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Essay Reviews

Adaption and Evolution

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JANE AZEVEDO, *Mapping Reality: An Evolutionary Realist Methodology for the Natural and Social Sciences,* Albany: State University of New York Press, 1997, xvii + 322 pp., illus., $22.95.

ALISON JOLLY, *Lucy's Legacy: Sex and Intelligence in Human Evolution*, Cambridge, MA: Harvard University Press, 1999, 518 pp., illus., $29.95.

RANDY THORNHILL and CRAIG T. PALMER, *A Natural History of Rape: Biological Bases of Sexual Coercion*, Cambridge, MA: The MIT Press, 2000, x + 251 pp., $28.95.

When I first picked up Azevedo's book and flipped through the chapters in order to get warmed up for the task of reading it from cover to cover, I was struck by the series of figures in Chapter 4, entitled 'The Nature of Validity', that were identified as different types of maps of the same geographical region in Australia. There was first a black and white photograph of the area in question, with trees, rocky outcrops, and obvious topographical dimensionality relatively identifiable, and then a blurry oblique aerial photograph, a patchily speckled vertical aerial photograph, a streaky and pixilated 2.2 micron wavelength image, and, finally, more recognizable 1:100,000 topographic 1:250,000 geological maps. Ah, I thought, the meaning of the title of the book: mapping reality.

Which map is real? The answer is: They all are. The differences between them depend on the information the map maker is trying to convey to a particular audience. You might think that each map is actually also a false representation (and the map maker of each a falsifier of information) because each hardly represents the totality of the available information. But, argues Azevedo, this is not actually true, because no single mapping technique could ever reproduce clearly and intelligibly the multitude of hierarchically layered data that

can be garnered from scrutiny of the land and landscape in question. In brief, the kind of question being asked constrains the approach used to interpret the situation at hand. And this, she also argues, is exactly what characterizes the natural sciences, particularly the domain of evolutionary biology.

In an amazing declaration, Azevedo summarizes the impetus not just for scientists, but also for 'regular folk' in general, to try to understand from every possible way the world of the past and present:

> The major function of the human brain is to model reality, and the distinction between the real world (the operational environment) and our models of it (the cognized environment) is fundamental to any attempt to understand how we know what we know. Humans interact with the operational environment, and it is that interaction that determines their survival and well-being or otherwise. But the models of that environment that guide their interactions are necessarily partial, inaccurate, interest driven, and often culturally specific. Nonetheless, there is a constraint on the modelling process, because the construction of knowledge is a biological process, and thus open to selection. Natural selection would not have left us with grossly misleading perceptual and cognitive mechanisms.

For me, at least, this statement, coming as it does toward the end of the book, crystallized both the major point of the endeavor and the difficulties I had been having grasping it.

One of the themes of *Mapping Reality* is that sociology is not a doomed and outdated enterprise, but a discipline equal in merit and vibrancy to any of the natural sciences, particularly the science of evolution. The metaphor of the maps is supposed to illustrate the similarities. Just as evolutionary biologists can come to different interpretations about how evolution works depending on the 'source' of their information (whether, for example, it be paleontology, population genetics, or ecology), so, too, can sociologists approach the study of humans and society from different perspectives. In addition, if, following Karl Popper, the viable approaches to evolutionary questions conform to the constraints of hypothesis testing and falsification (rather than proving), so, too, do those in sociology. Indeed, the very properties of the study of evolutionary biology – complexity and historicity – are precisely those of sociology. Thus, and bearing in mind the statement quoted above about the major function of the human brain, one can, as Azevedo attempts, propose an 'evolutionary realist methodology' that encompasses the natural as well as the social sciences.

