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INEVITABLE HUMANS: SIMON CONWAY MORRIS'S EVOLUTIONARY PALEONTOLOGY

by Holmes Rolston, III

Life's Solution: Inevitable Humans in a Lonely Universe. By Simon Conway Morris. Cambridge: Cambridge Univ. Press, 2003. 486 pages. $30.00.

Abstract. Simon Conway Morris, noted Cambridge University paleontologist, argues that in evolutionary natural history humans (or beings rather like humans) are an inevitable outcome of the developing speciating processes over millennia; humans are "inherent" in the system. This claim, in marked contrast to claims about contingency made by other prominent paleontologists, is based on numerous remarkable convergences—similar trends found repeatedly in evolutionary history. Conway Morris concludes approaching a natural theology. His argument is powerful and informed. But does it face adequately the surprising events in such history, particularly notable in unexpected co-options that redirect the course of life? The challenge to understand how humans are both on a continuum with other species and also utterly different remains a central puzzle in paleontology.

Keywords: convergence; Simon Conway Morris; co-option; evolution; human uniqueness; natural theology; nature and culture; origin of humans; possibility space; self-organizing complexity.

Simon Conway Morris's *Life's Solution: Inevitable Humans in a Lonely Universe* is a remarkable book by a remarkable paleontologist. Anyone interested in philosophy of biology or the dialogue between biology and religion must read it, if only to get slapped with what radically different metaphysical frameworks eminent biologists can read into, or out of, the same evolutionary facts. Here is Conway Morris, the paleontologist who did

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the detailed work on the fossil animals in the Burgess Shale, drawing conclusions that are the "exact reverse" (p. 283) of those of Stephen Jay Gould, who wrote the best-selling *Wonderful Life* based on Conway Morris's paleontological data. Gould concludes, famously, "Almost every interesting event of life's history falls into the realm of contingency" (1989, 290). "We are the accidental result of an unplanned process . . . the fragile result of an enormous concatenation of improbabilities, not the predictable product of any definite process" (Gould 1983, 101–2). Conway Morris concludes, "This book aims . . . to refute the notion of the 'dominance of contingency'" (p. 297). "The science of evolution does not belittle us. . . . Something like ourselves is an evolutionary inevitability, and our existence also reaffirms our one-ness with the rest of Creation" (pp. xv–xvi). This paleontologist is headed toward a natural theology, but readers must travel through millennia of evolution and several hundred pages of text to get there.

Conway Morris is swimming upstream against a powerful current in contemporary theoretical biology. John Maynard Smith and Eörs Szathmáry (1995, 3) analyze "the major transitions in evolution" with the resulting complexity, asking "how and why this complexity has increased in the course of evolution." "Our thesis is that the increase has depended on a small number of major transitions in the way in which genetic information is transmitted between generations." Critical innovations have included the origin of the genetic code itself, the origin of eukaryotes from procaryotes, meiotic sex, multicellular life, animal societies, and language, especially human language. But they find "no reason to regard the unique transitions as the inevitable result of some general law"; to the contrary, these events might not have happened at all.

Physics discovered that startling interrelationships are required for the cosmological processes to work, that astronomical phenomena such as the formation of galaxies, stars, and planets depend critically on the microphysical phenomena. In turn, the mid-range scales, where the known complexity mostly lies, in Earth's biodiversity or in human brains, depend on the interacting microscopic and astronomical ranges. These results have been summarized as the anthropic principle, which holds that the universe has been fine-tuned from the start and in its fundamental construction for the subsequent construction of stars, planets, life, and mind.

Biology has seemed a stark contrast, at least at first. Biology has also developed at ranges of the very small and of big-scale history. Molecular biology's discovering of DNA has decoded life, and evolutionary history has located the unfolding of life in natural selection's operating over incremental variations across enormous time spans, with the fittest selected to survive. The process is prolific but no longer fine-tuned. To the contrary, evolutionary history can seem tinkering and makeshift. Natural selection is thought to be blind, nonteleological.

Most evolutionary theorists today insist that nothing in natural selection theory guarantees progress; many doubt that the theory predicts the long-term historical innovations that have occurred. Michael Ruse insists, "Evolution is going nowhere—and rather slowly at that" (1986, 203). Anyone who today believes that progress was a heading during evolutionary history, Ruse concludes, is guilty of "pseudo-science." Trying to document this in his 400-page *Monad to Man* (1996), Ruse himself goes rather slowly, and one reason is that he has to argue away what many classical biologists have believed: that there is some tendency toward increased biodiversity and complexity across the millennia of natural history.

Nor have such biologists vanished from the contemporary scene. Christian de Duve, presumably not a pseudoscientist since he is a Nobel laureate, concludes, "Life was bound to arise under the prevailing conditions, and it will arise similarly wherever and whenever the same conditions obtain. There is hardly any room for 'lucky accidents' in the gradual, multistep process whereby life originated. . . . I view this universe [as] . . . made in such a way as to generate life and mind, bound to give birth to thinking beings" (de Duve 1995, xv, xviii).

