mind, respectively, rarely intersected. Many philosophers believed, and still believe, that the mind is somehow beyond the ken of science, given its unique and seemingly mysterious properties, and philosophy of mind set about addressing these metaphysical aspects of mind. However, we seem to have come a full circle as is characterised by a recent paper where Chemero and Silberstein in no uncertain terms declare that 'philosophy of mind is over' (2008: 1). They go on to explore recent developments in empirical approaches to matters concerning mind and cognition, which they consider to be 'philosophy enough', in line with Quine's dictum that 'philosophy of science is philosophy enough' (1).

While I agree with the authors' view that a scientifically-grounded approach to mind and cognition is essential, and that many of the traditional metaphysical concerns of philosophy of mind seem obsolete, I do not agree that all philosophically relevant aspects of mind and cognition can be addressed through science alone—thinking through the ethical implications of scientific findings regarding mind and cognition is a good example here. Furthermore, philosophy of mind and cognitive science have been very much intertwined for much of their history, with philosophy of mind playing a greater role in cognitive science than many realise. Perhaps the fact that the evolutionary origins of our cognitive faculties is being taken much more seriously within cognitive science and philosophy of cognitive science[2] (e.g. Deacon 1997a, 1997b, 2000; Dennett 1995, 1996, 2004; Milikan 1987; Papineau 1984, 2003; Pinker & Bloom 1990; Pinker 1995, 1997, 2002; Ramachandran 2011)[3] should be taken as an indication that philosophy of mind proper should also take it more seriously than it seems to at present.

Given that Darwinian evolutionary theory placed human beings on par with other organisms in terms of their origin and development, it may seem curious that a central aspect of the human animal, its mind, has for so long remained impervious to evolutionary-based approaches in a discipline devoted to its study. As something (at the very least) reliant on and linked to an indisputably biological entity, the human organism as a whole and the human brain in particular, and given the success with which the theory of evolution has been applied to the rest of the biological realm, one would have thought that an evolutionary approach would be an inevitable move in the study of the mind. However, the theory has traditionally been quite absent and even shunned from philosophical theories of the mind and in the cognitive sciences. That this trend persists is illustrated by the fact that few, if any, contemporary compendiums of the central problems of philosophy of mind make any mention of evolution, even in sec-

2 In this paper, I distinguish between philosophy of mind and philosophy of cognitive science in the following manner: *Philosophy of mind* refers to the philosophical approach to mind as traditionally conceived, where the mental (or the philosophically interesting aspects of the mental, at least) is seen as fundamentally metaphysical. In this conception, philosophy of mind does not need to concern itself with what is being done in the various sciences of mind. *Philosophy of cognitive science* is defined as a broader philosophical discipline that extends beyond the narrower scope of philosophy of mind to consider the implications of the work being done in the cognitive sciences (i.e. the interdisciplinary study of mind, which includes neuroscience, psychology, linguistics, artificial intelligence, biology, anthropology and philosophy).

3 It should be stressed that incorporating evolutionary considerations into the cognitive sciences is a relatively recent and quite sporadic phenomenon (see Boden 2006 Vol. II)

tions dedicated to contemporary debates on materialism.[4] The question arises: Why should it be that despite the tremendous impact that evolutionary theory has had on other aspects of biology in the twentieth century, it has been virtually absent when it comes to theories of mind during the same period?

Thus, my intention with this paper then is to address what I believe to be a major failing in contemporary philosophy of mind, which is the lack of attention paid to the implications that the evolutionary origins of mind may have for its research projects. Whereas the cognitive sciences have made the move towards taking the evolution of our cognitive faculties more seriously, the same cannot be said of philosophy of mind proper. I would contend that this failing is part of the reason that some now consider philosophy of mind to be obsolete. My main contention in this paper is that the reasons for disregarding evolution within these disciplines has had less to do with due consideration and well-founded scepticism about its relevance and more to do with historical accident and faulty assumptions on the part of key theorists in these disciplines. The question then remains as to whether there are good reasons for dismissing evolutionary theory from the philosophical study of mind, or whether it may provide us with some useful insights with which to amend, develop and revise our current conceptions of mind. As is obvious from this introduction, my position is that incorporating evolutionary theory into the study of the mind will enhance our understanding of where mind comes from, what it entails, how it works and what we can and cannot know about it.

It should be made clear that is not my claim that all questions that we may have about the mind will necessarily be answered by means of the theory of evolution or by means of the empirical sciences in general. Philosophy still has an important role to play in the study of mind. It is my belief that the advantage that can be had by taking evolutionary theory into account in our approach to mind is that it gives us a problem horizon from which to work by constraining what mind can, in actual fact, entail (*in principle* possibilities and theoretical flights of fancy not withstanding); a point echoed by V. S. Ramachandran (2011) and illustrated in his work.[5] There exist significant facts about our brains, our cognitive structures, our overall biological composition and the history of how these developed that constrain what mind can and cannot be, what it can and cannot do and how it can and cannot function. To ignore these facts when theorising about the mind is foolhardy—how can a theory that does not take the basic characteristics of an entity into account have any relevant contribution to make to knowledge about that entity?

It should also be noted that the theory of evolution has not been wholly absent from philosophical theories on mind. In the aftermath of the publication of the *Origin of Species* in 1859 a few early philosophers seized on Darwin's theory of natural selection and speculated on its implications for our assumptions about mind (William James, John Dewey and C. S. Peirce come to mind here). However, these first tentative steps faltered and it took the best part of the twentieth century for this approach to be taken up again in earnest. And resistance to the application of the theory of evolution to the study of mind remains fervent, with the likes of Fodor (e.g. 1998, 2000, 2005), Chomsky (e.g. 1972, 1975, 1994, 2000a, 2000b, 2004) and even Gould (e.g. 2000) as prominent critics. So much so, that an approach that may have seemed inevitable from the point of view of biology is seen as radical from certain philosophical points of view. As Pinker (1997: 23) puts it: '…the study of the mind is still mostly

4 See, for example, Chalmers 2002a.

5 See section 6 below.

Darwin-free, often defiantly so… The allergy to evolution in the social and cognitive sciences has been, I think, a barrier to understanding.' It is in this regard that I believe a look at some of historical reasons for this state of affairs could be useful. Upon examination, it becomes clear that the antipathy towards (or simple disinterestedness in) evolutionary theory in philosophy of mind and initially in cognitive science is as much due to historical accident and faulty assumptions as it is to fundamental metaphysical convictions on the part of theorists. A good place to start our historical overview is to look at the state of the theory of evolution at the inception of philosophy of mind. As we shall see, as philosophy of mind proper was being established as an independent discipline, the scientific merit of Darwin's theory was being questioned, which did not make it an obvious avenue for philosophical exploration.

