The problem of continuity and discontinuity with special reference to modern biology
II

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Opsomming

Die denke van Hobbes, Malthus en Adam Smith weerspieël die invloed van die geesteswetenskappe op die denke van Darwin. Volgens Gould is natuurlike seleksie Adam Smith se ekonomie soos toegepas op die natuur. Dit blyk dat die kontinuïteitspostulaat van die moderne humanistiese wetenskapsideaal 'n diepste oortuiging verteenwoordig wat sy denke, asook dié van sy huidige aanhangers, deursuur. Dit dien ook as grondslag vir die dominante "gradualism" in die Neo-Darwinistiese denke sedert die "New Synthesis". Die stryd tussen die voor- en teenstanders van hierdie geleidelike oorgangsgedagte belig bykomend die feit dat die dialektiese grondmotief van natuur en vryheid ook in die gebied van die huidige biologiese uitwerking gevind het. Hoewel Huxley beswaar gemaak het teen Darwin se oortuiging dat die natuur geen spronge maak nie (wat 'n affiniteit met Leyll se identifisering van "gradualism" en rasionaliteit vertoon – Natura non facit saltum*), was Darwin nie bereid om van hierdie grondoortuiging afstand te doen nie. In die ontleding van die teenstelling tussen "gradualism" en stasis word aangetoon hoedat die meerderheid Neo-Darwiniste huself in 'n onhoudbare hoek geposisioneer het. Gould het hierdie onhoudbare posisie raakgesien en sterk in sy laaste groot werk gekritiseer. Die ontsnappingspoging wat 'n beroep op die "onvolledigheid" van die fossielrekord doen bied geen uitkoms nie, want waar stasis data verteenwoordig berus die idee van "imperfection" op die afwesigheid van data. Hierdie probleme wat in die New Synthesis aanwesig is betref beide die skielike verskyning as die abrupte*

verdwyning van tipes. Die positivistiese aanspraak of "brute feite" kan nie die toets van wat werklik in die verskillende akademiese dissiplines aan die gang is deurstaan nie. Gould is daarom geregverdig in sy siening dat feite geen onafhanklike bestaan in die wetenskap en elke ander menslike aktiwiteit besit nie, aangesien teorieë verskillende gewig, waarde en beskrywings aan selfs die mees empiriese en onloënbare waarnemings toeken. Alles in ag genome toon die probleem van (dis)kontinuïteit nie slegs sommige van die dringendste inkonsekwensies van die moderne Neo-Darwinistiese biologie aan nie. Dit vra tegelyk ook na 'n alternatiewe benadering waarin die realiteit van diskontinue tipes – soos dit in die stasis-gestempelde paleontologiese rekord en die huidige natuurlike sisteem van plante en diere na vore kom – erken word.

1. Background

In the first article on the problem of continuity and discontinuity we have seen that Darwin's thought is ultimately in the grip of the humanistic natural science ideal with its inherent *continuity postulate*. Because Darwin's epoch-making book of 1859, *The origin of species*, is normally appreciated as a natural scientific work, scholars may be surprised to learn that, nonetheless, some of the chief impulses of his theoretical approach are derived from disciplines within the humanities.

Recall for a moment Gould's assessment regarding the influence of the classical school of economics and the thought of Adam Smith in particular: "In fact, I would advance the even stronger claim that the theory of natural selection is, in essence, Adam Smith's economics transferred to nature" (Gould, 2002:122).

A broader picture emerges from the fact that Darwin is also indebted to Hobbes's idea of the *social contract* which proceeded from a hypothetical "state of nature", seen as a battle of everyone against everyone (*bellum omnium contra omnes*). These ideas of Hobbes were mediated by the thought of Malthus. In 1798 Malthus (1766-1834) published the following work: "An Essay on the Principle of Population and its Effects of the Future Improvement of Society." It is generally acknowledged that Malthus influenced Darwin's thought. Although Sober remarks that "the degree to which Malthus changed the direction of Darwin's thought remains controversial" (Sober, 1987:15). Gould explored this issue once more in his last big work of 2002, where he argues that the two main themes of Darwin's thought, namely the idea of a struggle for existence and the idea of natural selection, are derived from Malthus (and – as pointed out – Adam Smith). Gould remarks: "Darwin, after all, had also read Malthus" (Gould, 2002:120). Two pages further he elaborates the effect of this thrust more extensively:

> The link of Darwin to Malthus has been recognized and accorded proper importance from the start, if only because Darwin himself had explicitly noted and honored this impetus. But if Darwin required Malthus to grasp the central role of continuous and severe struggle for existence, then he needed the related school of Scottish economists – the *laissez-faire* theorists, centered on Adam Smith and the *Wealth of Nations* (first published in the auspicious revolutionary year of 1776) – to formulate the even more fundamental principle of natural selection itself (Gould, 2002:122).

