

## **Challenge and Opportunity In Evolution Education**

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The question of evolution still inspires passionate debate 137 years after the presentation of Darwin and Wallace's ideas on descent with modification as an explanation of the origin of the diversity of form and function we see in the plant and animal world. Not long ago the news reported a legislative battle in the same state that was the site of the famous Scopes trial. In 1925, Scopes, a biology teacher in Tennessee was prosecuted for teaching the theory of evolution in violation of state law. Seventy years later the Tennessee legislature debated passing a law that would require biology teachers to teach "Creation Science" as a legitimate alternative to the Darwinian theory of evolution. The contention is that both are legitimate theories explaining the origins of animals and, more importantly, of the human being. The epistemological equivalency of Biblical interpretation and scientific methodology is painfully ludicrous. But the concern that lies behind religious objections to the theory of evolution can evoke more sympathy. The traditional scientific view is one of the human being as an animal with no spiritual component, or at best a spiritual component that has to be tucked away and cannot form any part of a scientific theory. It is a view that profoundly alienates us from the world, our fellow human beings, and not the least, ourselves. It is no wonder that there is rebellion against such a view. How can we form a moral framework for life if, fundamentally, we are a chance accumulation of random events, resulting in some complex organic structure that is deluded into the view that it is somehow a free, moral being?

### **Genetics and Evolution**

Darwin's theory was on the wane until the rediscovery of Mendel's research on genetics at the turn of the century. There followed within a few decades monumental work by Thodosius Dobzhansky, Ernst Mayr, and George Gaylord Simpson which developed the neo-Darwinian theory of natural selection. This theory was based on the statistical treatment of small, slightly advantageous traits and how they could become established in a population over long stretches of time, thus giving rise to morphological and behavioral changes - evolution. Even with this powerful mathematical treatment there are still those who look at the many bizarre and complex forms and behaviors of animals and wonder how such features could have evolved step-wise over even very long stretches of time.<sup>1</sup> Most evolutionists do not regard such objections as serious, but rather as challenges to be answered in terms of the theoretical framework. Scenarios are hypothesized to explain, for instance, the Pandas' thumb or the cuckoo's parasitic nesting behavior. This has in turn led to other scientists critiquing such "scenarios" as little more than science fiction.<sup>2</sup> These scenarios are too often ad hoc rationalizations that change as quickly as contrary evidence is gathered, but the modus operandi of "story telling" is never given up. In any event, a mere listing of strange and wonderful forms and behaviors will never constitute a serious critique of the theory. It has proven too powerful and beguiling an explanatory tool to suffer a demise as a result of morphological or behavioral conundrums, Karl Popper's critique notwithstanding. According to Karl Popper, strictly speaking, an instance which contradicts a theory falsifies the theory and should result in its replacement. In reality the contradictions only

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<sup>1</sup>Wesson, Robert. 1993. *Beyond Natural Selection*. Cambridge: MIT Press.

<sup>2</sup>Gould, Stephen J., and Lewontin, R.C. 1979. "The Spandrels of San Marco and the Panglossian paradigm: a Critique of the Adaptationist Programme." *Proc. Roy. Soc. London B*, 205: 581-598.

spawn ad hoc “exceptions to the rule” and a theory is only overthrown when a demonstrably better one is offered, or (according to Stephen J. Gould) it becomes culturally unfashionable.<sup>3</sup>

Given that modern evolutionary theory is a powerful (although increasingly challenged) explanatory tool, why would one want to consider an alternative such as that embodied in Rudolf Steiner’s cosmology? Bear in mind that even those scientists who challenge the neo-Darwinian framework do so only within a materialistic structure.<sup>4</sup> One reason might be to provide an explanation of the same phenomena (change in form over time) that does not have as a presupposition an exclusively material basis of the world (cosmos). This cosmology would not simply provide comfort for human beings with a view that is somehow “soft” and non-alienating, a solace for the faint-hearted who tremble at the hard-edged reality of the modern scientific world view. It would provide a view of the cosmos in which the human being is more than an animal and one in which the process of evolution is more than an accident resulting from chance or luck. In addition, this world view is founded on an epistemology that is truer to the original intent of science - understanding the world without recourse to abstract model building or scenario spinning.<sup>5</sup>