One of the better extensions of Azevedo's argument based on the multiplicity of realities is that of eschewing reductionism, which she

exemplifies in debates between sociobiologists, with their limitless vision of Darwinism, and those who think otherwise. Given the seductiveness of Darwinian explanations for the existence of everything in terms of having purpose, because everything must be selective and adaptive (even rape), Azevedo's comment about reductionism is particularly relevant: '...reductionism as a research strategy rules out in an a priori fashion all analyses and explanations at any level but the supposedly fundamental one' (p. 215). Yet Azevedo is herself not exempt from the pull of such reductionism, as is clearly evident in the quote above. How does she 'know' that the major function of the human brain is to model reality? It would seem to be a result of assuming that the human brain had been modeled by interactions with the environment and, since this constitutes a biological process, natural selection had to have been the constraining force in the achievement of this capacity. As she puts it, '[n]atural selection would not have left us with grossly misleading perceptual and cognitive mechanisms'. And how does she know this? Probably the way every other individual consciously or unconsciously thinks she or he knows this. To be sure, there is the often sought-after intellectual link with Darwin via the champions of Darwinism of the formative period of the 'grand evolutionary synthesis' of the 1940s. But, more importantly, we have been conditioned to this point of view because it is difficult to *imagine* that organisms and their parts did not have purpose, and, because of this assumption, we are obliged to invoke the existence of a force – natural selection – that continually chooses, from among an infinite array of possibilities, those attributes that are beneficial and useful.

Perhaps thinking in terms of selecting the 'best' or 'most useful' is applicable when trying to envision how cultures and societies change or 'evolve'. But it has never been demonstrated to be the case with biologically significant or evolutionary change. Like the fable of the emperor's clothes, the data are just not there. They are only assumed, and this for various reasons.

Darwin was among the first to suggest that an individual's attributes exist because they are beneficial in some way, leading to increased reproductive success. But Darwin came to this conclusion largely because, in the case of breeding plants and animals for economic purposes, attributes that were considered important were selected, artificially, by the breeders. In terms of artificial selection, benefit accrues to the bearer of the selected feature by virtue of the selector – the breeder, societal needs and demands, economics – choosing it as the progenitor of the next generation. Reproductive success here is meaningless.

In the wild, attributes may be selected in ways that appear to conform to the artificial-selection model. For example, a faster predator may be selected over a slower one because it obtains more food on a regular basis and, for whatever reasons, this might allow the faster predator to increase its reproductive success. The assumption that follows is that if this process were to continue, the predator would change, that is, evolve. But this conclusion is not warranted by the example, which, at most, demonstrates the survival of a species, not its advent or its transformation into something else. Comparative concepts such as 'more', 'better', 'faster', 'taller', etc., and their counterparts of 'less', 'worse', 'slower', 'shorter', etc. can only have meaning once the attribute in question is already present. And the process by which novel biological features emerge is an entirely different matter. Once present, a novel feature, as other features, will no doubt vary in its expression from one individual to the next, and this situation lends itself to the model of Darwinian selection that we have been taught. But, as first argued in the late 1800s and early 1900s by the Dutch plant geneticist, Hugo de Vries (1), there is another possible meaning of selection, essentially: If a feature doesn't kill you, you have it.

Given the inescapable and continually iterated picture in the fossil record of the sudden emergence of novel features linked to what we would consider new species, it is likely, especially given the impact of regulatory molecules via signal transduction pathways on the orchestration of organismal development, that the emergence of novelty – that is the origin of species – is an abrupt process (but not as envisioned by the model of punctuated equilibrium, which, as originally formulated is truly Darwinian) (2-4). It is in the context of the origin of species that de Vries' model of selection is the appropriate one. The more familiar Darwinian notions would only, if at all, be applicable thereafter, during the existence of a species. For those among you who fear the invocation of hopeful monsters or other non-Darwinian matters, I can assure you that the genetics of the mechanisms that produce major organismal difference (e.g. in the reorganization of a bilaterally symmetrical larval stage into a radially symmetrical adult, or the advent of a single, deformable-lensed eye in a bony socket) are the same as those involved in the transmission of iris color (2-4). It is simply that neither Darwin nor any subsequent Darwinian has actually dealt with the origin of species – which is the only biological process that should be recognized as producing evolutionary change. Rather, as an extension of Darwin's arguments in the *Origin* (5), the research of evolutionary biologists has been at the level of the survival of species, which is a different concern altogether. I am not suggesting that minor swings in the means of expression of

attributes within a population do not occur. Only that these shifts will not lead to the origin of species. Such an extrapolation is only an attempt at explaining how the distribution of species (as we think we know them) might have occurred. There are other, clearly more biologically and developmentally appropriate models to be had now that the genetic underpinnings of each 'level' of the hierarchy of organismal development are becoming known. The genetics of inheritance for developing an eye in a bony socket may be the same as iris hue, but an alteration in the sequence of molecular communication that would otherwise lead to the formation of the former feature will certainly have the more profound effect.