The continuity postulate of the modern science ideal turned out to be one of the basic beliefs that permeated the thought of most of the contemporary adherents of Darwin's thought. It also serves as the foundation of the entire Neo-Darwinistic dominant *gradualist* trend in modern biology since the "New Synthesis". Just recollect the words of William Provine, where he denies that anyone adhering to the theory of Darwin can defend the view that human beings truly have a freedom of choice (see the preceding article and Johnson, 1991:124-125). Interestingly Gould, who rejects the gradualist view, also wants to uphold genuine human freedom! In his thought the dialectical tension between nature and freedom is found in his reaction against the *biological determinism* of the sociobiologist E.O. Wilson (see Wilson, 1975). On the one hand Gould upholds the basic thesis that humans are animals. However, for him this statement does not "imply that our specific patterns of behavior and social arrangements are in any way directly determined by our genes" (Gould, 1992:251). For that reason he answers the question regarding the "evidence for genetic control of specific human social behavior" totally in the negative: "At the moment, the answer is none whatever" (Gould, 1992:252). He explicitly states that he rather opts for freedom: "Better to stick resolutely to a philosophical position on human liberty: what free adults do with each other in their own private lives is their business alone" (Gould, 1992:267).

Gould mentions a statement of Wolfgang Wickler: "It follows from evolutionary theory that the genes run the individual in their own interest." Gould's reaction is radical: "I confess I cannot regard such a statement as much more than metaphorical nonsense" (Gould, 1992:269). However, the question is: how does Gould reconcile his view that humans are animals with the freedom and liberty of

1 Rousseau already stated: "Nature commands every animal, and the brute obeys. The human being experiences the same impulse, but recognizes the freedom to acquiesce or to resist; and particularly in the awareness of this freedom the spirituality of humankind manifests itself. ... but in the capacity to will, or much rather to choose, and the experience of this power, one encounters nothing but purely spiritual acts which are totally inexplicable through mechanical laws" (Rousseau, 1975:47).

humankind?[1] Clearly, the basic humanistic motive of *nature* and *freedom* gives direction also to "biological" thought. Gould believes that "the issue is not universal biology vs. human uniqueness, but biological potentiality vs. biological determinism" (Gould, 1992:252). Potentiality here represents the humanistic freedom motive and determinism of the classical humanistic science ideal. In reaction to the meaningless speculations of sociobiologists Gould therefore posits human flexibility with a vast range of potential behaviour.[2] In the final analysis Gould attempts to maintain a relative balance between the dialectically opposed poles of the ground motive of *nature* and *freedom*.

Gould refers to the fact that one has to accept Darwin's entire conceptual world: "To accept Darwin's full argument about the creativity of natural selection, one must buy into an entire conceptual world – a world where externalities direct, and internalities supply raw material but impose no serious constraint upon change; a world where the functional impetus for change comes first and the structural alteration of form can only follow. *The creativity of natural selection makes adaptation central, isotropy of variation necessary, and gradualism pervasive*" (Gould, 2002:158-159). The gradualist position of Neo-Darwinism is also characterized as being *functionalist* in nature. But at this point Gould raises questions in defense of an alternative position "that seriously challenges the predominant functionalism of classical Darwinism" (Gould, 2002:159 – he has his own theory of punctuated equilibrium in mind).

Gould points out that "Lyell's conflation of gradualism with rationality itself" attracted Darwin, but generated the serious criticism of his friend Huxley who complained: "You have loaded yourself with an unnecessary difficulty in adopting *Natura non facit saltum* so unreservedly" (quoted by Gould, 2002:151).