There are certain facts in the fossil record that remain difficult to explain. One of the most troubling is the change from one group of animals to another. If we look at the fossil forms of the amphibians we find them too specialized to have given rise to the reptiles, which appear next in the fossil record. The same difficulty pertains in the change from amphibians to reptiles or reptiles to mammals. Classic examples of highly specialized animals are the Horseshoe Crab (*Limulus*) which has existed virtually unchanged for over 300 million years, or the Koala bear which can only subsist on Eucalyptus leaves. How do we envision the change from a specialized, highly evolved amphibian, for example, to the fundamentally different and specialized forms of the first reptiles? These are the issues of macro-evolution that are the heart of evolution theory. Can we imagine these changes occurring in small incremental steps or is some other process active? Darwin was greatly troubled by the gaps in the fossil record and hoped that time and vigorous exploration would eventually close the gaps with many slightly changed forms as required by his theory. Alas, this has not happened. It was paleontologists Stephen Gould and Niles Eldredge who finally told us that the emperor had no clothes with their theory of “punctuated equilibria.”<sup>6</sup> They declared that we cannot continue to hold our heads under the sand and not recognize that what the fossil record tells us unequivocally is that there are long stretches of time where there is virtually no change in a species and suddenly a new form appears, a new species or even a new class (reptiles where before there were only fish and amphibians, for instance).

### **Heterochrony\***

How can animals escape from their specialization? Karl Ernst von Baer was one of the first biologists to recognize that the embryos of more recently developed animals resemble the embryos of earlier developed animals.<sup>7</sup> Thus the embryo of a fish has striking similarities to the early embryo of a mammal, for instance. The early 19th century naturalists recognized this singular feature. Von Baer drew attention to the similarity of embryonic forms and regarded

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<sup>3</sup>Gould, Stephen J. 1977. *Ontogeny and Phylogeny* Cambridge: Belknap (Harvard University Press)

<sup>4</sup> Kaufman, Stephen 1995. *At Home in the Universe* New York: Oxford University Press

<sup>5</sup> Edelglass, et al 1997. *The Marriage of Sense & Thought*. Lindisfarne Books

<sup>6</sup> Eldredge, N., and S.J. Gould. 1972. Punctuated equilibria: an alternative to phyletic gradualism, in T.J.M. Schopf, ed, *Models in paleobiology*. Freeman Cooper & Co., San Francisco.

<sup>7</sup>de Beer, Sir Gavin. 1971 *Embryos and Ancestors*, Oxford: Oxford University Press

them as images of the archetypal forms from which specific forms were derived. Darwin recognized the utility of this concept when he quoted von Baer in his Origins, “The embryos of mammalia, of birds, lizards, and snakes are in their earliest states so exceedingly like one another, that we can often distinguish the embryos only by their size. The feet of lizards and mammals, the wings and feet of birds, no less than the hands and feet of man all arise from the same fundamental form.” Ernst Haeckel recognized the relation between embryos and ancestors and incorporated this recognition into the Darwinian framework when he formulated his famous law of recapitulation, namely “ontogeny (the history of an embryo) recapitulates phylogeny (the history of the species).” For Haeckel this “law” of embryonic development constituted a window into the past - a window on the evolutionary development of a species. But for Haeckel each successive stage was added on to the *end* of a particular embryonic development, the exact opposite of what von Baer observed, namely from similar embryonic beginnings the particular species diverged more and more as development progressed. Thus while the embryo of a reptile may resemble the embryo of a fish, the embryo of the reptile will never resemble the adult fish. Recognition of some relationship between embryos and ancestors has led to various hypothesis of a mechanism for dramatic evolutionary change. For instance, if there is a process whereby the embryonic development of an organism could be held back, and/or its ability to reproduce itself accelerated, (or progress at a normal rate relative to a slower development of the rest of the organism), one could imagine an “embryo” with the ability to reproduce itself - an embryo with a body form less “specialized” than its presumptive adult form and hence able to develop further in new directions proscribed by the specialized nature of the usual adult form. Consider, for example the human being. Newborn chimps have a striking similarity to newborn human beings. Yet while the human being retains its embryonic structure (see Gould for details)<sup>8</sup> the ape specializes -- its jaw lengthens, for example, into the typical prognathous countenance of the ape; the cranium flattens and the foramen magnum retreats. In the human the skull remains “embryonic” with its flat face, rounded cranium and foramen magnum suitable for an upright posture.