2. The Fall and Rise of Darwin

It is sometimes difficult for a contemporary scholar to appreciate the revolutionary character of Darwin's theory of evolution through natural selection and the impact that it had (and continues to have) on almost all aspects of scientific thinking. With the publication of *Origin of the Species* in 1859, the theory of evolution was to turn an entire, seemingly unproblematic world-view on its head, and it is well known that the theory was met with ardent opposition, vestiges of which still remain today. The intricacy in the natural world which Rational Christianity had attributed to a divine designer could now be explained in terms of Darwin's law of natural selection, where the struggle for life resulted in the preservation of random variations in offspring. Darwin's theory implied not only that the world was not designed according to the purposes of a superintending Being, it now seemed that the world was not designed according to any purpose at all but was merely the result of 'blind chance and struggle, and man [was] a lonely, intelligent mutation, scrambling among the brutes for his sustenance' (Burrow 1985: 43). More interesting for the purposes of this paper, however, is to remember that initial objections to Darwin's theory were not based on traditional worldviews and fidelity to religious and metaphysical dogma alone. For some time, mainstream science itself provided reasons to doubt Darwin's claims. This state of affairs had implications for the development for philosophy of mind, for, as the theory of evolution waited for scientific validation, philosophy of mind took up a course where the biological basis and vicissitudes of the mind seemed irrelevant.[6]

One of the main reasons why evolution seemed implausible was the short period of geological time thought to have been available for evolution to have taken place. It was assumed that the earth was not old enough to allow for the time that would be needed for random mutations to take hold eventually lead to speciation. Furthermore, it was difficult to conceive of a process by means of which 'transmutations' are transmitted to offspring. Darwin (1985: 76) himself was also at a loss when it came to explaining how random variations in organisms could be transferred to future generations.[7] These criticisms caused Darwinism to face considerable opposition in the scientific mainstream as well as religious circles.

6 Cunningham (1996) speculates that the disputes and questions raised with the sciences with regard to the theory of evolution as a whole and between different variants of the theory contributed to Russell's rejection of both Darwin's account of the theory and of any possible significance that any variant of the theory may have for philosophy.

7 For instance, he states (Darwin 1985: 76): The laws of inheritance are quite unknown; no one can say why the same peculiarity in different individuals of the same species, and in individuals of different spe-

Eventually, however, mainstream science came up with much evidence that lent credence to Darwin's theory. For example, in early the nineteenth century most people would have believed that the earth was roughly six thousand years old and would have taken biblical narratives relatively literally, which meant that the world had not been around long enough for a gradual evolutionary process to create the variety and complexity of the organisms found on earth. However, by the middle of the nineteenth century geological evidence was pointing to longer and longer periods in which the evolutionary process could have taken place. Furthermore, fossil records showed that entire species had become extinct, which ran counter to the then prevalent assumption that species were permanent and fulfilled specific, predetermined roles within the natural world.

The problem of identifying the process by which evolved characteristics are passed on to offspring took longer to overcome. Although uncertain about how variations could be passed on to offspring, Darwin drew upon what he knew about heritable variation–-partly from his experience as an avid breeder of pigeons—and sketched a scenario of variation through slight heritable mutations. He made a convincing case, for instance, for how an organ as complex as the eye—an organ of 'extreme perfection and complication'—could have evolved from slight, random variations across an adequate time span (1985: 217-224). Darwin also indicated how characteristics such as instinct could be brought about by his principle (1985: 236-263). And, despite his inability to explain how mutations could be inherited, Darwin's theory would subsequently be borne out by the science of genetics, allowing evolutionary theory to firmly establish its scientific credentials. So, it was only by the 1930s, with the incorporation of Gregor Mendel's theory of genetics into the theory of natural selection that Darwin's theory would be reinstated in mainstream biological thinking (Dennett 1995: 20ff, 58-60).[8] By this time, however, philosophical approaches to mind had already been set on a different track, one that seemed immanently more suitable to the study of mind, partly because it dovetailed neatly with our commonsensical conceptions of mind, in a way that a biological (naturalistic) approach seems unable to do.

3. The Immaterial Mind

As hinted at in the introduction, evolutionary theory as it pertains to mind had not been entirely ignored by philosophers. A few early philosophers saw the potential implications that evolution would have for our understanding of the human mind. Prominent among these were William James, John Dewey and C. S. Peirce. William James' belief that a naturalistic approach to mind was needed was inspired by Darwin's theory, and the evolution of the brain formed part of his naturalistic project.[9] In his 1890

cies, is sometimes inherited and sometimes not so; why the child often reverts in certain characters to its grandfather or grandmother or other much more remote ancestor; why a peculiarity is often transmitted from one sex to both sexes, or to one sex alone, more commonly but not exclusively to the like sex.

8 When Gregor Mendel's 1866 work on inheritance was rediscovered in 1900, it first supplanted the theory of natural selection. It is only in the 1930s with the work of theorists such as R. A. Fisher, J. B. S. Haldane, and Sewall Wright, which indicated that genetic theory and natural selection were fully compatible, that evolutionary research was rekindled as a legitimate scientific concern (Patterson 1998: 234). During the late 1930s and early 1940s genetic theory was integrated with more traditional fields of evolutionary interest such as anatomy, palaeontology and systematics. In 1953, interest in evolution shifted focus to the molecular level with Francis Crick and James Watson's model of the structure of DNA, which indicated the material basis of heredity (234).

9 Although evolutionary considerations were addressed by prominent philosophers like Spencer, Nietzsche and Bergson to some extent, their reception of evolution is omitted here, due to the ambivalence of

compendium of psychological knowledge, *Principles of Psychology*, based on the new science of psychology and on traditional philosophical thinking about mind, James recognised that there was a deep tension between a scientific theory of mind and traditional philosophical ways of thinking about the subject (Flanagan 1991: 23-53). One of the greatest influences on traditional philosophical ways of thinking about mind was, of course, the Cartesian position that the 'higher mental processes' are impervious to scientific study due to the fact that the mind is an immaterial entity and hence not subject to the same laws and regularities as matter (the proper subject-matter of science). James (1890) attempted to counter this Cartesian assumption and formulate a naturalistic approach to mind by viewing the mind as a product of natural selection. However, although he believed that the causes of our mental structure are natural and connected to our nervous system, he could not conceive of a way to go about tracing the 'the actual course of psychogenesis' that gave rise to our mental attributes (1890). As with so many philosophers, he did not think that evolution would be able to account for the apparent discontinuity between the physical and the mental—how could a physical process at work on physical entities result in something as apparently 'unphysical' as the mind? The answer that he eventually came up with was a metaphysical view that has come to be known as 'neutral monism', according to which there exists a fundamental 'stuff', 'pure experience', which underlies the mental and the physical and which the mental and the physical are aspects of (Goodman 2009; Stubenberg 2010) . This allowed him to develop a 'positivistic' and 'non-metaphysical psychology' without having to explain the apparently intractable mystery of mind-body interaction (1890: 181).

Peirce's attempt to develop an evolutionary account of mind faltered on the same point, and as well as on the problems of determinism and free will. His was one of the early attempts to integrate language, mind, science and evolutionary theory (although not a purely Darwinian evolutionary theory (Peirce 1965 Vol. VI: 15 [6.13], 16 [6.15], 16-17 [6.16], 17 [6.17]). In his theory, Peirce rejects traditional Cartesian dualism; however, he does not endorse materialism in its stead. He sees materialism as repugnant to both common-sense and scientific logic because he believes that it implies that some kind of mechanism (whatever process it is that governs the mind) should feel, since feeling is one of the elementary characteristics of mind (1965 Vol. VI: 42-43 [6.61]).[10] Peirce could not reconcile free will (a 'mindful' property) with mechanical ('mindless') matter. So, he fell back on the assumption that underlies most traditional approaches to mind, which is generally used to discredit any role that science may conceivably play in the study of mind: What we call 'mind' has to be something so far removed from what we call 'matter' that our approach to it needs to be fundamentally different from our approach to the physical world. Peirce could not break from the Cartesian dualism that he so vehemently rejected.