2. The two opposing paradigms: gradualism versus discontinuous stasis

Darwin was convinced that "natural selection acts solely by accumulating slight, successive, favourable variations", that is to say it cannot produce "great or sudden modifications" because "it can act only by short and slow steps". His high expectations about every "fresh addition to our knowledge" is seen in one of the four places, quoted more extensively in Strauss (2010), where he posits the idea

2 "We are both similar and different from other animals. In different cultural contexts, emphasis upon one side or the other of this fundamental truth plays a useful social role. In Darwin's day, an assertion of our similarity broke through centuries of harmful superstition. Now we may need to emphasize our difference as flexible animals with a vast range of potential behavior. Our biological nature does not stand in the way of social reform" (Gould, 1992:259).

that nature does not make jumps: "Hence, the canon of "Natura non facit saltum," which every fresh addition to our knowledge tends to confirm, is on this theory [simply – Darwin, 1859:444-445] intelligible" (Darwin, 1859a:307).

Unfortunately the subsequent "fresh addition to our knowledge" did not confirm his *a priori* belief in short and slow steps over long periods of time. Eldredge states: "The fossil record flatly fails to substantiate this expectation of finely graded change" (Eldredge, 1982:163). Instead, prominent paleontologists during the past forty years had to acknowledge openly that they knew all the time that the fossil record contradicts Darwin's expectations. The often quoted statement of Gould reads as follows: "The extreme rarity of transitional forms in the fossil record persists as the trade secret of paleontology. The evolutionary trees that adorn our textbooks have data only at the tips and nodes of their branches; the rest is inference, however reasonable, not evidence of fossils" (Gould, S.J., 1977:14).[3]

Darwin indeed succeeded to burden all his followers with the *a priori* faith in continuous or gradual change, a conviction that resulted in what is known as *gradualism*. However, as Berlinski remarks, "[M]ost species enter the evolutionary order fully formed and then depart unchanged" (Berlinski, 2003:158).[4] Jones articulates this state of affairs more extensively: "The fossil record – in defiance of Darwin's whole idea of gradual change – often makes great leaps from one form to the next. Far from the display of intermediates to be expected from slow advance through natural selection, many species appear without warning, persist in fixed form and disappear, leaving no descendants. Geology assuredly does not reveal any finely graduated organic chain, and this is the most obvious and gravest objection which can be urged against the theory of evolution" (Jones, 1999:252). Eldredge adds the remark: "and this destroys the backbone of the most important argument of the modern theory of evolution" (as quoted by Van den Beukel, 2005:106).

Gould tells the story of an example of this burden as it is displayed in the academic career of one of his Ph.D. advisors, John Imbrie. The latter was a distinguished

3 What Eldredge said is even more embarrassing in this context: "We paleontologists have said that the history of life provides support for the interpretation of gradual development through natural selection while all the time we knew that it was not true" (see Van den Beukel, 2005:105).

4 "The clear predominance of an empirical pattern of stasis and abrupt geological appearance as the history of most fossil species has always been acknowledged by paleontologists, and remains the standard testimony … of the best specialists in nearly every taxonomic group. In Darwinian traditions, this pattern has been attributed to imperfections of the geological record that impose this false signal upon the norm of a truly gradualistic history. Darwin's argument may work in principle for punctuational origin, but stasis is data and cannot be so encompassed" (McGar, 2006:242).

paleontologist who accepted the "canonical equation of evolution with gradualism". Gould explains that his conjecture was "that our documentary failures had arisen from the subtlety of gradual change, and the consequent need for statistical analysis in a field still dominated by an "old-fashioned" style of verbal description" (Gould, 2002:760). John Imbrie schooled himself in these quantitative methods and then applied this "exciting and novel" method of analysis "to the classic sequence of Devonian brachiopods from the Michigan Basin – where rates of sedimentation had been sufficiently slow and continuous to record any hypothetical gradualism". Gould mentions that he "studied more than 30 species in this novel and rigorous way". However, he found "that all but one had remained stable throughout the interval, while the single exception exhibited an ambiguous pattern". The effect was that Imbrie became so "disappointed at such 'negative' results after so much effort" that he "buried his data in a technical taxonomic monograph that no working biologist would ever encounter (and that made no evolutionary claims at all) – and eventually left the profession for something more 'productive')" (Gould, 2002:760).