What, then, to do with Azevedo's concerns? I have no difficulty accepting her argument that, if natural science is 'scientific', so is sociology. But her grander attempt at developing 'an evolutionary realist methodology for the natural and social sciences' is so steeped in the largely unquestioned premise that 'change' is always and unequivocally equivalent with 'evolution' that I fear hers, as well as any that follow in the same vein, will remain unsatisfactory. Shifts from one generation to the next of a population around the mean of features that characterize that population may be thought of as constituting a kind of change. But this cannot be taken merely as representing a segment of a continuum of change that leads to the production of the level of novelty that distinguishes species, that is, to evolution. Clearly, it is time to alter the way in which we use the word 'change'. If societies and cultures 'change' in a Darwinian fashion, this is not the same as biological evolution. I am also not certain that we can use the Kuhnian model of a paradigm shift as a better analog for biological evolution. As I understand the genetics of inheritance, the emergence of novelty will most likely occur through the silent spread of a mutation in the recessive state until it reaches a critical threshold in a population to be expressed. I'll have to think about this some more. In the meantime, it may be worth our while to question the longstanding attempt to unify the studies of biology and culture and society under the same rubric and reductionist umbrella.

In her latest book, *Lucy's Legacy* ('Lucy' referring to the most famous specimen of the early fossil hominid species, *Australopithecus afarensis*), the primatologist Alison Jolly attempts to tackle the elusive interface between biology and behavior. She tries to tread cautiously between the global application of Darwinism so characteristic of sociobiologists, and notably espoused by one of its champions, Richard Dawkins, and the rejection of biology altogether in the development of social and sexual behavior by the more humanistic social scientists.

Inasmuch as Jolly has studied the lemurs of Madagascar over the course of decades, she adopts primarily the perspective of a biologist. And because of this, as tradition would appear to demand, she begins with Darwin and his contributions to evolutionary biology. But as with so many works that must be evolutionarily grounded, the Darwin she writes about is essentially myth. One case in point is Jolly's assertion that Darwin did not subscribe to notions of blending inheritance, as is supposed to be evident in the *Origin* (5). This seems to be a common misunderstanding among biologists. But I think the root of this problem is that, even if they have read the *Origin*, rather than a secondary source on it, most biologists have probably not read much else by Darwin. Yet, in his notebooks (6) and especially in *The Variation of Plants and Animals Under Domestication* (7), there can be no doubt not only that Darwin subscribed to a notion of blending inheritance (his theory of pangenesis), but also that this 'process' was crucial to his arguments on how variation was produced. Nonetheless, I have heard others lecture that, had Darwin read the reprint of Mendel's experiments that was in his library, he would have figured out the 'grand evolutionary synthesis' then and there. I doubt it. Darwin was committed to his belief that there was infinitesimally minute and continuous variation between individuals within species, between males and females of a species, and even between individuals of different species. Blending inheritance was essential for this view of life. In fact, in the early days of genetics, with the 'rediscovery' of Mendel, one could not be both a Mendelian, who perforce embraced discontinuous variation, and a Darwinian (see review in ref. 2). But, clearly, if one is going to lionize Darwin, then one must expunge the (now known to be) biologically unacceptable elements, such as blending inheritance (and, certainly, notions of use and disuse), from the intellectual baggage of one's idol.