Despite these difficulties, Peirce did not abandon the idea of evolution but instead attempted to overcome the problems of determinism and free will by constructing an elaborate theory of *objective idealism*, where 'matter is effete mind' (Peirce 1965 Vol. VI: 20 [6.25]). In order to construct his metaphysical system, Peirce attributes the traditionally mental property of feeling to matter and the traditional material property of extension to mind. This theory is not materialistic, given that mind is not governed by

each philosopher towards a specifically Darwinian approach to evolution (as opposed to Lamarckian, for example) (Cunningham 1996)

10 Also see Peirce (1965 VI: 30 [6.37-6.38]).

mechanical law; in fact, the 'original law' of the universe becomes the law of mind—the law of association—and the laws of matter become special instances of this law. So, in his attempt to reconcile a materialistic, evolutionary account of mind without abandoning free will, which he believed is an impossibility in a 'mechanical' universe, Peirce developed a theory of a universe that is imbued with the characteristics that philosophers generally attribute to mind. Peirce is aware of possible objections to his theory, but insists that it should be judged through comparing its consequences with observation, which he of course believes is a favourable comparison (184 [6.277]).

Following in the tradition of James and Peirce, John Dewey incorporated Darwin's theory of evolution into his philosophy, arguing that the theory necessarily implied that philosophy needed to be naturalised. As Popp (2007: 1) puts it,

> While other philosophers may have given some attention to evolutionary theory, it was Dewey alone who saw that if the mind emerged from earlier mindless forms, then this fact portended a new account of knowledge, ethics, and democracy.

Dewey extended his naturalised approach to philosophy in general to problems surrounding mind in particular, arguing that we have to consider the brain and its 'organism' in nature in order to solve the philosophical problems associated with it (1929: 295). For example, Dewey rejects mind-body dualism as a 'cultural mistake' and argues for a continuity between the mental and the physical, without the mental being identical to the physical (Solymosi 2011). Solymosi goes on to argue that Dewey was, in fact, the first practitioner of neurophilosophy and draws fascinating parallels between Dewey's work and work being done in contemporary neurophilosophy and philosophy of cognitive science. Despite his pioneering work on 'mind and world', however, Dewey was not taken very seriously within subsequent development of analytic philosophy and philosophy of mind (Godfrey-Smith 2010)[11]. Which raises the question, why has the naturalistic, evolutionary-based approach to the study of mind lain dormant for a good part of the twentieth century; and why has this approach been resurrected in recent years?

It is not simply the case that Darwinian evolution came to be ignored by twentieth century philosophers (both in the analytical and the continental traditions). As Cunningham (1996) points out, prominent theorists within these two traditions (she focuses specifically on Husserl, Moore and Russell) explicitly rejected its relevance to philosophy. Moore rejected Spencer's application of evolutionary theory to ethics, primarily because of his (Moore's) rejection of naturalism. He insisted that whereas the sciences deal with natural facts, philosophy deals with the realm of the normative.[12] Russell's concerns with possible implications that evolutionary theory could have for philosophy were broader than those of Moore (Cunningham 1996). Whereas Moore limited his critique to ethics and evolution, Russell was concerned with the theory's implications for issues such as immortality, religion and free will (60-96). In *Our Knowledge of the External World* Russell identifies 'evolutionism' as one of three

11 The same can be said for other pioneers who incorporated human evolution into their studies of mind and cognition, such as Piaget (see Messerly 1996) and Lorenz (1978)

12 See Cunningham (1996: 31-58) for a more detailed discussion on the use that Spencer made of Darwin's theory to develop his evolutionary ethics and Moore's extremely influential dismissal of Spencer (and, by extension, the relevance of evolutionary theory to philosophy as a whole).

'current tendencies' in philosophy (the others being 'the classical tradition' in the spirit of Kant and Hegel, and what he calls 'logical atomism') and wholly rejects it. He advocates logical atomism as the 'new realism' and as embodying the same kind of advance for philosophy as Galileo introduced to physics (1914). With Russell's rejection of 'evolutionism' and his influential advocation of logic as the 'essence of philosophy' (1914) subsequent analytic philosophy and, following from that, philosophy of mind would ignore the implications that evolution could hold for philosophy as a whole and mind in particular until late into twentieth century.

The objections that a naturalistic approach to mind 1) necessarily entails determinism and undermines free will and, 2) that the 'immaterial mind' and the 'material world' cannot conceivably interact led either to these pioneering philosophers abandoning their early forays into the theory of evolution and mind, or to their work being rejected by other philosophers. These objections still haunt philosophy of mind today and cause much resistance to evolution and other naturalistic approaches to mind. One of the main reasons for the resistance to incorporating the theory of evolution into philosophy of mind is the traditionally held and very powerful conviction that mind is so different from matter it cannot be studied by means of traditional scientific methods. For example, in the introduction to a contemporary compendium of philosophy of mind the editors note that, despite the rapid growth of the science of mind since the mid-twentieth century and the subsequent blurring of the boundary lines between sciences of mind and philosophy of mind,

> [T]he philosophy of mind at its core remains a branch of metaphysics, traditionally conceived. Philosophers continue to debate foundational issues in terms not radically different from those in vogue in previous eras' (O'Conner & Rob 2003: xi).

It is then not surprising that one of the strongest objections to an evolutionary approach to mind is the conviction that the mind is different from matter and that it should thus be studied in a different way. The specifics of this 'different approach' may vary among the assorted theorists that hold this view, but there is a basic assumption that they all have in common: mind cannot be studied by means of the methodology of the natural sciences because it is 'bits of not-clockwork' to quote Ryle (1960: 21). Such dualism not only has a long tradition within philosophy, but in all probability forms a fundamental part of our commonsensical understanding of the world and how it works—which does not necessarily make it true, of course.

While early philosophical attempts to reconcile evolution and mind floundered, another, seemingly more promising, approach to studying mind came to the fore. While philosophers had been theorising about mind since Descartes, at the very least[13], it had become clear that mind needed to be (and could be) studied in a systematic way, one which was more in line with the scientific method which had been applied to great effect in various other fields of study. However, mind posed a unique problem: whereas science dealt with objective fact, mind was inherently a subjective entity. How could objective consensus be reached on subjective experience? For the early philosophers of mind the answer would lie in the study of language.