The general attitude of those "infected" by the continuity postulate (gradualism) of Darwin was to view *stasis* "as just another failure to document evolution" (Gould, 2002:759) – normally camouflaged by stating that the fossil record is "imperfect". Yet Gould claims that every paleontologist knew all the time that *stasis* existed abundantly: "Stasis existed in overwhelming abundance, as every paleontologist always knew" (Gould, 2002:759). His confession is honest: "But this primary signal of the fossil record, defined as an absence of data for evolution, only highlighted our frustration – and certainly did not represent anything worth publishing. Paleontology therefore fell into a literally absurd vicious circle. No one ventured to document or quantify – indeed, hardly anyone even bothered to mention or publish at all – the most common pattern in the fossil record: the stasis of most morphospecies throughout their geological duration" (Gould, 2002:759-760).

The prejudice of a continuous transition therefore met with fierce resistance from the paleontological record, because the latter did not conform to Darwin's expectations – neither during his own life-time nor now, a hundred and fifty years later. The clash between the factual state of affairs and Darwin's expectation is confessed by himself: "But I do not pretend that I should ever have suspected how poor was the record in the best preserved geological sections, had not the absence of innumerable transitional links between the species which lived at the commencement and close of each formation, pressed so hardly on my theory" (Darwin, 1859a:209).

The followers of Darwin who accepted his *a priori* continuity postulate ("gradualism") by and large tend to settle for the escape-explanation claiming that

the fossil record is "imperfect". The assumed continuity postulate caused Gould to remark that we often fail to realize "how much of the *Origin* presents an exposition of gradualism, rather than a defense of natural selection" (Gould, 2002:151). However, if natural selection is the chief agent causing (incremental) change, then the dominant pattern of the paleontological record, given in stasis which, in many instances, stretches over a time-span of millions of years, generates a serious question. The constancy of fossil forms – which most of the time appear fully formed and remain unchanged until they disappear – must be assessed against the ever changing natural conditions. Constancy (stasis) over millions of years inevitably had to face numerous "attacks" from environmental changes, providing *natural selection* with ample chances to cause visible (and in the long run or sometimes: drastic) changes to the adapting species. The empirical (paleontological) fact that this is not the case does not bypass the sharp insight of Gould where he writes: "… if stasis merely reflects excellent adaptation to environment, then why do we frequently observe such profound stasis during major climatic shifts like ice-age cycles (Cronin, 1985), or through the largest environmental change in a major interval of time (Prothero & Heaton, 1996)?" (Gould, 2002:878).

The priority of the continuity postulate in the thought of Darwin made it impossible for him to accept the fossil record on face value. Instead he advanced arguments intended to secure his prejudice, of which the strongest one is the claim that the fossil record is *imperfect.* What ought to be explained is, in Darwin's own words, why "we do not find interminable varieties, connecting together all extinct and existing forms by the finest graduated steps"? (Darwin, 1859a:232).

Apart from the unsurmountable difficulties in explaining the genesis of the first living entities, the subsequent picture also does not support the continuity postulate. The hope that the Precambrian era will disclose a picture of continuous transition was in vain. Gould remarks:

> Paleontologists have now established a good record of Precambrian life. The world did swarm indeed, but only with single-celled forms and multi-cellular algae, until the latest Precambrian fauna of the Ediacara beds (beginning about 600 million years ago). The explosion of multicellular life now seems as abrupt as ever—even more so since the argument now rests on copious documentation of Precambrian life, rather than a paucity of evidence that could be attributed to imperfections of the geological record (Gould, 2002:154).

Although he is just as much attached to the continuity postulate, Simpson had to acknowledge *abrupt appearance*:

> It is a feature of the known fossil record that most taxa appear abruptly. They are not, as a rule, led up to by a sequence of almost imperceptibly

> changing forerunners such as Darwin believed should be usual in evolution. ... These peculiarities of the record pose one of the most important theoretical problems in the whole history of life: is the sudden appearance ... a phenomenon of evolution or of the record only, due to sampling bias and other inadequacies? (quoted by Tax, 1960:149).

