

Embryology and Evolution: A Re-examination of the Evidence

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‘Sit down before a fact as a little child; be prepared to give up every preconceived idea; follow humbly wherever and to whatever abyss Nature leads, or you shall learn nothing.’

T. H. Huxley

Abstract

A re-examination of evidence from comparative human and mammalian embryology which is normally classed under the general heading of ‘neoteny’. It is argued that the significance of these phenomena for an understanding of the course of animal evolution has been overlooked, primarily as a consequence of a priori assumptions about evolutionary history which a careful examination of the facts does not support but rather demand a re-examination of orthodox theory, in particular in relation to the supposed descent of humans from ape-like ancestors. There are considerable consequences for science, evolutionary theory and religious belief.

Sir Gavin Rylands de Beer (1899–1972) was professor of embryology in London and subsequently director of the Natural History Museum for ten years from 1950–1960. He was generally considered to have been one of the leading embryologists of his day. In 1930, de Beer published a book entitled *Embryology and Evolution*, which was republished in 1940 in expanded form under the title *Embryos and Ancestors*. A revised second edition appeared in 1951, a third edition in 1958. All references are taken from this third edition, published by Oxford University Press.

In the Preface to this third edition, de Beer wrote that it was ‘a particularly appropriate time [approaching the centenary of the publication of the *Origin of Species*] for a critical appraisal of the relations between embryology and evolution’. Having reviewed the facts that he had first presented nearly thirty years before, and having also considered ‘... a great deal of new evidence ... [which had] become available ... during the intervening years [especially between 1951 and 1958], [he had] seen no reason to alter the plan of [his] former book in the slightest degree’.

Indeed, ‘... these fresh data have fitted into place in my scheme like pieces of a puzzle’.

In this paper I will focus on those facts relating to human embryology and development which de Beer listed in Chapter VIII of *Embryos and Ancestors* – the chapter devoted to ‘Neoteny’ – in the section dealing with the evolution of man (pp. 63–91). Though the phenomena of neoteny and heterochrony are well-known to evolutionary biology and have received significant attention since de Beer’s day (e.g. by Gould, McKinney and McNamara and others), the facts have been interpreted solely according to the dominant neo-Darwinian theory of evolution, with the result that their real significance has been missed. The essential facts remain as he described them. (For the purposes of this essay, it is not important whether the characters described by de Beer are indeed accurately termed ‘neotenous’, or whether McKinney and McNamara (*Heterochrony*, 1991) are correct in describing the essential process as one of ‘hypermorphosis’.)

De Beer defines neoteny as the phenomenon ‘... in which the adult form of an animal bears features by which it resembles the young form of its ancestors, or, to put it the other way, in which the young features of the ancestor have been retained in the adult stage of the descendant’ (de Beer, *op. cit.* p. 63). Such characters which are present or make their appearance in the young stage of an ancestral animal are referred to as *neanic* characters: ‘... evolutionary novelties ... which first appeared in early stages of ontogeny’ (de Beer, *op. cit.* p. 35).

‘Interpreting these cases in terms of heterochrony, they imply a *relative* retardation in the rate of development of the body (soma) as compared with the reproductive glands (germen), so that in respect of certain characters the body does not undergo as much development in the ontogeny of the descendant as it did in that of the ancestor’ (p. 63). *Heterochrony* is simply defined as ‘the alteration and reversal of the sequence of stages’ in ontogeny (de Beer, p. 8).

Thus, in relation to human development, de Beer is stating that humans, and in particular adult humans, exhibit features which resemble those of the young form (embryonic and neonatal) of the presumed ancestors, but which differ from the known or presumed characters of the adult form of those presumed ancestors, as they also differ from the adult forms of the descendants of the presumed common ancestors of man and his closest relatives, the apes.