13 See Bermúdez (2005: 3-15) for a concise overview of approaches to mind since Descartes.

4. The Linguistic Mind

Much of the subject matter that would characterise 20th century philosophy of mind derives from attempts to reconcile our knowledge of our immediate and seemingly inherently subjective experience of our own minds with the seemingly objective knowledge that we can obtain about the rest of the world by means of science. As Livingstone (2002: 17) puts it, the inauguratory move of 20th century analytical philosophy (and ultimately philosophy of mind) was to integrate this prevailing concern with 'a programme of linguistic and logical analysis'. The intention with this move was to specify the relationship between immediate, subjective experience and objective knowledge

Subjective experience was equated with 'consciousness' or 'mind', while objective knowledge was equated with scientific explanation, primarily understood as something akin to the methodology of classical physics. The assumption was that consciousness entails something over and above the structure and function of physical entities; hence, explaining the structure and function of the brain would ultimately not explain why or how such material structures and functions give rise to 'subjective' consciousness, a view that still pervades today (e.g. Chalmers 2002b: 247ff).

Furthermore, in such a structuralist understanding, scientific explanation consists of a totality of propositions that describe the structural and functional characteristics of the entities to which they refer. Thus, science describes the totality of relationships between physical entities and forms a 'logical network of explanation' (Livingstone 2002: 23). This logical unity of scientific description entails that further meaningful scientific propositions can be *deduced* from the structure of the scientific proposition itself. In this vein, Carnap, for example, concerned himself with the epistemological status of first- and third-person psychological reports. His contention was that if we wanted to establish (an objective) consensus on the knowledge that we form in terms of subjective experiences, we had to resort to the formal description of the structure of these entities of experience. Carnap argued that objective knowledge is such that when we formulate the experience on which that knowledge is based in language (more specifically, *protocol language*) and compare it to sentences of *physical language* (the language in which the unified system of science should be formulated) and these sentences are 'inter-translatable', that instance of personal experience can be said to be objective (Carnap 2002 [1933]: 39ff). Carnap advocated the adoption of this 'physical language'as the system language of all science, which would lead to all science becoming 'physics' and would render metaphysics obsolete.[14] Our language would then be exclusively about physical occurrences and its 'law' would be all-encompassing. This move by Carnap allowed for the possibility that the analysis of the logical relationships among the concepts of such a language could yield epistemological insights (Livingstone 2002: 24). As a result, it was thought that the analysis of the language that we use to describe the world would allow us to differentiate between the logical structure of a proposition (the objective, scientific aspect of such propositions) and its individual, empirical content (its subjective aspect).

Much of the research project of 20th century analytical philosophy, including matters pertaining to mind and consciousness, was to be founded on this assumption. It was accepted that analysing first-person introspective accounts of our subjective experi-

14 It is somewhat ironic then that O'Connor and Rob (2003) describe philosophy of mind as a fundamentally metaphysical.

ences in terms of the logical structure of these accounts would yield objective knowledge regarding mind. And, for some time, this method seemed to be the only viable method with which mind could be studied. Before the relatively recent advent of various brain scanning-techniques, advances in neurosurgery, etc., it was hard to imagine how else we would gain insight into the mind. First-person introspective reports 'translated' into objective data were the best that we could hope for. Studying the mind in this manner represented a major conceptual breakthrough in that the possibility that the mind is something that could be conceptualised and studied was being entertained. We were moving closer to conceiving of a science of mind, where the mind could be subjected to scientific scrutiny, just like any other physical entity in the universe.

As this research project developed, numerous attempts were made at reconciling subjective experience with objective knowledge in physicalist terms, including behaviourism (e.g. Ryle 1960), identity theory (e.g. Place 1956, Smart 1959 and Fiegl 1958) and functionalism (e.g. Putnam 1960, 1976 and Armstrong 1981). Despite this move towards materialism within the discipline, the assumption remains that a first-person linguistic account of 'mental events' is a legitimate, and indeed the only legitimate way of describing the mind. In this manner, the (probably correct) intuition that language is somehow fundamentally intertwined with the mind has led to an unwarranted role being given to linguistic analysis in the study of mind. In all probability, language is fundamental to the mind, as is borne out by recent work done by Deacon (1997a) and Solms and Turnbell (2002), for example. However, this does not logically lead to the conclusion that 'mental events' in any way mirror linguistic propositions or that they are best studied in terms of first-person reports. Ironically, in an attempt to subject mind to objective scientific enquiry and in assuming that first-person linguistic reports somehow reflect the structure and the content of the mind, philosophy of mind closed itself off to another promising scientific approach to studying the mind—evolutionary theory.

Of course, it is always possible to argue that there is nothing wrong with philosophy of mind being closed off from scientific approaches to cognition. Bermúdez, for example, holds that philosophy of mind is primarily concerned with metaphysical and epistemological issues pertaining to mind which can legitimately be insulated from empirical research. As he puts it, 'nothing that one might say about the metaphysics of the mind is empirically refutable' (2005: 15). He contrasts philosophy of mind with philosophy of psychology, which he defines as being concerned with the nature and mechanisms of cognition and which hence cannot afford to be insulated from empirical facts. However, one has to wonder what would be left for philosophy of mind to claim as exclusively part of its own domain if this distinction were to be strictly adhered to. How would it avoid becoming, what Daniel Dennett (2006: 39) calls, 'artifactual puzzles of no abiding significance'? This is not to say that philosophy and specifically a philosophy of mind has no important contribution to make to the study of mind and cognition. Indeed, philosophy has a crucial role to play in the cognitive science and in all sciences, especially with regard to systematically analysing foundational presuppositions that scientific assumptions proceed from, establishing conceptual clarity within and between disciplines and thinking through the moral implications that may arise from scientific conclusions, to name a few. However, I would argue that in order to fulfil this role, philosophers need to be aware of their own inherited presuppositions and metaphysical allegiances. And one way of testing their presuppositions

and allegiances is to consider how they measure up against current scientific consensus on the issue under investigation.

As we have seen, early attempts were made by philosophers such as James, Peirce and Dewey to incorporate evolutionary theory into the study of mind. However, as the research agenda for the study of mind was being set evolutionary theory had fallen out of favour and its legitimacy was being called into question. And, by the time that the theory of evolution started to regain its credibility as its tenets where being corroborated by other scientific disciplines and the idea of genes began to take shape, the linguistic/analytic research agenda had taken hold and gained momentum within philosophy. In this conception, even if one were to concede that the mind is reliant on and influenced by the physical properties of the brain, not a lot could be gained from studying the evolutionary origins and development of the brain. A linguistic/analytic approach to the mind requires the study of the structure and functioning of the mind/brain as is, and the history of the entity in question should not have any relevant implications for its current structure and operations, which is what the philosopher is interested in, after all. But there is a further dimension to this disregard for the developmental history of the brain and physical manifestation of the mind. It lay with developments that took place within mathematics and logic in the 1930s—developments that would lead to a new notion of thought and of the notion of mechanical 'minds' – computers.