Jolly also falls into the common Darwinian trap of first stating that natural selection only appears to act with purpose (whereas it actually acts blindly), and then proceeding to give supposed examples of the effects of natural selection and evolution that can be seen in no other way than as purposeful. Indeed, on the first page of the first chapter, Jolly analogizes natural selection with humans inventing tools in order to smash nuts, dig for roots, and hurl at prey; in Chapter 9 she reiterates the position that 'sex itself evolved to randomize genes among one's offspring'; and in Chapter 16, she tells us that, with a world-scale environmental change approximately 5 million years ago, 'many species evolved to explore the new habitat'. [In examples presented the other way around, she opines in Chapter 1 that 'even eyes are jettisoned when they are no longer useful', and in Chapter 18

that 'neurons that find no functions wither away'. The latter, however, is not how neuroanatomists would describe the developmental 'wiring' of the central nervous system (see ref. 8).] Indeed, one finds in chapter after chapter strings of examples that are supposed to demonstrate that natural selection has acted according to Darwinian principles, with the clear implication that this should also suffice as evidence of how natural selection produces evolution. With the added weight of a biologist who can also invoke the economic theory that John Maynard Smith (9) smuggled into evolutionary theory decades ago, Jolly promotes the notion that an organism's attributes must, of course, have a reason for being, otherwise the cost of selecting them would likely contravene their development. As is so common in 'evolution speak' these days, we are invited to accept selectionist arguments for the evolution of one thing or another through the mental device of imagining how we would 'evolve' under similarly contrived circumstances.

Attendant to the notion that an organism's features and behaviors 'evolved' to serve a purpose is the element of adaptation, and Jolly uses this device liberally throughout. As Darwin saw it, organisms (actually animals) track their environment, continually adapting and re-adapting to its whims and vicissitudes. This remains the Darwinian point of view, which in and of itself is not necessarily incorrect, as seen, for instance, in the Grants' long-term study of the Galapagos finches (10). Even Hugo de Vries [as well as William Bateson (11) and Thomas Hunt Morgan (12,13)] would agree that this scenario could reflect a part of nature. But the real issue is whether adaptation and evolution are synonymous. De Vries and Bateson, and even Morgan, would have disagreed.

Adaptation has only to do with the survival of species, not their origin. Current Darwinians, however, have revived Darwin's conflation of the two processes, and herein lies a major difficulty: How do we know what is adaptive and when it was adaptive? Just because one sees an organism with certain features and behaviors does not mean either that these traits were 'evolved' in the emergence of that organism's species, or that we can ever figure out what their adaptive significance is. In order to get around some of these problems, evolutionary psychologists have embraced the notion of the 'environment of evolutionary adaptiveness.' This convenient catch-all phrase takes care of those situations about which one has absolutely no idea why a feature exists in extant species. But since all features are supposed to have arisen because they were adaptive, their original significance must lie with an earlier ancestor, about whom, then, one can contrive an argument for the 'evolution' of the trait in question. I

still prefer de Vries' suggestion with regard to the origin of a new trait: If it doesn't kill you, you have it. How can one discuss something being more or less adaptive when, for instance, contrasting the states of having scales versus feathers? Notions of 'adaptiveness' are only relevant in the context of comparing slight variations of a trait among individuals of the same species. In this context, 'adaptiveness' makes sense.

But translating continually variable traits and their adaptive significance into evolution is a natural extension of Darwin's formulation of a seamless web of variation, which he envisioned existing between individuals, sexes, and species in the present as well as between those of the present and the past. This is the essence of gradual evolution, which, not unsurprisingly, Jolly invokes in deriving modern humans from a distant ape-like ancestor through 'Lucy' and subsequent fossil hominids. As she puts it in Chapter 1, 'each stage [is] a minor tweaking of a previous body plan'. To back up this kind of assumption, she reverts to the always available scenario for the gradual evolution of the vertebrate eye. Surely, as did Darwin's argument for gradual and continual transformation of one species into another, this thought would make saltationists such as St. George Mivart turn over in their graves.