The theoretical biologist closest to Conway Morris is perhaps Leigh van Valen. In a favorite metaphor of the biologists, he asks what would happen if we were "to play the tape of evolutionary history again." If played just once more, the differences would strike us first. Van Valen continues, "Play the tape a few more times, though. We see similar melodic elements appearing in each, and the overall structure may be quite similar. . . . When we take a broader view, the role of contingency diminishes. Look at the tape as a whole. It resembles in some ways a symphony, although its orchestration is internal and caused largely by the interactions of many melodic strands" (Van Valen 1991, 48).

Contingency disappears, Conway Morris argues, when we look at the remarkable convergences that have characterized evolutionary history. Eyes, ears, legs, wings appeared more than once. If the tape were replayed, life would begin in the sea and move to land. There would be plants and animals, predators and prey, genetic coding, sexuality. Sentience would appear in some forms, based on something like neurons, and some of these sentient forms would become increasingly intelligent. Here is "the main theme of this book": "As all the principal properties that characterize humans are convergent, then sooner or later, and we still have a billion years of terrestrial viability in prospect, 'we' as a biological property will emerge" (p. 96).

Looking back across Earth's natural history and wondering if things might have been otherwise, searching the possibilities for "evolutionary counterfactuals," "possibly . . . we shall discover in the end that there are none. And, despite the almost crass simplicity of life's building blocks, perhaps we can discern inherent within this framework the inevitable and pre-ordained trajectories of evolution?" (p. 24). "Convergence occurs because of 'islands' of stability, analogous to 'attractors' in chaos theory" (p. 127).

Conway Morris asks whether "intelligence is some quirky end point of the evolutionary process or whether in reality it is more-or-less inevitable, an emergent property that is wired into the biosphere" (p. 148). His discovery is that "life . . . is full of inherencies" (p. 8). "Life shows a kind of homing instinct . . . given enough time, the inevitable must happen" (p. 20). He asks, and answers: whether "given time, evolution will inevitably lead not only to the emergence of such properties as intelligence, but also to other complexities, such as, say, agriculture and culture, that we tend to regard as the prerogative of the human? We may be unique, but paradoxically those properties that define our uniqueness can still be inherent in the evolutionary process. In other words, if we humans had not evolved then something more-or-less identical would have emerged sooner or later" (p. 196).

"Human language may, on this planet, be unique, but waiting in the wings of the theatre of consciousness are other minds stirring, poised on the threshold of articulation"; examples are the dolphins and bonobo chimps. "What we call language is an evolutionary inevitability" (p. 253). "If we hadn't walked out of Africa then probably sooner, rather than later, our analogues would have strolled out of South America, holding tools, and probably enjoying the taste of meat" (p. 268). "'Hominization' is not as unique a process as many may think" (p. 274). "Rerun the tape of life as often as you like, and the end result will be much the same. On Earth it happens to be humans" (p. 282). "If humans were inevitable from the Cambrian period, a visit to the Moon was on the cards when the Palaeolithic painters surveyed the bare cave walls of Les Chauvet" (p. 275).

Maybe the visit to the Moon was in the cards from the Cambrian period onward, but Conway Morris can simultaneously find that "what evolution cannot do is see into the future diversification as far as the envelope of possibilities is concerned, although it can be equally sure that a great deal of what does one day evolve will have emerged in parallel circumstances in other times and places" (p. 307). In evolutionary biology "we can only retrodict and not predict" (p. 12). At this point Conway Morris can seem to want it both ways—both inevitability and openness in natural history.

The account seems to be that, despite these inherencies and inevitabilities, they can only be known ex post facto. If, *per impossibile*, some extraterrestrial biologists had had Earth under observation back in the pre-Cambrian, the headings of natural history were not then predictable. They would not have known what the convergences were to be. But after these inherencies home in, converge on intelligent life, after these surprises do happen, biologists, terrestrial or extraterrestrial, can see that they had to happen more or less as they did. "Life has a peculiar propensity to 'navigate' to rather precise solutions in response to adaptive challenges. I would suggest that one such solution is manifested in a biological property that we choose to call 'mammal-ness'. So, too, within this 'zone' there are more localized solutions, one of which is 'ape-ness'. . . . On any other suitable planet there will I suggest be animals very much like mammals, and mammals much like apes. Not identical, but similar, perhaps surprisingly similar" (p. 308). Conway Morris also reminds us that the chances of finding such a similar planet are remote. Space is mostly "the Empty Quarters of biological non-existence" (p. 309).