5. The Representational-Computational Mind

When it comes to studying the mind, the theory of evolution was not only conspicuously absent in philosophy of mind proper. Even as the theory was being incorporated into various natural sciences, many of the scientific disciplines dedicated to studying and replicating cognition ignored the theory. Ironically, even while rejecting philosophy of mind's *a priori* approach to studying the mind, these disciplines would find themselves greatly influenced by some of these very *a priori* assumptions, especially when it came to the role played by language in the functioning of the mind and the nature of the thinking process. As Dupuy (2000) points out, the emphasis placed on language within philosophy of mind, a result of the linguistic turn in philosophy in general, would also set up some of the fundamental assumptions and research agendas of the cluster of scientific disciplines directly or indirectly concerned with modelling human thought and cognition, the cognitive sciences.[15] Despite the interdisciplinary approach being taken in the emerging cognitive sciences, the mind was seen primarily as a disembodied, computational system rather than as a biological system, and this approach had fundamental implications for some of the disciplines' fundamental assumptions about the mind's structure, function and status. As a result, one could argue along the same lines as Pinker (1997) that this omission is the reason that the various

15 Haugeland (1981: 31) gives the following definition of cognitive science:

> The basic idea of cognitive science is that intelligent beings are semantic engines – in other words, automatic formal systems with interpretations under which they consistently make sense. We can now see why this includes psychology and artificial intelligence on a more or less equal footing: people and intelligent computers (if and when there are any) turn out to be merely different manifestations of the same underlying phenomenon. Moreover, with universal hardware, any semantic engine can in principle be formally imitated by a computer if only the right program could be found.

cognitive sciences ultimately did not reach their goal of replicating the human cognitive process in its complexity and flexibility.

This novel approach to mind stemmed from the work on formalising thought done by mathematicians and logicians in the 1930s and the resulting application of their ideas in 'thinking machines' or computers. Up until then, it had been unclear how one could conceive of and study thought, that elusive property of the immaterial mind. As we have seen, the linguistic turn allowed for the possibility that thought could be studied in terms of the most concrete aspect of it that we had access to—language. In the 1930s, with the work of Gödel and Turing in particular, another possibility arose—one that seemed eminently amenable to the scientific ideal of objectively accessible knowledge. Up until the 1930s in mathematics, the Hobbesian notion of genetic definition was thought to hold, namely that all properties of an object can be derived from its definition (a notion paralleled in the practice of linguistic analysis within the philosophy of language) (Dupuy 2000: 30). The work of Gödel and Turing, however, caused this notion to be called into question. The result was, as Dupuy argues, a conceptual revolution that was the point of departure for the new science of mind.

In 1931 Kurt Gödel published his seminal paper, 'On Formally Undecidable Propositions of *Principia Mathematica* and Related Systems'. His aim with this paper was to solve a logical problem posed by Hilbert, the *Entsheidungsproblem*, namely: Given any formula of the predicate calculus, does there exist an effective, general, finite and systematic procedure for deciding whether or not the formula is provable within the system? (Dupuy 2000: 33) In attempting to answer Hilbert's problem, Gödel established his 'incompleteness theorem', namely that any formal system in the logical sense[16] that is rich enough to accommodate arithmetic has one of the following properties: either the system is inconsistent in that it generates contradictory theorems or there exists at least one true proposition that cannot be proved within that system (Hofstadter 1984: 15-19; Meltzer 1962: vii). In this way, Gödel showed that the consistency of arithmetic cannot be proved in arithmetic itself. As a result, whereas it had once seemed obvious (to theorists such as Frege and Russell, for example) that every mathematical truth is provable, it now seemed that all properties of mathematical entities were not derivable from their definition. Important for our purposes is the fact that, in constructing his theorem, Gödel demonstrated that it was possible to use integers to code formulas and sequences of formulas. A proposition that asserts that a given formula is provable can be expressed in terms of a mathematical proposition – hence, he demonstrated that logic could be arithmeticised. With this move, he gave foundation to the idea that reasoning (thinking) can be characterised as computing with integers (Dupuy 2000: 34). And, since thinking is an integral function of mind, the possibility arose that the mind may be coded or modelled accordingly, and hence studied. This would form the point of departure for the new science of mind.

Along with Gödel, Alan Turing provided the foundations for this new science of mind, beginning with his seminal 1936-1937 paper, 'On Computable Numbers, with an Application to the *Entscheidungsproblem*' (see Pylyshyn 1981: 68). Gödel's theorem went some way towards addressing Hilbert's problem; however, it lacked a rigorous, mathematical definition of an *algorithm* as the mechanical operational procedure within formal systems (Dupuy 2000; Penrose 1989 and Dennett 1995). The concept of a 'mechanical procedure' was alien to normal mathematical theory at the time, and it

16 Dupuy (2000: 33) describes such a formal system as one that provides a formal language, thus one with a set of formulas that function as axioms, and with rules of inference.

was thus necessary to clarify the notion in order to address the *Entscheidungsproblem*. Such an operational procedure could be thought of as an 'effective' or 'mechanical' method for achieving a desired result within logic and mathematics that required no insight on the part of the user (Copeland 2004). Copeland (2004: 101) explains that such a method would have to meet the following requirements:

1. It had to consist of a finite number of instructions (expressed in terms of symbols)
2. When these instructions were carried out without error, they would necessarily achieve the desired result
3. It had to be able to be carried out by a human being (in principle, at least)
4. No insight or creativity would be required on the part of whoever carried out the instructions

In other words, the process of calculation had to somehow be defined and formalised.

Turing attempted to formalise the notion of calculation by developing the abstract notion of a machine as a device for carrying out a finitely definable calculational procedure (an algorithm), which subsequently became known as the Turing machine. The Turing machine is an idealisation of an ideal, finite calculating agent and hence an abstract mathematical entity (Penrose 1989: 45-56; Copeland 1997). It consists of an infinite tape (which represents the machine's memory and is divided into squares), a head which reads symbols from a finite list and writes or erases symbols accordingly and a finite number of states. A machine table with instructions that specify in every given state what could be overwritten on the tape at that point, as well as the next state, in accordance with the mark that is written in the square (or not). The head can move one square at a time to the left or the right, or stand still (cf. Putnam 1980: 365; Copeland 1997). The output of the Turing machine is completely determined by the input, which is made up of the configuration of the machine at a given moment, i.e. the machine's internal state, and the content of the scanned square.

With his model, Turing believed that he had succeeded in penetrating the essence of mechanical procedure/calculation—a procedure that can be implemented correctly by a machine which, of course, possesses no insight into the task that it is performing. His thesis was that every mechanically computable function is computable by a Turing machine, although this claim was not provable (Turing 1969). He puts it as follows (Turing 1950: 436):

> The idea behind digital computers may be explained by saying that these machines are intended to carry out any operations which could be done by a human computer.

With his model, Turing managed to reveal a kinship between the notion of effective computability and that of mechanical procedure. In terms of Hilbert's problem, Turing could rephrase it to: 'Does there exist a (Turing) machine capable of deciding whether or not such a formula is provable?'(Dupuy 2000: 36). And his answer was, 'No'. In the process, Turing developed a model of what was once believed to be a uniquely mental property—thought; or a certain kind of thought at least—that of mechanical calculation.

From here it was a small step to the idea that thought in general may also be amenable to modelling, and thus to study and analysis, not to mention artificial replication. The result was a cognitive revolution where the mind came to be regarded as an entity that could be studied like any other object of scientific interest, and the science of

mind was born. [17] His ideas would also serve as basis for a functionalist approach to the mind-body problem within philosophy. In subsequent years, research in cognitive science would be dominated by representational and computational functionalism of the mind as Turing machine.