De Beer includes the following among those ‘features of the adult structure of man [which] show resemblances to those of the embryonic structure of the anthropoid apes’:

- the relatively high brain weight
- the position of the *foramen magnum*
- the cranial flexure

- the dentition
- the flatness of the face (orthognathy)
- the position of the vagina
- the light colour of the skin
- ‘a number of other features’ including: the big toe; the absence of large brow ridges; the rounded shape of the head

1. *Relatively high brain weight*

‘The new-born chimpanzee resembles man more closely than does the adult chimpanzee in respect of the relative preponderance of the different lobes of the cerebral hemispheres.’

2. *The foramen magnum*

‘The position of the *foramen magnum* resembles that which is found in the embryos of apes.’

3. *The Cranial Flexure*

‘The axis passing through the front and back of the head forms a right angle with that of the trunk in the embryo of all mammals (and of nearly all vertebrates). This bend is known as the cranial flexure.

Whereas in mammals other than man the axis of the head is rotated during later development so that the animal’s head points in a direction which is a continuation of the line of its backbone, in man the cranial flexure is retained, so that the head points in a direction at right angles to the axis of his body.

The foetal condition ... is retained unchanged in adult man. Since the direction in which man’s head points, i.e. his line of sight, is horizontal, the position of the body will be vertical; and so man’s erect attitude is associated with the retention during ontogeny of a condition which in other animals is embryonic and temporary, as it must have been in man’s ancestors.

The erect posture of man is ... a consequence of neoteny of the shape of the head.’

4. *Orthognathy*

‘The retention of the embryonic condition also accounts for the flatness of the human face, as compared with the elongated muzzle which is found in other mammals.’ [a feature also characteristic of the young of other mammals]

5. *The position of the vagina (pubic flexure)*

‘The retention of the cranial flexure in adult man is paralleled by his [surely rather *her*!] retention of what may be called the ‘pubic flexure’.

In the hind region of the body in embryos of all mammals including man, the orientation of the urogenital sinus and rectum is such that the axis of these structures is directed ventrally, ie parallel with the backbone, with the result that the aperture of the vagina is directed backwards.

In adult man, on the other hand, the embryonic orientation of these structures is retained, with the result that the aperture of the vagina is directed ventrally.

The human mode of copulation is therefore associated with the neotenuous condition of the pubic region of the body.'

6. The light colour of the skin

'Apes when new-born have very much lighter skins than adults; additional pigment becomes deposited during later development.... In this respect, the white races are neotenuous, for they retain the embryonic condition.'

7. The big toe

'Man's big toe provides another example of neoteny, for there is reason to believe that the foot in the ancestor of man had a big toe, which, as in the lower primates, was capable of opposition. This feature has been retained and perfected in the great apes, but lost in man, whose foot is particularly adapted for walking erect on firm ground. This loss of power of opposability in man, is, however, an example of neoteny, for his foot retains throughout life the simple condition of the toes found in early foetal apes, where it is only transient.'

8. Absence of large brow ridges

'Another interesting feature is the absence of large brow-ridges (such as characterize the skulls of adult apes, Australopithecines, *Pithecantropus*, and Neanderthal man) in adult man and in foetal apes. These brow-ridges are subsequent developments in the apes ... Man is neotenuous in not having developed them.'

9. The rounded head-shape

'A particularly instructive example is provided by the shape of the head in mammalian embryos. These have round, bulging foreheads and short jaws, but they rapidly elongate and give rise to the long snout and flat head characteristic of such animals as the rabbit and the wolf.'

We are thus dealing with a significant number of features, all of which distinguish adult humans from the adult forms of their nearest relatives. Indeed, these

features could be taken to be among the defining morphological and structural features of *homo erectus*. That they are also to be seen in the foetal and neonatal stages of a wide variety of mammals presents a challenge to explanation. Merely to label these features as ‘neotenuous’, ‘neanic’, ‘heterochronic’, ‘caenogenetic’ (de Beer’s term) or ‘hypermorphic’ adds little to our understanding of their origin and significance. Description is not the same as explanation, a fact de Beer acknowledges in his concluding chapter:

‘It goes without saying that even if the views set forth here are correct, they do not provide an ‘explanation’ of evolution, for there remains the problem of how and why novelties arise, and why they show heterochrony in those cases in which they do.’ (de Beer, op.cit. p. 171)

Even more strikingly in view of the confident assertions of the preface mentioned above, in this concluding chapter we find de Beer making a surprising admission: ‘Evolution therefore does not explain embryology’ (op.cit., p. 173).