This state of affairs explains why paleontologists avoided evolution. The observation of Eldredge is striking: "No wonder paleontologists shied away from evolution for so long. It never seemed to happen. Assiduous collecting up cliff faces yields zigzags, minor oscillations, and the very occasional slight accumulation of change over millions of years, at a rate too slow to account for all the prodigious change that has occurred in evolutionary history. When we do see the introduction of evolutionary novelty, it usually shows up with a bang, and often with no firm evidence that the fossils did not evolve elsewhere! Evolution cannot forever be going on somewhere else. Yet that's how the fossil record has struck many a forlorn paleontologist looking to learn something about evolution" (Eldredge, 1995:95).

The crucial issue in this regard is that the *conviction* that the fossil record is *imperfect* does not have a foundation in factual evidence. *Stasis*, however, is based upon actual fossil findings, that is to say, on *data* and not on the absence of data. Of course one has to realize that the prejudice of gradualism "forced" Darwin to interpret the fossil record in such a way that its obvious discontinuity is denied.[5] The fundamental question is if one can refute gradualism "from within"? Once again Gould captures this key issue adequately: "For the data that should, *prima facie,* rank as the most basic empirical counterweight to gradualism – namely the catalog of cases, and the resulting relative frequency, for observed stasis and geologically abrupt appearances of fossil morphospecies – receive *a priori* interpretation as signs of an inadequate empirical record" (Gould, 2002:758).

Gould and Eldredge are therefore fully justified in emphasizing that *stasis is data* and in getting frustrated with many colleagues who failed to grasp this evident point. To help these colleagues "a mantra or motto" is suggested – to be said "ten times before breakfast every day for a week" so that the "argument will [surely] seep in by osmosis: 'stasis is data; stasis is data ...'" (Gould, 2002:759). Gould further elaborates by suggesting: "sample a species at a large number of horizons well spread over several million years, and if these samples record no net change,

5 Darwin acknowledges that he only understood the extreme imperfection of the geological record when paleontological evidence of stasis and abrupt appearance threatened to confute the gradualism that he "knew" to be true.

with beginning and end points substantially the same, ... then a conclusion of stasis rests on the presence of data, not on absence!" (Gould, 2002:759).[6] As it was reaffirmed more recently by McGar: "The clear predominance of an empirical pattern of stasis and abrupt geological appearance as the history of most fossil species has always been acknowledged by paleontologists, and remains the standard testimony … of the best specialists in nearly every taxonomic group. In Darwinian traditions, this pattern has been attributed to imperfections of the geological record that impose this false signal upon the norm of a truly gradualistic history. Darwin's argument may work in principle for punctuational origin, but stasis is data and cannot be so encompassed" (McGar, 2006: 242).

The standard "incompleteness-response" to stasis and abrupt (dis)appearance did not realize that this interpretation of the "facts" is embedded in the continuity postulate. Also here Gould shows that he has digested the important results of the developments within the philosophy of science of the previous century: "Facts have no independent existence in science, or in any human endeavor; theories grant differing weights, values, and descriptions, even to the most empirical and undeniable of observations. Darwin's expectations defined evolution as gradual change. Generations of paleontologists learned to equate the potential documentation of evolution with the discovery of insensible intermediacy in a sequence of fossils. In this context, stasis can only record sorrow and disappointment" (Gould, 2002:759).

Gould is therefore justified in asking how gradualism could face stasis as the "most prominent signal" from the fossil record, something that could not "be explained away as missing information?" The answer to this question reveals an embarrassing perspective, because Gould believes that "this project could not even succeed in its own terms, for gradualism occurs too rarely to generate enough cases for calculating a distribution of rates" (Gould, 2002:761-762). He continues by pointing out that alternatively "paleontologists worked by the false method of exemplification: validation by a 'textbook case' or two, provided that the chosen instances be sufficiently persuasive". At this point the irony of side-stepping stasis as data turns into something tragic: "And even here, at this utterly minimal level of documentation, the method failed". But this is not yet the end of the story, for the few examples that did enter the literature were "replicated by endless republication in the time-honored fashion of textbook copying" (Gould, 2002:759-760).

6 Concerning groups of invertebrate animals even Dawkins had to acknowledge: "And we find many of them already in an advanced state of evolution the very first time they appear. It is though they were just planted there, without any evolutionary history" (Dawkins, 1987:229).

