

Did Darwin get Over the First Hurdle? (Lacking Evidence for the Assumed Origination of “Life”)

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Samevatting

Terwyl die middeleeuse en reformatoriese tradisie wel God se wet vir skepsele erken het, het die moderne nominalisme die weg gebaan vir die verontagsaming van enige orde vir of ordelikheid van die werklikheid. Die rasionalistiese implikasies van hierdie ontwikkeling het gelei tot die opvatting van Immanuel Kant dat die menslike verstand die a priori (formele) wetgewer van die natuur is. Gekombineer met die historisme het hierdie ontkenning dit vir Darwin en sy nakomelinge moontlik gemaak om lewende dinge te sien as individue wat nie tipes is of tipes het nie (Simpson). Die Darwinisme het die ander kant van hierdie munt ontgin deur klem te lê op die unieke individualiteit van lewende dinge. Weliswaar sou die vermeende ontstaan van die eerste lewende dinge een van die ernstigste probleme vir hierdie teorie daarstel. Die Oparin-Haldane hipotese, die eksperimentele toetsing daarvan deur Stanley Miller en die daaropvolgende ontwikkelinge word beoordeel tot op die punt waar Behe die hopeloosheid van hierdie hele onderming aan die lig gebring het – wat ernstig vra vir ’n erkenning van die diskontinuiteit tussen die “lewende” en die “nie-lewende”. Vervolgens is ook aandag gegee aan die klassifikasie van lewende dinge in die lig van ’n alternatiewe strukturele verstaan van die verhouding tussen die lewende en nie-lewende boustene

van lewende entiteite – met die vermyding van sowel die Platoniese erfenis (die idealistiese morfologie) en die nominalistiese benadering (Darwin).

1. At the cross-roads of modernity

While natural scientists all over the globe celebrate both the birth of Darwin (1809 – 200 years ago) and the appearance of his epoch-making work *On the Origin of Species* (1859 – 150 years ago) another historically significant birth – 500 years ago – appears to be forgotten. What the author has in mind is the birth of John Calvin in 1509. Calvin succeeded in surpassing the church dominated medieval by opening up all of life, instead of keeping it enclosed within the confines of the institutional church.

The Protestant Reformation indeed also paved the way for the rise of the modern natural sciences, although other spiritual trends that emerged during the transition from the medieval era to the Renaissance increasingly led to a secularization of the academic world. In particular one can mention modern nominalism which – by denying any universality outside the human mind – in fact thought away the (universal) *laws for* creatures and the (universal) *orderliness of* creatures. This intellectual tradition left reality unstructured and chaotic and soon inspired the newly emerging life and world view of modern humanism to nominate a candidate for this vacancy, namely the creative power of *human reason*. Human reason now had to step in and create order within this chaos – as Kant asserted: human understanding does not derive its laws from nature, but prescribes them to nature (Kant, 1783, II:320; § 36, see Kant, 1787-B:163). Human understanding turned out to be the (universal) formal law-giver of nature – the stance of *conceptual rationalism*.

Yet soon after Kant the rise of historicism, by the end of the 18th century and the beginning of the 19th century, shifted the emphasis to what was considered to be changeful, unique and unrepeatable. Darwin digested this new historicistic perspective in his own pre-occupation with the idea of *variability* and *change* at the cost of constancy – the stance of (concept-transcending) *irrationalism*.¹

Both Darwin and his Neo-Darwinian followers in the 20th century assumed a strange position in respect of the status of “natural laws”. Within the domain of physics (and the material world) they continued to subscribe to

1 In his *Origin of Species* the term ‘constancy’ appears twice and ‘persistent’ (or: ‘persistently’) three times, whereas the term ‘change’ occurs 268 times, ‘variation’ 281 times, and ‘variations’ 162 times.

universal (and constant) *natural* laws, but as soon as living entities enter the scene they deny any *typicality* or the existence of *biotic* laws. Darwin does speak of a “general law of nature” (Darwin, 1859:143) and of “a universal law of nature” (Darwin, 1859:268)² – but he never speaks of *biotical* laws of nature – even if phenomena of life are at stake. For him physical laws (or: natural laws) are sufficient – his underlying *physicalism* that dominates his entire work *On the Origin of Species* (see Strauss, 2007). Later on Simpson echoed this position. According to him the physical sciences are largely *typological* and *idealistic* for they “usually deal with objects and events as invariant types, not as individuals with differing characteristics” (Simpson, 1969:8). This characterization reflects the basic orientation of the classical humanistic science ideal in its *rationalistic* orientation – resolving the factual side of physical reality into the law side, thus turning physical entities into “invariant types”. But as soon as truly biotical phenomena are considered, this rationalistic inclination makes room for the irrationalistic side of modern nominalism – denying any and all *type* concepts: “Organisms are not types and do not have types” (cf. Simpson, 1969:8-9).