The degree of order versus contingency in the natural world is under intense debate in both the physical and the biological worlds. The strength of Conway Morris's case lies in his survey of the convergences in biological natural history. "The details of convergence actually reveal many of the twists and turns of evolutionary change as different starting points are transformed towards common solutions via a variety of well-trodden paths" (p. 144). (There is a separate five-page index to these convergences, pp. 457–61.)

The evolution of the placentals around most of the planet compared to the marsupials in Australia is perhaps the best known example. That marsupials came to characterize the Australian fauna is, most would say, a historical accident of biogeography, resulting from the drift of tectonic plates and the resulting isolation of the Australian continent—not uncaused but resulting from the unrelated interactions of geological plates and the ancient mammalian fauna that once happened to be located there. But, given that circumstance, there are striking parallels in the ways that placentals and marsupials evolved, both in Australia and elsewhere, especially South America, where also marsupials have at times survived. Some are rodentlike, some molelike, some catlike with canine teeth.

We can expect that life diversifying on Earth will learn to exploit various kinds of available environments and that, when they do so, the species that fill similar niches will require parallel skills. Some will learn to live above ground, others underground, some in trees; some will learn to live at night, others during the day. Some species will be plantlike, some animallike. Some animals will be herbivores, some carnivores. Some animals will evolve feet adapted for running, others for digging, some will grow horns for fighting, some evolve noses for smelling, others whiskers for feeling.

But does this add up to making the whole life story more or less inevitable? It is not enough that evolution converges. Events have to converge "upward." Convergent evolution produces serrate leaf margins and compound leaves repeatedly. Does evolution converge "up" on biodiversity and biocomplexity repeatedly? Evolutionary natural history also contains numerous surprises, and these seem to introduce unpredictable novelties, often dramatically changing the course of life on Earth. About 2.7 billion years ago eucaryotes developed from the ongoing procaryote line. Much later, but before plants and animals had diverged, by endosymbiosis what were to become mitochondria transferred into the pre-plant/animal line and became the powerhouse organelles for all subsequent life. There emerged a new kind of system in which the organism has highly efficient and specialized power modules, the mitochondria, something not possible to either of the precedents before they interacted, criss-crossed, synthesized, and transformed each other.

About 1.6 billion years ago the plant and animal lines diverged. Later still, by another remarkable endosymbiosis this time, plastids made the lateral transfer into the plant line to become the chloroplasts critical for the capture of solar energy. Again, new, higher-powered forms of life became possible, both in the plants and in the animals that feed on plants (see Fig. 1; data from Dyall, Brown, and Johnson 2004). Perhaps one can say that endosymbiosis is likely to occur, there are frequently "mobile elements" that transpose and reshape evolution, DNA sequences that can be "cut and pasted" in multiple locations within a genome or laterally transferred "hopping" from one species genome to another (Kazazian 2004).

But is there any "inherency" in the earliest microbial life making inevitable or even probable these two especially vital endosymbioses, both thought to initiate as singularities, and both dramatically changing the history of life on Earth? One can say that evolution is disposed toward exciting serendipity. (This cascading serendipity, however, is found so far only on Earth; the moon and Jupiter are quite unserendipitous.) But is serendipity predictable or even retrodictable in such singular and profound events?

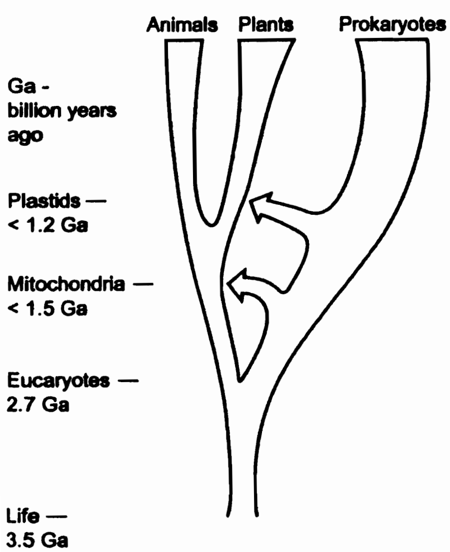

Fig. 1. Evolutionary development by endosymbiosis.

Even inside descending lineages of organisms there are novelties that would be difficult to predict. Biologists call this "cooption." Within the cell Conway Morris notices "some of the proteins being recruited in quite surprising ways from some other function elsewhere in the cell" (p. 111). "Evolution is a past master at co-option and jury-rigging: redeploying existing structures and cobbling them together in sometimes quite surprising ways. Indeed, in many ways that *is* evolution" (p. 238). The crystallins used in lenses in eyes started out as heat-shock proteins, which happened to be transparent, and got co-opted into lenses for eyes.

What were once float bladders got transformed into lungs. Acetylcholine, an ancient molecule, has been around for millennia doing other things in plants and bacteria, but when nerves appear it gets co-opted for use in synaptic transmission.