\* I am using heterochrony as defined by Sir Gavin De Beer as a change in the timing of development of a trait which can appear sooner or later than the same trait in an ancestor. Neoteny and paedomorphosis are specific examples of this change, which I am not differentiating in this article.

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<sup>8</sup>Gould, Stephen J. 1977 *Ontogeny and Phylogeny*, Cambridge: Belknap (Harvard University Press).



Infant and adult chimpanzee from Naef,<sup>9</sup> 1926b.

This phenomena can be observed as well in the salamander axolotl which exists in Mexico in an aquatic form. Under stressful conditions this aquatic form (which is its normal adult state) can transform into a terrestrial form with lungs, etc. of the genus *Ambystoma*. This genus can be found as the adult in North America and it has an embryonic form identical to the adult aquatic Mexican form. If the terrestrial form could be induced to hold back its normal adult development and become reproductive as the aquatic larval form, then we would have heterochrony. This ability to become able to reproduce in an embryonic form is often invoked as a possible mechanism whereby specialized forms can “escape” from their specialization and go off in new evolutionary directions. It is hypothesized that any new line of evolutionary development has initial forms that are more general which become more specialized in time. Heterochrony gives a theoretical rationale of how we can envision these less special forms being derived from their more specialized predecessors.

This view is, in a certain respect, quite contrary to Darwin's. Darwin viewed organisms as becoming more specialized over time, and this potential escape from specialization through heterochrony is one which leads away from extinction, not towards it through increasing specialization. Heterochrony requires that in a real way we must envision the ancestors of animals, and also of man, as being of an embryonic form. Stephen J. Gould makes this quite explicit when he writes, “What juvenile among living primates is most similar in form to the young stages of our forebears? The answer must be: our own juvenile form itself.”<sup>10</sup>

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<sup>9</sup> Naef, A. 1926a. Zur Morphologie und Stammesgeschichte des Affenschadels, *Naturwiss.* 14: 89-97.

<sup>10</sup>Ibid.

The periodic resetting of the developmental clock in order to allow new developments to occur seems improbable, at least within the framework of traditional evolutionary theory. Complexity theory may offer a theoretical underpinning with regulatory genes acting as an “attractor” which could dramatically shift developmental sequences. But this is at an early stage of formulation and it is much too early to put forward as an idea with more than an interesting possibility.<sup>11</sup>

### **Anti-Darwinian Evolution?**

A theme which runs through vertebrate evolution is one which has been interpreted as progressive emancipation from the environment. According to Darwinian theory it is the environment which limits and determines the direction of evolutionary change by “selecting” for traits which give a particular advantage in a particular environment. As the environment changes ( through mountain upbuilding, continental drift, etc.) particular traits become disadvantageous and others advantageous, and so change drifts in one direction or another, sometimes leading to extinction, at others to new forms. In this way many biologists do not see species as distinct entities, but as a long chain of gradually transforming forms with our labeling of a species as an arbitrary isolation of a particular form in time. Paleontologists used to view gaps in the fossil record with relief since such gaps provide a convenient demarcation between one species and another.