With time, it was accepted that all activity of the human mind can be accurately described and is executable by a suitably programmed Turing machine. In subsequent years, research in cognitive science would be dominated by representational and computational functionalism of the mind as a Turing machine. Just about all of the pioneers of cognitive science worked with the notion that the activity of thought (the faculty of mind that had knowledge as its object) is in essence a rule-governed mechanical process which required no insight (Dupuy 2000: 39). The research programme that arose around this assumption dominated the science of mind in the twentieth century**.** The mind as an unembodied information processing entity was studied in terms of models of information-processing and scant attention was given to the origins and the actual functioning of the brain. The 'construction' of the mind was considered to be immaterial to research into the mind and its activities, seeing that a Turing machine can be built from many different materials. What mattered was the organisational structure of the machine. Thus, Turing's work spawned a conception of human beings as, in Hayles's (1999: 7) phrase, 'information processing entities who are *essentially* similar to intelligent machines'. Various disciplines would take their cue from this model, including systems theory, operations research, optimal control theory and decision theory (61). As Chomsky (1972: 3) puts it, the assumption arose that 'any apparent complexity would be disentangled by the electronic marvel'. With the notable exception of theorists such as John von Neumann (Boden 2008: 200, 890-892), it seems that the consensus was that mathematics, technology, behaviouristic psychology and linguistics would converge on a coherent and clear theory of human cognition, fully able to addressing the classic questions of mind and language. Certainly, the notion of mind as a biological entity did not feature in this research programme (Chomsky 1972).

It is interesting to consider the role that philosophy played (and plays) in theories of cognitive science. Dupuy (2000: 90), for example, argues that coherence was given to the various research programmes associated with cognitive science by the philosophical work which was done in connection with them, what he terms, 'cognitive philosophy'. It is philosophers (not cognitive scientists, psychologists, linguists, neurobiologists or computer scientists) who have reflected upon and systematised the basic attitudes shared by various workers in the various disciplines that make up the field. This situation is ironic, given that the cognitive sciences purported to have claimed the ancient philosophical questions of mind for science. Dupuy's (2000: 91) position is that the 'science' that connects the various disciplines that make up the field (neuroscience, artificial intelligence, cognitive psychology, linguistics and so forth) is in, actual fact, philosophy. More accurately, it is philosophy of mind; hence his description of cognitive philosophy as 'the most active and flourishing branch of analytical philosophy'. An important result of the dominance of philosophy of mind in the cognitive sciences is its exclusion of 'rival philosophies' such as philosophies of consciousness, phenomenology, and existentialism, as well as rival psychologies and sciences from the cognitive domain.

17 For an overview of this process see Newell and Simon (1981: 35-66).

Within the different sciences of mind and brain that developed out of the origins discussed above, the ultimate goal of modelling the human mind in an artificial form remained elusive. Researchers could not come close to imitating the complexity and the extent of the abilities of the human mind. Whereas theorists were enthusiastic about the possibility of creating artificial intelligence in the 1950s through to the 1980s[18], the possibility had already come to seem remote for some.[19] More recently, Clark (2001: 124) notes that current work in cognitive science finds itself in a 'process of inner-symbol flight' moving away from the classical approaches to modelling thought as, to use his terminology, 'linguaform reason'. He argues that theorists in this field have begun to doubt the centrality of the exemplars of thought and reason in the discipline, the 'Turing-Fodor vision' (of the mind as a symbol processor) and identifies a trend to re-invent rationality as 'an active, distributed, environment-exploiting achievement'.

Part of this trend towards an 'embodied-embedded' approach in the cognitive sciences is the rediscovery of Darwin and his theory of natural selection by theorists studying the mind and brain (Clark 2001: 122). It seems that the symbolic-computational approach had come up against an insurmountable hurdle: thought in all probability constitutes more than the algorithmic computation of symbols. What remains critically absent in traditional computational approaches to mind were concepts of the environment in which the mind operates (receives its input), constraints in terms of which the mind must function, the historical development of the mind (the mind is not programmed by a human programmer, but by evolution, learning, and experience), and a notion of the purpose of mind (what its input is used for).[20] In the light of these considerations, it seems highly unlikely that the human mind can successfully be conceived of as an abstract, disembodied logic-machine.

Today, despite criticism from the likes of Fodor and Chomsky, the evolutionary history of the brain and mind plays an important role in various research projects within the cognitive sciences and the philosophy of cognitive science with theorists from various disciplines taking evolution into account when studying the brain and mind. Various philosophers have also taken up this approach, applying insights gained from the evolutionary cognitive sciences to traditional philosophical problems of mind with interesting results. Prominent among these are Peter Carruthers (e.g. 2006), Daniel Dennett (e.g. 1995, 1996, 2004), Owen Flanagan (e.g. 2000), Ruth Millikan (e.g. 1987), David Kim Sterelny (e.g. 2001, 2003). However, these philosophers face staunch criticism from others within the field. The kind of criticism usually levelled at an evolution-based approach to mind from a philosophical point of view generally mirrors that levelled at naturalistic approaches to mind in general. The most notable and persistent of these objections is the contention that it is impossible to develop a physical account that explains and illuminates the possibility and character of subjective experience (e.g. Nagel 1974; Block, 1980; McGinn 1989; Chalmers 1995, 1996 and Kim 1998, 2005). In the meantime, traditionally philosophical questions of mind are being taken up by various cognitive scientists with interesting results that are very relevant to philosophers concerned with mind; neuroscientist V. S. Ramachandran is an excellent example here (see, for example, Ramachandran, 2011). I would argue that

18 See Haugeland (1981); Newell and Simon (1981).

19 See Minsky (1981: 123) where he criticises the 'logistic approach' in simulating world-knowledge, arguing that it had been tried 'since Aristotle' with little success.

20 See, for example, Dreyfus, 1981; and Putnam, 1981.

in dismissing or ignoring this approach to mind, philosophers of mind run the risk of becoming irrelevant in the study of mind.

When we accept that mind and brain are inextricably linked, and thus study the mind as 'embodied', we cannot ignore the history of its development and embodiment – its evolution. To quote Ramachandran (2011: xii), 'it is impossible to understand how the brain works without also understanding how it evolved…in biological systems there is a deep unity between structure, function and origin.' And judging from Ramachandran's forays into aspects of mind traditionally reserved for philosophy and particularly philosophy of mind—consciousness, free will, qualia, theory of mind, self, and even metaphor, aesthetics and universals—an evolutionary approach to mind makes for rich philosophical pickings (See, for example, Ramachandran 2011).