What start out as body pressure cells in fish get transformed into ears, with the radical co-option of skull bones as amplifiers; this makes possible first hearing, which is widely present, but then hearing is co-opted for language in human brains, making possible the transmission of ideas that characterizes a cumulative transmissible culture. Does this make eyes, lungs, ears, brains, culture, and modern science inevitable? Inherent from the beginning? Perhaps. But one can as plausibly say that new possibility spaces open up en route in evolutionary history.

In such cases of co-opted emergence, repeatedly compounding, something that is genuinely new pops out, pops up. The novelty is, of course, based on the precedents, but there is genuine novelty not present in any of the precedents. What emerged required the precedents, but the presence of the prior organisms did not determine or make inevitable these results. There are critical turning points in the history of life that hinge on events more idiographic (unique events) than nomothetic (lawlike, inevitable, repeatable trends). Things get recruited for new roles. Novel possibilities open up whole new regions of search space; old molecules recombine to learn new tricks.

Sometimes the explanatory account is by laws applied to initial conditions, and the same laws reapplied to the resulting outcomes, now treated as further initial conditions. But sometimes, with co-options, endosymbioses, lateral genetic transfers, and mutations, the outcomes are not just further sets of initial conditions. The novel outcomes revise the previous laws; the rules of the game change, and the future is like no previous past. One can say that all of this surprising serendipity is somehow inherent from the start, but the explanatory power of such a claim is rather vague. The main idea in co-option is the unpredictable and unexpected. Co-option is as revolutionary as it is evolutionary.

Retrospectively, of course, after these novelties happen, the historian can trace the steps by which events happened. One can claim that the possibilities were always there; one can with equal plausibility claim that new possibility space has opened up en route in the course of natural history. Prospectively, if one could stand at each present moment, at each *now* over the course of evolution, there is always the great unknown. There is the generation of new possibility space in which information breakthroughs become possible. The pivotal element in a metaphysics of such evolutionary biology is the future, not the past, not even the present. Past and present are necessary but never sufficient for the future. In that sense our accounts will always be insufficient, incomplete, before this capacity for future innovation.

Despite this inevitability of the evolutionary destiny to produce humans, or something more or less anthropic, Conway Morris can with equal enthusiasm proclaim, "Self-evidently we humans are now utterly different" (p. 282). "Humans are very peculiar creatures indeed; clearly a product of evolution, yet a species that has, or has been allowed, to know mental states that transcend (so far as we know) any other sentience on Earth" (p. 325, following John Greene). "We need to acknowledge that not only does our unique knowledge reveal a transcendence in wholly remarkable ways, but it also enables us to understand how the emergence of sentience is imprinted in the evolutionary process" (p. 303). So we seem to be simultaneously "on a continuum" with the other more or less cultural creatures and "utterly different."

Conway Morris finds that culture is one of these inherencies in natural history. There are convergences toward culture. "It is difficult to escape two conclusions: first, that the emergence of cultural capacities represents a continuum, and second, that convergences are inevitable. This is not to deny that humans have gone further; they have what has been termed a 'hyperculture', but it does not rule out such a phenomenon evolving elsewhere" (p. 259).

But convincing precursors to culture in nature are not so persuasive. Individual ants coordinate their stereotyped and genetically determined activities with millions of other ants, but this is a doubtful analogue of culture. Leaf-cutter ants carry leaf fragments to fungi in their underground anthills, the products of the fungi benefiting the ant colony. But this bears no serious resemblance to the development of human agriculture: one generation teaching another how to select seeds to plant, how to plow the ground, grind grains, build fires to cook food. Even the much-discussed primate analogues are borderline. Chimps imitate tool use; vervet monkeys communicate with simple calls. None of these approaches within several orders of magnitude the complexity of human cumulative transmissible cultures, in which ideas are consciously taught and evaluated from one generation to the next, passing from mind to mind over many centuries.

Conway Morris closes approaching "a theology of evolution" (Chap. 11). Where in evolutionary history is there place for divine action? His account (so to speak) frontloads it all into the evolutionary system, and events thereafter both naturalistically and marvelously unfold. Conway Morris might also find that God is always there, in, with, and under the ongoing system, doing everything in general and nothing in particular.

But to see humans landing on the moon as "in the cards" at the pre-Cambrian, even retrodictively, is quite a stretch. Certainly such life adventures are nowhere inherent in any current theories in evolutionary history, much less lurking among those facts established by fossil or genetic evidence. One can, at best, find room for this view in the current lack of consensus among biologists as to what the real determinants in evolutionary history are. Others who approach a natural theology may focus on the emergence of novel information at critical turning points, on the opening up of novel possibility spaces en route, which were not there at the startup, on the autonomous self-development of complexity, or on intelligent design. There must be some way to get from microbes to rocket scientists and saints, since this has managed to happen. Conway Morris's account is the most important contribution to this literature in the last decade.

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