Deconstructing the all too common and inaccurate conflation of ‘evolution’ with the particular neo-Darwinian theory of descent with modification, we can more accurately state: ‘Darwinian theory does not explain embryology’. The facts of embryology cannot possibly be inconsistent with the reality of evolution; it is merely the currently orthodox theory of evolution which cannot explain these interesting facts of embryology.

In the current understanding, humans are latecomers on the evolutionary scene. They are considered to have branched off the primate line some 5 million years ago, at which point they are presumed to have been ape-like in appearance, initially possessing none of the ‘neotenuous’ characters listed by de Beer, but over succeeding ages gradually acquiring uprightness and bipedality, losing most of their body hair and evolving the large brain which allowed the development of the ‘higher’ faculties of speech, reason etc. – the characters which distinguish us from the other primates, despite the almost total similarity of our genomes.

Applying the standard mechanism of descent with modification – the natural selection of modified characters as the result of random mutation, genetic drift etc. – it has been retrospectively explained how the present human being could have evolved from the presumed ape-like common ancestor over the 5 million or so years since the ‘branching’ occurred – though many, not unreasonably, remain unconvinced either of the power of random genetic change to accomplish the remarkably ‘orthogenetic’ evolutionary path humans (and other species) have followed or of the selective advantage in Darwinian fitness terms (when not viewed through the rose-coloured spectacles of hindsight) of many if not most of the new human characters. However, these objections can for the moment be ignored.

The real challenge to orthodox Darwinian theory arises from the appearance of those 'human' features in animals which have not shared the human line of evolution and for whom, therefore, these features make no evolutionary sense. It was presumably to this difficulty that de Beer was referring when he conceded that 'evolution therefore does not explain embryology'. His awareness of the insurmountable logical inconsistency presented by the appearance of the characters listed is clear from other comments he makes, for example in the passage relating to the 'cranial flexure' already quoted, where de Beer finds it necessary to emphasize 'the retention [in the human] during ontogeny of a condition which in other mammals *is embryonic and temporary, as it must have been in man's ancestors*'; or again, when referring to the characteristically human roundness of the head in mammalian embryos, he states that '... such an embryonic condition *could not possibly* represent any ancestral adult condition'; or that the shape of the head in the embryonic and young dog 'has no phylogenetic significance and is purely caenogenetic'.

For in terms of the standard theory it could not be conceived that the presumed common ancestor – or any earlier ancestor – had enjoyed uprightness, bipedality or the benefits of a forward-facing vagina (allowing a *meeting* in the act of love which is much more than a mere *mating*). De Beer provides no evidence for the assertions mentioned above; they merely reflect assumptions which *must* be made, even if unfounded, out of the need to preserve the appearance of a consistency of the phenomena with the theory which he ultimately concedes cannot be sustained.

For by what logic of development would animals, both living and fossil – the latter having mostly preceded the appearance of humans and both of which (in current orthodox understanding) had shared no common line of development with them – have independently evolved a large number of features which only make sense in human terms, features which could have served no function in their own development, especially as they appear only embryonically and temporarily? For what conceivable reason would evolution go to the extraordinary lengths of first evolving a forward-facing vagina in the foetal stage of the animals, only to have to arrange for it to be rotated backwards into its 'normal' ultimate position?

The problem for de Beer – and indeed for all biologists working out of a neo-Darwinian interpretation – is that he was forced to accommodate his facts to a pre-existing theory, a theory which had already become hardened into dogma. The 'story' of evolution, according to which man is a late and accidental arrival on the evolutionary scene, imposed itself mercilessly on the facts, so that de Beer, in common with most evolutionary biologists, had become incapable of following T. H. Huxley's advice 'to give up every preconceived idea; to follow humbly wherever and to whatever abyss Nature

leads, or you shall learn nothing'. De Beer himself had in effect 'learned nothing' and the lesson of these extraordinary facts is still waiting to be learned by evolutionary biology.