7. Conclusion

We have seen that, despite the ever-increasing appeal that evolutionary theory (in various forms) held for the biological sciences in the twentieth century, studies of mind have remained 'Darwin-free' for much of that time. Some of the reasons for this state of affairs seem to be accidents of history and others are due to faulty assumptions on the part of theorists. As a result, I argue that evolutionary theory has not been given due consideration within most of philosophy of mind and in classical cognitive science; and whereas cognitive science proper and philosophy of cognitive science have moved to incorporate the evolution of the brain into their studies of mind, philosophy of mind has predominantly failed to do so. Viewing the mind as a biological, information-processing entity, the primary purpose of which is to ensure the survival and reproduction of its possessor, conceivably offers a way out of many apparent theoretical quandaries that philosophy of mind finds itself in. It appears to be the case that the problems of philosophy of mind as traditionally conceived – explaining the 'phenomenal feel' of states of mind, the apparent lack of spatial location of states of mind, the intentionality of mental states, the counter-positioning of introspection and perception, and the apparent inaccessibility of the mental are, in fact, pseudo-problems, rooted in conventional, common-sensical assumptions about mind rather than in actual attributes of the mental. If the mind, as 'something that the brain does' (Pinker 1997), is the product of (not necessarily symbolic) computational processes, where the human organism gains information about the world in various modalities through its senses, and structures and interprets that information in terms of its inherent structure, symbolic thought provided by language learning, the evolutionary goals of the organism, and past experiences, there is no reason to assume that our 'introspective knowledge' is any less subject to interpretation and 'material interference' than knowledge that we gain through 'perception'. There is also no reason to believe that mental knowledge or states are more easily accessible or more trustworthy than 'material knowledge'. Hence, there is no reason why the mental should not be studied through a radically interdisciplinary science of mind.

This is not to say that philosophy and specifically a philosophy of mind has no important contribution to make to the study of mind and cognition. Indeed, philosophy has a crucial role to play in cognitive science, as in all sciences, especially with regard to systematically analysing the foundational presuppositions that scientific assumptions proceed from, establishing conceptual clarity within and between disciplines and thinking through the moral implications that may arise from scientific conclusions, to

name a few. However, I would argue that in order to fulfil this role, philosophers need to be aware of their own inherited presuppositions and metaphysical allegiances. One way of testing their presuppositions and allegiances is to consider how they measure up against current scientific consensus on the issue under investigation – not uncritically, of course.

References

Armstrong, D.M. 1981. *The Nature of Mind and Other Essays*. New York: Cornell University Press.

Bermúdez, J.L. 2005. *Philosophy of Psychology: A Contemporary Introduction.* New York and London: Routledge.

Block, N. 1980. 'Troubles with Functionalism', in N. Block (ed.) *Readings in the Philosophy of Psychology*. Cambridge, MA: MIT Press.

Boden M.A. 2006. *Mind as Machine: A History of Cognitive Science. Volumes 1 and 2*. Oxford: Claredon Press.

Burrow, J.W. 1968. 'Introduction', in C. Darwin. *The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*. London: Penguin Books.

Carnap, Rudolf (2002 [1933]). 'Psychology in Physical Language', in D.J. Chalmers (ed.) *Philosophy of Mind. Classical and Contemporary Readings*. Oxford: Oxford University Press.

Carruthers, P. 2006. *The Architecture of the Mind.* New York: Oxford University Press, USA.

Chalmers, D.J. 1995. 'Facing Up to the Problem of Consciousness', *Journal of Consciousness Studies* 2(3), 200-219.

Chalmers, D.J. 1996. The *Conscious Mind: In Search of a Fundamental Theory*. New York and Oxford: Oxford University Press.

Chalmers, D.J. 2002a. 'Foundations', in D.J. Chalmers (ed.) *Philosophy of Mind. Classical and Contemporary Readings*. Oxford: Oxford University Press.

Chalmers, D.J. 2002b. 'Consciousness and Its Place in Nature', in D.J. Chalmers(ed.) *Philosophy of Mind. Classical and Contemporary Readings.* Oxford: Oxford University Press.

Chemero, A. and Silberstein, M. 2008. 'After the Philosophy of Mind: Replacing Scholasticism with Science', *Philosophy of Science* 75, 1-27.

Chomsky, N. 1972. *Language and Mind*. New York: Harcourt Brace Jovanovich, Inc.

Chomsky, N. 1975. *Reflections on Language.* New York: Pantheon House.

Chomsky, N. 1994. 'Chomsky, Noam', in S. Guttenplan (ed.). A *Companion to the Philosophy of Mind.* Oxford: Blackwell Publishers.

Chomsky, N. 2000a. *The Architecture of Language*. New Delhi: Oxford University Press.

Chomsky, N. 2000b. *New Horizons in the Study of Language and Mind.* Cambridge: Cambridge University Press.

Chomsky, N. 2004. *The Generative Enterprise Revisited. Discussions with Riny Huybregts, Henk van Riemsdijk, Naoki Fukui and Mihoko Zushi.* Berlin and New York: Mouton de Guyter.

Clark, A. 2001. 'Reasons, Robots and the Extended Mind', *Mind and Language* 16(2), 121-145.

Copeland, J. 1997. 'The Broad Conception of Computation', *American Behavioral Scientist* 40(6), 690-716.

Copeland, J. 2004. 'The Church-Turing Thesis', *NeuroQuantology*. 2, 101-115.

Cunningham, S. 1996. *Philosophy and the Darwinian Legacy*. New York: University of Rochester Press.

Darwin, C. 1985. *The Origin of Species by Means of Natural Selection or The Preservation of Favoured Races in the Struggle for Life.* London: Penguin Books.

Deacon, T. 1997a. *The Symbolic Species. The co-evolution of language and the human brain.* London: Penguin.

Deacon, T. 1997b. 'What makes the Human Brain Different?', *ProQuest Social Science Journals. Annual Review of Anthropology*. 26, 337-357.

Deacon, T. 2000. 'Evolutionary perspectives on language and brain plasticity', *Journal of Communication Disorders*. 33(4), 273-291.

Dennett, D.C. 1995. *Darwin's Dangerous Idea. Evolution and the Meanings of Life*. New York: Simon and Schuster.

Dennett, D.C. 1996. *Kinds of Minds: Toward an Understanding of Consciousness*. New York: Basic Books.

Dennett, D.C. 200). *Freedom Evolves.* London: Penguin Books.

Dennett, D.C. 2006. 'Higher-order Truths about Chmess', *Topoi*. DOI 10.1007/s11245-006-0005-2.

Dewey, J. 1929. *Experience and Nature*. London: George Allen and Unwin Ltd.

Dreyfus, H.L. 1981. 'From Micro-Worlds to Knowledge Representation', in J. Haugeland, (ed.) *Mind Design. Philosophy, Psychology, Artificial Intelligence*. Montgomery, Vermont: Bradford Books.

Dupuy, J.P. 2000. *The Mechanization of Mind: On the Origins of Cognitive Science.* Princeton and Oxford: Princeton University Press.

Flanagan, O. 1991. *The Science of Mind*. Cambridge, Mass: MIT Press.

Flanagan, O. 2000. Dreaming *Souls: Sleep, Dreams, and the Evolution of the Conscious Mind*. Oxford: Oxford University Press.

Feigl, H. 1958. *Concepts, Theories, and the Mind-Body Problem*. Minneapolis: University of Minnesota Press.

Fodor, J. 1998. 'The Trouble with Psychological Darwinism', in *London Review of Books* 20(2).

Fodor, J. 2000. The *Mind Doesn't Work That Way: The Scope and Limits of Computational Psychology*. Cambridge, MA: MIT Press.

Fodor, J. 2005. 'Reply to Steven Pinker "So How *Does* the Mind Work?",' *Mind and Language* 20(1), 25-3.