This explains why a physical approach is inappropriate when it comes to “phenomena special to the biological levels” (Simpson, 1969:8). What is striking here is that Simpson distinguishes between two *types* of phenomena, namely *physical phenomena* and *biotical phenomena*. In other words, in order to demarcate the domain of biotical phenomena – where a typological (and so-called idealistic) method is *inapplicable* and *inappropriate*, a prior *typological classification* is required – given in the distinction between the two *types* of phenomena: *physical* and *biotical*. The logical flaw in this approach is evident: biology as a discipline can only proceed in a non-typological manner when it is founded in a typological classification!

The law side of the biotical aspect is completely sacrificed in this irrationalistic nominalism – biology does not investigate types, for according to Simpson “no two are likely ever to be exactly alike” (Simpson, 1969:9). The unique-individual side of biotical factuality is accentuated at the cost of both the universal (factual) orderliness of living entities and by rejecting any order determination, every form of a conditioning biotical type law.

In the meantime physics realized that it had to formulate its typical laws in statistical terms precisely because the unique individuality of entities

2 See also Darwin, 1859, pp.143 (2x), 147, 427, and 445.

cannot be seen as a mere extension of the law side, and are therefore also not merely “objects and events” with “invariant types”. Simpson has a rationalistic (and deterministic) understanding of physical phenomena, and an irrationalistic (and nominalistic) view of living entities – on both scores, the true law side factual side correlation is misunderstood.

What is currently known as modernity and postmodernity (modernism and postmodernism) derives from a rationalistic understanding of physical laws and an irrationalistic understanding of uniqueness and contingency – reflected in the theoretical view of a Neo-Darwinist thinker such as Simpson. The orientation of modern nominalism was digested by Darwin in respect of living entities. First of all he states that “no line of demarcation can be drawn between species” (Darwin, 1859:443) – and to this he adds the nominalistic remark: “In short, we shall have to treat species in the same manner as those naturalists treat genera, who admit that genera are merely artificial combinations made for convenience” (Darwin, 1859:456).

2. The critical problem of demarcation for Neo-Darwinism

Under the influence of Platonism biology inherited a system of classification known as *idealistic morphology*. This idealistic morphology accepts universal forms that are themselves not subject to change (like Platonic ideas or ontic forms). The nominalistic legacy within modern philosophy, largely dominating the scene since the Renaissance, denies any universality outside the human mind. In the absence of any persistent structural features within the world of living entities, the nominalist introduces general concepts or words as the substitute for the multiplicity of individual things outside the human mind. These intra-mental concepts or words merely have a *mental universality*. The implication is that any classification is purely *arbitrary*, within reality there are no boundaries (“no line of demarcation”) and “genera are merely artificial combinations made for convenience”, as Darwin said. Once the basic nominalistic view is accepted, namely that within reality there is no persistence or constancy, every attempt to erect a system of classification is relativized, up to being fully and totally arbitrary.

What are the consequences of the nominalistic position for the most basic demarcation problem, the delineation of *living* entities as distinct from *non-living* entities?³ Any attempt to explain the origination of the first

3 Von Weizsäcker prefers to designate physical entities as “unbelebt” (“not-having-lived”; cf. Von Weizsäcker, 1993:32) and not as “dead” – because in the latter case it is presupposed that physical matter once was alive!

living entity first of all has to give a positive content to the distinction between the non-living and the living. It should be kept in mind that – from a purely physico-chemical perspective – the largest macromolecule is about a million times *smaller* than the smallest living cell. Even if one proceeds from a purely physicalistic starting-point and holds that in principle the cell is nothing but a very complex physical interaction-system, the large gap in size still poses a significant challenge to any hypothesis aimed at accounting for the origination of the first living cell, particularly when the complexity of a cell is taken into account.

Although the view that living things could spontaneously emerge out of non-living matter (*generatio spontanea*) has been known since Greek antiquity, it is no longer accepted in modern times by any natural scientist – *inter alia*, owing to the work of Pasteur. Nonetheless the mechanistic (or rather: *physicalist*) perspective must make at least one exception: the origination of the first living entity under circumstances entirely alien to those known to us today.

Some of the oldest known fossils of living entities are those of unicellular algae – found near Barberton in South Africa. By means of the half-life of radio-active substances the age of *Archaeosphaeroïdes barbertonensis* have been calculated as approximately 3 100 million years (cf. Schopf, W. & Barghoorn, 1967:508 ff).

Since living entities, considered physico-chemically, function on the basis of both (enzyme) protein and nucleic acid (DNA), the mechanistic point of view is obliged to presume that initially there must be a close relationship between protein and DNA. Already in 1971, however, Orgel and Sulston commented in this regard: “This approach leads to new difficulties so severe that it has never been carried very far” (Orgel & Sulston, 1971:91). They continue with the striking observation that “progress” can only be recorded in this regard when characteristics are attributed to protein and DNA “which have not been demonstrated experimentally, and which usually seem implausible” (Orgel & Sulston, 1971:91).

Initially (and independently) from each other Haldane (already in 1928)⁴ and the Russian, Oparin (cf. Oparin, 1953, chapters 4-7: pp.64-195), developed a hypothesis regarding the origination of the first living entity.

4 Names associated with the “New Synthesis” introduced by Julian Huxley in 1942 (*Evolution: The Modern Synthesis*) are: R. A. Fisher, Theodosius Dobzhansky, J.B.S. Haldane, Sewall Wright, E.B. Ford, Ernst Mayr, Bernhard Rensch, Sergei Chetverikov, George Gaylord Simpson, and G. Ledyard Stebbins.