It is curious that such a profound saltationist document as Mivart's *On the Genesis of Species* (14) sank to obscurity in the face of Darwin's pleas for overlooking the gaps in the fossil record as being unfortunate and artificial lapses in the what had to have been a continuous fossil record of gradual organismal transformation. To this day, excuses for the incompleteness of the fossil record, as in the fable of the emperor's clothes, overshadow the inescapable: The expression of novelty in nature arises suddenly [although, as I (ref. 2) have pointed out, the spread of the genetic underpinnings of the novelty would have occurred in a more gradualistic manner]. The only reason I can think of that would have prompted Darwin to push gradual transformation as the mode of evolutionary change is that, were he to have admitted the existence of gaps or discontinuity in the fossil record as the result of natural processes, he would have left the door wide-open for special creation. By eliminating the gaps in the fossil record, Darwin also eliminated the evidence for special creation. The advent of studies in regulatory genetics now makes such pleas unnecessary (2). As one of the best known for any land mammal, the human fossil record continually demonstrates not only species diversity, but also the abrupt appearance of morphological novelty (15).

Darwinian arguments are, however, seductive. It is nice to think that everything has a reason, a purpose, and that the trail of

evolution consists of continually changing dynasties of the reproductively successful, those happy but unwitting bearers of adaptively advantageous traits. Armed with this intellectual foundation and with the fall-back explanatory position of the 'environment of evolutionary adaptiveness', sociolobiologists and their scions, evolutionary psychologists, can account for all aspects of an organism, good or bad. Witness Thornhill and Palmer's recent opus, *A Natural History of Rape*, in which it is argued that rape has to have been adaptive. If it were not, this behavior would not exist. Since the inappropriateness and inapplicability of most of the studies upon which this premise is based have already been discussed at length elsewhere (16), it is not necessary to repeat this here. But I do think it is necessary to highlight the inconsistencies involved in the increasingly widespread invocation of Darwinism and the 'everything is adaptive' principle.

The argument about rape is that it has to be natural because it is part of the behavioral repertoire of certain males of our species. Rape would not be part of these repertoires had it not been adaptively advantageous and increased the reproductive success of those with this behavioral disposition. Because rape is natural and could only exist because it was favored by natural selection, it behooves human females to behave in ways that do not provoke this behavior in males.

In Chapter 1, Thornhill and Palmer reiterate a version of the Darwinian theme:

> Although there are four agents of evolution (that is, four natural processes that are known to cause changes in gene frequencies of populations), selection is the only evolutionary agent that can create adaptations like the human eye...An adaptation, then, is a phenotypic solution to a past environmental problem that persistently affected individuals for long periods of evolutionary time and thereby caused cumulative, directional selection. Evolution by selection is not a purposive process: however, it produces, by means of gradual and persistent effects, traits that serve certain functions – that is, adaptations.

The case for rape, which may not seem to be an adaptive behavior now, is that, as an assumed adaptation, it 'does not necessarily increase reproductive success in current environments if those environments differ significantly from past environments.' Thus, a rapist may today end up in prison, but things were different back in the past, when, because of its evolutionary adaptiveness, the proclivity to rape gradually emerged in some hominid ancestor. As Thornhill and Palmer summarize in Chapter 3, 'the proximate causes of human rape lie in the different adaptations of male and female sexuality that were formed by selection in human evolutionary history'.

In their scenario, Thornhill and Palmer bring out the element of population genetics – via gene frequencies – that Jolly did not in presenting a model of gradual evolutionary change. To be sure, in the 1930s and '40s, when population genetics was in its infancy, it seemed that shifts in the means of expression of phenotypic features from one generation to the next were a reflection of shifts in minor genetic differences within populations. As sociobiologists do in general, so Thornhill and Palmer eschew mutation as a vehicle for evolutionary change, leaving this to natural selection acting on variation within a population. Where, however, does new variation come from if not, as Thomas Hunt Morgan (13) argued, through mutation? Who knows? Curiously, this argument sounds very much like the original Darwin, but updated to view evolution merely as natural selection churning around and sorting through shifting gene frequencies leading to an accumulated effect. In addition, this leads to thinking that there are 'genes' for certain traits and/or behaviors. Thus, to paraphrase Richard Dawkins (17), if the body is the gene's way of getting itself around, then the persistence of a certain trait or behavior reflects selection of the genetic basis for it. In turn, the claim of a genetic foundation gives the argument even greater credibility.