Gödel, K. 1931. 'On Formally Undecidable Propositions of Principia Mathematica and Related Systems.' URL = http://www.csee.wvu.edu/~xinl/library/papers/math/Godel.pdf. Accessed 24 November 2010.

Godfrey-Smith, P. 2010. 'Dewey, Continuity and McDowell', in M. de Caro and D. MacArthur. *Naturalism and Normativity.* New York: Columbia University Press.

Goodman, R. 2010.'William James', in *The Stanford Encyclopedia of Philosophy.* URL = http://plato.stanford.edu/archives/win2009/entries/james/ Accessed 10 August 2011.

Gould, S.J. 2000. 'More Things in Heaven and Earth', in H. Rose and S. Rose (ed.) *Alas, Poor Darwin: Arguments Against Evolutionary Psychology*. London: Random House.

Haugeland, J. 1981. 'The Nature and Plausibility of Cognitivism', in J. Haugeland (ed.) *Mind Design. Philosophy, Psychology, Artificial Intelligence*. Vermont: Bradford Books.

Hayles, K. 1999. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Information.* Chicago and London: Chicago University Press.

Hofstadter, D.R. 1984. *Gödel, Escher, Bach: An Eternal Golden Braid*. Harmondsworth: Penguin Books.

James, W. 1890. *Principles of Psychology*. URL = http://psychclassics.yorku.ca/James/Principles/. Accessed 4 November 2010.

Kim, J. 1998. *Mind in a Physical World*. Cambridge, Mass.: MIT Press.

Lorenz, K. 1978. Behind *the Mirror: A Search for a Natural History of Human Knowledge.* Boston, Massachusetts: Mariner Books.

Kim, J. 2005. *Physicalism, or Something Near Enough*. New Jersey: Princeton University Press.

Livingstone, P. 2002. 'Experience and Structure. Philosophical History and the Problem of Consciousness', *Journal of Consciousness Studies*. 9(3), 15-33.

Nagel, T. 1974. 'What is it Like to Be a Bat?', *Philosophical Review* 4, 435-50.

Newell, A. and Simon, H.A. 1981. 'Computer Science as Empirical Inquiry: Symbols and Search', in J. Haugeland (ed.) *Mind Design. Philosophy, Psychology, Artificial Intelligence.* Montgomery, Vermont: Bradford Books.

McGinn, C. 1989. 'Can we solve the mind-body problem?', *Mind.* 98, 349-66.

Meltzer, B. 1962. 'Preface', in K. Gödel. *On Formally Undecidable Propositions of Principia Mathematica and Related Systems*. URL = http://www.csee.wvu.edu/~xinl/library/papers/math/Godel.pdf. Accessed 24 November 2010.

Messerley, J.G. 1996. *Piaget's Conception of Evolution: Beyond Lamarck and Darwin.* Maryland: Rowman and Littlefield.

Millikan, R.G. 1987. *Language, Thought and Other Biological Categories: New Foundations for Realism.* Cambridge, Massachusetts: MIT Press.

Minsky, M. 1981. 'A Framework for Representing Knowledge', in J. Haugeland (ed.) *Mind Design. Philosophy, Psychology, Artificial Intelligence*. Montgomery, Vermont: Bradford Books.

O'Conner, T. and Robb, D. 2003. 'Preface', in T. O'Conner and D. Robb (ed.) *Philosophy of Mind: Contemporary Readings.* London and New York: Routledge.

Papineau, D. 1984. 'Representation and Explanation.' *Philosophy of Science* 51, 55-73.

Papineau, D. 2003. 'Human Minds', in A. O'Hear (ed.) *Minds and Persons.* Cambridge: Cambridge University Press.

Patterson, C. 1998. 'Evolution: Neo-Darwinian Theory', in R.L. Gregory (ed.) *The Oxford Companion to the Mind.* Oxford and New York: Oxford University Press.

Peirce, C.S. 1965. *The Collected Papers of Charles Sanders Peirce Vol. I-VI*. Cambridge, Mass: The Belknap Press of Harvard University Press.

Penrose, R. 1989. *The Emperor's New Mind*. Oxford: Oxford University Press.

Pinker, S. and Bloom, P. 1990. 'Natural Language and Natural Selection', *Behavioural and Brain Sciences* 13, 707-784.

Pinker, S. 1995. *The Language Instinct.* New York: William Morrow and Company, Inc.

Pinker, S. 1997. *How the Mind Works.* New York and London: W. W. Norton and Company.

Pinker, S. 2002. *The Blank Slate. The Modern Denial of Human Nature*. London: Penguin Books.

Place, U.T. 1956. 'Is Consciousness a Brain Process?', *British Journal of Psychology* 47(1), 44-50.

Popp, J. A. 2007. *Evolution's First Philosopher. John Dewey and the Continuity of Nature.* Albany: State University of New York Press.

Putnam, H. 1960. 'Minds and Machines', in S. Hook (ed.) *Dimensions of Mind: A Symposium.* New York: New York University Press.

Putnam, H. 1976. 'The Nature of Mental States', in *Mind, Language and Reality.* Cambridge: Cambridge University Press.

Putnam, H. 1981. 'Reductionism and the Nature of Psychology', in J. Haugeland (ed.) *Mind Design. Philosophy, Psychology, Artificial Intelligence.* Montgomery, Vermont: Bradford Books.

Pylyshyn, Z. 1981. 'Complexity and the Study of Artificial and Human Intelligence', in J. Haugeland (ed.) *Mind Design. Philosophy, Psychology, Artificial Intelligence.* Montgomery, Vermont: Bradford Books.

Ramachandran, V.S. 2011. *The Tell-Tale Brain: Unlocking the Mystery of Human Nature.* London: William Heinemann.

Russell, B. 1914. *Our Knowledge of the External World: As a Field for Scientific Method in Philosophy.* London: George Allen and Unwin, Ltd.

Russell, B. 1962. *The Problems of Philosophy*. London: Oxford University Press.

Ryle, G. 1960. *The Concept of Mind*. London: Hutchinson.

Smart, J.J.C. 1959. 'Sensations and Brain Processes', *Philosophical Review* 68, 141-156.

Solms, M. and Turnbull, O. 2002. *The Brain and the Inner World*. New York: Other Press.

Solymosi, T. 2011. 'Neuropragmatism, old and new', *Phenomenology and the Cognitive Sciences* 10, 347–368.

Sterelny, K. 2001. *The Evolution of Agency and Other Essays*. Cambridge: Cambridge University Press.

Sterelny, K. 2003. *Thought in a Hostile World. The Evolution of Human Cognition*. Malden, Ma: Blackwell Publishing.

Stubenberg, L. 2010. 'Neutral Monism', in *The Stanford Encyclopedia of Philosophy* URL = <http://plato.stanford.edu/archives/spr2010/entries/neutral-monism/>. Accessed 10 August 2011.

Turing, A M. 1969 'Intelligent Machinery', in B. Meltzer. and D. Michie (eds.) *Machine Intelligence*. Edinburgh: Edinburgh University Press.

Turing, A.M. 1950. 'Computing Machinery and Intelligence', *MIND: A Quarterly Review of Psychology and Philosophy* LIX (236), 433-460.