Theoretically, according to the traditional view, if we had a complete fossil record we would find a continuous gradation of forms from earliest times to the present. Therefore drawing a line and declaring organisms before the demarcation and those after to be different species is quite arbitrary. Species as real entities do not exist, but, according to this view, are an artifact of the incomplete fossil record. Now paleontologists have, for the most part, rejected this view. Species are real and gaps in the fossil record are real and record the stability of species, not their gradual transformation. Furthermore, gaps in the fossil record are not artifacts of collecting or a result of the rarity of fossil formation.

Others see a liberation from the environment. And so the amphibian, by developing the lung, has liberated itself from total dependence on an aquatic environment; the reptile completes this by developing the hard-shelled (cleidoic) egg; the bird and mammal are not so dependent on external warmth because they have internalized warmth production.<sup>12</sup> Of course the traditional evolutionist would look at these same phenomena and simply describe these changes as adaptations to new conditions, or changes that came about by random changes in the genetic code which proved to be advantageous to the species and so were passed on to the descendants through producing more offspring with the new trait than the competitors were able to do.

Emancipation and heterochrony can be seen as complementary. If through heterochrony an organism becomes less specialized then it follows that that organism could live in a less specialized environment. Natural selection tends to edge an organism into increasingly narrow niches until it becomes walled in on all sides and thereby vulnerable to extinction if the narrow environmental requirements for its survival change. (What would happen to Koala bears if eucalyptus trees suffered a blight?) One can see evidence for this specialization all around us and in the fossil record, several examples of which are described above. Natural selection provides the theoretical framework for understanding adaptation. But there is no framework whereby we can consider emancipation, hence it is ignored or the attempt is made to explain it in terms of natural selection. Here the ideas of Rudolf Steiner can provide a help.

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<sup>11</sup>Goodwin, Brian. 1994. *How the Leopard Changed Its Spots*. London: Weidenfeld & Nicolson

<sup>12</sup>Schad, Wolfgang. 1971. *Man and Mammals: Toward a Biology of Form*. Garden City: Waldorf Press (Adelphi University).

## The Invisible In Us

What so many people find objectionable about science in general and evolutionary theory in particular is the absolute exclusion from consideration of any spiritual component when considering the nature of the human being. Perhaps one of the most significant contributions of Rudolf Steiner is an epistemology that does not exclude, *a priori*, a science of the spirit.<sup>13</sup> While Rudolf Steiner considered the formulation of the theory of evolution as one of the most significant and positive developments in the history of thought<sup>14</sup> he also viewed the human being as endowed with an ego, a spiritual entity that marks the ultimate individuality of each human being.<sup>15</sup> This individuality has its own developmental story, but for our purposes it suffices to say that this spiritual entity has to have an appropriate vehicle to “incarnate” into. The evolution of the physical form of the human being is a story of this preparation.

What is the relation between the development of the human form and the history of animal development that we see preserved in the fossil record? Firstly, we must remember that evolution leads to specialization and that new directions in development appear suddenly in the fossil record. Some biologists hypothesize that such sudden change could only come from some process of heterochrony where forms become more general and hence more malleable to change. Such a generalized form would be the hypothetical common ancestor that is never found but always hypothesized. There have been many such events in macroevolution. Could there also then be many heterochronous events? This does not seem likely, so how can we understand the developmental sequence we see? Steiner suggests that we view these hypothetical forms not as a series of hypothetical heterochronous forms spontaneously turning up at critical points in time (i.e., the change from fish to amphibian), but as a sequence of a continuous development from which the fossil forms are the evidence of branching off at different point in time.<sup>16</sup> In other words, there was an embryonic line from which groups (amphibians, reptiles, etc.) branched off and then became more susceptible to environmental constraints and the strictures of natural selection. Meanwhile the “embryonic line” continued to develop a form more and more emancipated from the environment until finally a form suitable for the human spirit was developed.