But we know better now. We know that an organism's 'parts' derive from a cascade of communication of regulatory molecules via signal transduction pathways. We also know that most if not all of the regulatory molecules that may be co-opted into such a pathway were already present and that only their combinations and sequences, timing, and location of interactions may be new (2,8). For example, the *engrailed* homeobox gene is recruited along with other regulatory genes in vertebrate central nervous system segmentation, the conversion of a bilaterally symmetrical larva into a radially symmetrical adult echinoderm, and the development of a butterfly's wing spot. In the realm of developmental genetics, gradualism is difficult to defend. Even without knowledge of developmental regulatory genetics, the great comparative anatomists, such as Mivart (14), could not imagine how any functionally important feature, such as an eye, a mammary gland, or a sexual organ, could gradually evolve. But one doesn't have to imagine this. The combination of various interacting regulatory molecules would produce the organ in question in full–full stop. Witness the experiment in which the *Rx* gene that is active in the cascade of molecular communication leading to eye formation was mutated to the inactive or recessive state: Homozygotes for the mutation lacked eyes and bony sockets (see ref. 2). Now, think of this pathway in the

reverse. In contrast, shifting gene frequencies would only be relevant at the level populational geneticists have always studied: individual variation in the expression of a trait that is already present.

With this in mind, the argument behind the idea that rape 'evolved' as something that had been adaptively advantageous to its bearers becomes even more curious. If we accept that a feature specific to a species is something that distinguishes that species, and thus all of its members, from all other species, then, if this trait was emergent with *Homo sapiens*, we would expect to find the proclivity to rape rampant throughout all males of the species. For instance, *H. sapiens* is the only hominid that developed a 'chin', with some of us having more prominent 'chins' than others. If rape was a derived feature of *H. sapiens*, then all males should be rapists, with variation between them in the intensity, frequency, or other aspects of the behavior. If, on the other hand, rape 'evolved' in an earlier hominid ancestor, then its presence in *H. sapiens* would not be specific to this species, but would be a primitive retention. Still, the retention of features from ancestor to descendant would be an all-or-nothing affair, just as we retain the development of a vertebral column from the ancestral vertebrate and pentadactyly from an earlier tetrapod.

But rape is not a behavioral characteristic of *Homo sapiens*, regardless of whether it would be derived for the species or primitively retained from an earlier ancestor. Only some males, although a notorious minority, are rapists. And because of this incomplete representation within our species, we cannot suggest that rape is inexorably and evolutionarily tied to our heritage. In a realm of variable behavior, there is not even a bimodal distribution of those who rape and those who do not. Even the invocation of sexual selection does not warrant the expansion of a sometime present trait to the level of a species characteristic. Selectionists may argue that sexual selection can cause, for example, not only the 'evolution' of different antler branching patterns, but of antlers themselves. Or the different tails of peacocks and peahens. But this does not make it so. The basic differences between males and females had to exist in some form at the beginning in order for sexual selection to have a playing field in which to operate – for example, for larger peacock tails or buck antlers. To reiterate, natural selection in the broadest sense, or sexual selection more specifically, would not have 'produced' a species in which only some males rape, because, basically, neither of these processes produces new species, that is, evolution. To add another thought on rape, and lest we forget Hugo de Vries, we might simply consider that this behavior exists, not because it is adaptive, but because it doesn't prevent its bearers from siring offspring.

So, where does this all leave us? Hopefully to ponder received wisdom and its wholesale resale. With regard to evolutionary psychology, and its current extension into the matter of rape, we might heed Frans de Waal's (18) review of Thornhill and Palmer's book: 'Why can't evolutionary psychology put a little less evolution and a little more psychology into its thinking?' More broadly, it is about time that evolutionists put a little more thinking into the significance of the hierarchical nature of organismal development for understanding, in turn, the hierarchical relationships of adaptation and selection, on the one hand, and evolution and the origin of species, on the other. Non-Darwinians are often accused of throwing out altogether adaptationist and selectionist arguments. I am not advocating this at all. I am only suggesting that the emphasis on these elements as being the 'stuff' of evolution has long obscured the enigma that Darwin unsuccessfully attempted to address in 1859: the origin of species.

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