The most striking of these "examples" are Simpson's story of the horse and the untrue story about the peppered moths in England.[7] Gould (1996:68) quotes Prothero and Shubin, who wrote in connection with the supposed evolution of the horse: "This is contrary to the widely held myth about horse species as gradualistically varying parts of a continuum, with no real distinctions between species. Throughout the history of horses, the species are well-marked and static over millions of years" (Gould, 1996:68 and Gould, 2002:846-847). Raup remarks: "We actually may have fewer examples of smooth transitions than we had in Darwin's time, because some of the old examples have turned out to be invalid when studied in more detail" (quoted by Johnson, 1991:171).

And then Gould formulates the final verdict in respect of the false method of exemplification pursued by gradualists:

> But, in final irony, almost all these famous exemplars turned out to be false on rigorous restudy (Gould, 2002:761-762).

Stasis over millions of years – THE dominant fact of paleontology up to date – questions adaptation and natural selection, for in spite of multiple environmental changes types simply remained constant over millions of years – as we have seen above this impasse is explicitly acknowledged by Gould (2002:878)!

3. Concluding remark

The majority of Neo-Darwinists is still fully in the grip of the *a priori* continuity postulate that dominated Darwin's thinking. Most of the time they do not realize that this postulate is assumed to be true prior to an investigation of whether it is supported by any empirical evidence.

All in all the problem of continuity and discontinuity not only highlights some of the most pressing intrinsic inconsistencies within modern (Neo-Darwinistic) biology, but also calls for an alternative approach in which the reality of discontinuous types – as evinced both in the stasis-stamped paleontological record and the current natural system of plants and animals – is recognized.

Of course modern biology is not exhausted by Neo-Darwinism, it indeed hosts various diverse schools of thought. In addition to the problem of continuity and discontinuity – as is argued, a conceptual contradistinction originally found only in the spatial aspect of reality (see Strauss, 2010 in this regard) – alternative modes of explanation are explored by the different trends of thought in modern biology. In the case of Eisenstein reality is subsumed under the classical mechanistic denominator of motion; among

7 Interestingly Gould still believed the peppered moth story (see Gould, 1994:257).

supporters of the general synthetic theory of evolution in principle understood in terms of a physical denominator in which apparent (but not principled) recognition is given to higher structural levels; in vitalism, holism, and organicism a biotical denominator is employed; in the pan-psychistic identism of Rensch a sensitive-psychic denominator is chosen, and in the personality ideal-oriented thought of Jonas the denominator of freedom serves as guiding principle. Emergence evolutionism wants to have it both ways – by recognizing a continuity of descent on the one hand and a discontinuity of being on the other.[8]

The choice of a mode of explanation or a denominator implies (with *ontological necessity*) that all other facets of the diversity of reality must be reduced to the chosen denominator which, as an absolutized perspective, is supposed to encompass all aspects and other dimensions of reality.

What is particularly striking is that all these mentioned diverse approaches continue to be confronted with the diversity of reality which can be logically identified and distinguished. No single understanding of continuity succeeded in denying the differences between material things, plants, animals, and humans, or the differences between movement, the physical, biotical, the sensitive, and the post-psychical aspects – they simply describe these different facets and structures as non-essential since apparently they can be reduced to one or another denominator.

The basic question remains whether this diversity of choices in denominator has any "objectively factual" foundation. It cannot be denied that the inherent diversity in reality offers a point of departure for this diversity in perspectives, but the belief that all of this diversity can be reduced to one particular facet which would, as basic denominator, encompass all others, doubtlessly indicates fundamental theoretical presuppositions – theoretical-philosophical presuppositions which exist since theoretical logical thought by nature requires an idea of the diversity in reality, while these theoretical presuppositions themselves are being directed and determined by supra-theoretical convictions – such as the continuity postulate of modern humanistic philosophy which took hold of the thought of Darwin. No single perspective in modern biology can avoid one or another basic motive which directs the course of its theoretical articulations.

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8 For an overview of these various biological trends of thought see Strauss, 2005 (Chapter 4) and Strauss, 2009 (Chapter 7 and in particular pp.470 ff. and 479 ff.).

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