But this hypothetical line, in order to remain unspecialized had to be free from the environmental pressures that lead to specialization. Accompanying each branching form is also the trend mentioned before of the embryonic line’s increasing emancipation from the environment. Ultimately a form must arise that can harbor the human individuality whose hallmark is the possibility of being a free human being, but this is only possible if the form carrying this individuality has developed so that it is maximally emancipated from environmental constraints. This is, parenthetically, the source of our alienation from nature, our “conquest” of nature, and the root of the environmental problem. Emancipation means our relation to nature (at least for modern human beings) must come from a thinking relationship - the struggle to find “right living” with nature. This problem will only be solved in the context of the free human being and not by reverting to an animal-like condition, alien to the nature and destiny of the human being. Human beings must now participate in their evolution.

One can see here the importance of the relation between embryos and ancestors, mentioned beforehand. If we view the ancestral line as itself embryonic then the embryo of our ancestor

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<sup>13</sup> Steiner, Rudolf. 1898. *Philosophy of Spiritual Activity: Anthroposophic Press*

<sup>14</sup> Steiner, Rudolf 1898. *Magazine Fur Literatur*, No. 28

<sup>15</sup> Steiner, Rudolf . 1904. *Theosophy* London: Rudolf Steiner Press.

<sup>16</sup> Steiner, Rudolf. 1909. *Occult Science - An Outline* London: Rudolf Steiner Press.

would look like the embryo of the descendent, with the adult forms as special branches that shoot off, much like the different transformations of leaves along the stalk of an annual herbaceous plant shoot off the stalk, each one slightly different from its predecessor yet united by the plant as a whole. The unity behind the fossil forms in the vertebrate record is the descending, incarnating human individuality working to mold a physical form suitable to hold the spiritual essence of the human being.

How can we begin to understand how such a process might work? Modern evolutionary theory incorporates two explanatory mechanisms in its attempt to deal with changes in form over time. These are genetics, the source of variation, and the environment, the filter for selecting those variations that are advantageous for the animals survival ( ability to produce viable, sexually reproducing offspring).<sup>17</sup> Rudolf Steiner's view completes this half of evolutionary thought by presenting us with the spiritual component of an incarnating human individuality. Steiner describes this human story as one in which the human being is on the road towards becoming a free being. This is the source of the need for emancipation from the environment. In fact the human being has very likely passed beyond the strictures of pressure coming from nature - at least in a significant sense. From the earliest times humans have demonstrated a lack of environmental restriction.<sup>18</sup> To the extent that evolution has as a prerequisite isolated populations in order for variation to become fixed, human beings have long ago, by their wandering over the face of the earth, left behind a necessary condition for further physical evolution – ecological isolation of a small population. We cannot, of course, ignore the environment and pretend that it doesn't influence us. But our relation to it comes out of understanding and not out of an instinctual boundedness. We are in fact conscious of our past evolution - a truly unique event in the history of the earth.

As has been noted by many authors, in one form or another, human evolution now occurs in the cultural realm and change is passed on through education. If the course of evolution is cultural, and possibly directed by the conscious acts of human beings, then it seems to be an obvious corollary that our conceptions of the world, or even more fundamentally our conceptions of the human being, will influence the course of future development. It seems obvious that we will develop according to what we think we are or can be. If we fundamentally believe that the human being is merely highly organized matter, organized by chance into a form which manifests self-consciousness as an epiphenomena of matter we will develop one kind of culture. But if human beings view themselves as spiritual beings evolving in the context of other spiritual beings in a cosmos in which matter is a manifestation of spirit then we will develop another culture. Another destiny will unfold.

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<sup>17</sup>Mayr, Ernst. 1988. *Toward a New Philosophy of Biology*. Cambridge: Belknap (Harvard University Press).

<sup>18</sup>Tattersal, Ian, 1998. *Becoming Human*. New York: Harcourt Brace.