Sitting down before the facts 'as a little child' – in the manner suggested more than half a century before Huxley by Goethe – might have allowed de Beer to make that vital shift of position which, as with the hologram, allows a completely new picture to emerge – a picture which then does make sense of the facts and allows embryology to be explained within a reconstructed history of evolution.

The shift can be achieved by accepting the strange appearance of 'human' features in animal embryology as a real, significant and revealing fact (rather than by trying to explain away this appearance as arbitrary and merely temporary, and therefore of no significance). What that appearance and the subsequent course of animal ontogeny expresses is that animals briefly manifest 'human' characteristics before 'reverting to type'. Alternatively, one could say that they subsequently 'fall' into the relative rigidity of their typical specializations, whereas the human retains an openness and flexibility connected with a lack of specialization and the retention of many 'primitive' features.

The shift can then be made from the orthodox position of interpreting humans from the perspective of the animals, to the more accurate and far more fruitful position of understanding the animals from the perspective of Man. When this shift is made, the pieces of de Beer's puzzle fall into place in a new and logically consistent way. It is no longer necessary either to make wild assertions or to admit hopeless incomprehension. It is, however, necessary to turn Darwinism on its head – a challenge too far, perhaps, for most evolutionists – and to accept the possibility of the centrality and primacy of human morphology at least with respect to the primates (and possibly far more widely), the piece of the puzzle without which none of the rest can be made to make sense.

From this perspective, the primary condition is the one retained in humans and in the embryos and neonatal forms of the other mammals. This is the condition which appears first in animal embryology and logically represents the prior state. Subsequently, the animals followed their individual paths of adaptation, paths which led to ever greater specialization and an inability to evolve 'upwards', as the gaps in the fossil record eloquently testify. To deny this explanation leaves one having to make the wholly unconvincing and 'escapist' assumption – given the large number of features involved – that Nature has here behaved completely whimsically and nonsensically. Such a charge should be unworthy of any serious scientist.

The logical objection that such a scheme requires the prior existence of humans, for which there is no fossil evidence, can be countered by the

observation that ‘absence of evidence does not mean evidence of absence’: it is entirely conceivable that earlier forms of humanity existed which left no fossil traces. This point was made by Schrammen in his *The Laws of Metamorphosis and Death in Animals and Humans*, Leipzig 1930:

‘Consequently, we may divide the development of all animals with mineralised or otherwise preservable hard parts into two main stages: an ancient period, which is revealed only to logical thought, can never be observed directly, and during which no bodily parts capable of fossilization (such as bones, teeth, shells etc.) were yet present, and a more recent one, from which the animals themselves are actually visible in their fossil remains. This realization has broad significance; namely, it shows why all beginnings and all transitional stages in the development of the animals must remain forever unknown. Furthermore, it shows why deep and far-reaching processes of cleavage and separation, which could only have occurred in the earliest stages of development, can never be directly accessible to our perception.’

It should of course be clear that the proposed ‘turning of Darwinism on its head’ does not imply a simple inversion of the orthodox view and thus a suggestion that animals have in some way ‘descended’ from primitive humans. Rather, the suggested liberation from the straitjacket of Darwinian dogma is intended to create the freedom to look for confirmations of early beliefs (reflected, for example, in many creation myths) in the existence of a human archetype, referred to as ‘Cosmic Man’, *Adam Kadmon*, the ‘Firstborn’ etc., which offers a possible explanation for the otherwise anomalous and puzzling appearance of the ‘human’ characteristics in animal embryology.

De Beer was in fact right in his conclusion that Darwinian theory is incapable of explaining the facts of embryology. It is my view that these facts present falsifying evidence against the current orthodoxy and that it should, therefore, be revised. de Beer was also right when he wrote (in the Preface to *Embryos and Ancestors*):

‘The first necessity in biology will always be further observation and experiment; but ... progress in thought is necessary as well. Outworn theories are not only dull in themselves, but they are actually harmful in thwarting the framing of new hypotheses ...’

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