The assumptions of the Oparin-Haldane approach eventually turned out to be questionable, namely that the initial atmosphere of the earth was mainly composed of hydrogen, methane, ammonia and water vapor. In particular Oparin holds that carbon “made its first appearance on the Earth’s surface not in the oxidized form of carbon dioxide but, on the contrary, in the reduced state, in the form of hydrocarbons” (Oparin, 1953:101-102).

Silver points out that there is at present “no evidence that the atmosphere was reducing (methane and hydrogen)” and remarks that “the prevalent opinion at the moment is that the Earth’s atmosphere, at the time that life emerged, was mainly carbon dioxide and nitrogen” (Silver, 1998:344). The role of methane is also unacceptable in the Oparin story since it is one of the components of natural gas which is produced by the “effect of millions of years of pressure and heat acting on prehistoric plant material” (Silver, 1998:344). Although the Haldane-Oparin conjecture was kept alive for a considerable time, supported by the experiments done by Stanley Miller (from Chicago) in 1953, it does not bring us closer to an understanding of the mystery of the genesis of the living cell. With regard to Miller’s experimentation Silver remarks:

The Haldane-Oparin hypothesis is out of fashion. Of the forty or so simple molecules that would be needed to form a primitive cell, the experiment produces two. It is worth bearing in mind that glycine contains only ten atoms and alanine, thirteen. The simplest nucleotide contains thirty atoms. The probability that a given large molecule will be produced by chance from small molecules, by sparks, falls drastically as the molecular size increases. It has to be realized that even if heat, radiation, and lightning, on the young Earth, had produced all the amino acids and nucleotides needed for present forms of life, the gap between an aqueous solution of these emolecules and a living cell is stupendous. It’s a question of organization: in the absence of a guiding intelligence, presentday scientists are not doing very well. For the moment, let’s show the Miller experiment to the side door and see who is next in line in the waiting room (Silver, 1998:345).⁵

5 Behe remarks: “Of course, if conditions on the ancient earth actually resembled Miller’s unsuccessful attempts, then in reality no amino acids would have been produced. Moreover, joining many amino acids together to form a protein with a useful biological activity is a much more difficult chemical problem than forming amino acids in the first place. The major problem in hooking amino acids together is that, chemically, it involves the removal of a molecule of water for each amino acid joined to the growing protein chain. Conversely, the presence of water strongly inhibits amino acids from forming proteins. Because water is so abundant on the earth, and because amino acids dissolve readily in water, origin-of life researchers have been forced to propose unusual scenarios to get around the water problem” (Behe, 2003:169-170).

In Neo-Darwinist thought natural selection receives much prominence. A similar story is used to explain the origin of the first living entities: by means of selection the accidental emergence of organic combinations (amino acids, nucleic acid, enzymes, etc.) supposedly gave rise to the formation of reproductive units, virus-like forms, proto-organisms and eventually true living cells. In view of physical laws, Von Bertalanffy, amongst others, also questions this construction:

In contrast to this it should be pointed out that selection, competition and 'survival of the fittest' already presuppose the existence of self-maintaining systems; they therefore cannot be the result of selection. At present we know no physical law which would prescribe that, in a 'soup' of organic compounds, open systems, self-maintaining in a state of highest improbability, are formed. And even if such systems are accepted as being 'given', there is no law in physics stating that their evolution, on the whole, would proceed in the direction of increasing organization, i.e. improbability. Selection of genotypes with maximum offspring helps little in this respect. It is hard to understand why, owing to differential reproduction, evolution should have gone beyond rabbits, herring or even bacteria, which are unrivalled in their reproduction rate (Von Bertalanffy, 1973:160-161).

Those who have respect for scientific modesty may do well to reflect upon a remark made by Haldane in a discussion with Silver: "I had a long conversation with J.B.S. Haldane, which started off with politics and ended with science. When I questioned him about evolution, one of his remarks sparked my interest, and sent me to the library that evening: 'Evolution's not the problem. Life is' Then he said, 'Oparin and I once had an idea about that, but we'll never know the real answer'" (Silver, 1998:353).

The past 50 years witnessed a tremendous increase in our knowledge of the micro-dimensions of living entities. On the one hand these developments opened up a domain that cannot be reconstructed from fossils⁶ and on the other it revealed such an astonishingly complex picture that questions now arise – not because we know too little – but because we know so much!⁷ Darwin honestly stated:

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- 6 It appears to be hopeless to provide an evolutionary explanation for the origination of the eye: "Anatomy is, quite simply, irrelevant. So is the fossil record. It does not matter whether the fossil record is consistent with evolutionary theory, any more than it mattered in physics that Newton's theory was consistent with everyday experience. The fossil record has nothing to tell us about, say, whether or how the interactions of 11-cis-retinal with rhodopsin, transducin, and phosphodiesterase could have developed, step by step" (Behe, 2003:292).
- 7 Behe remarks: "As a result, evolutionary biology is stuck in the same frame of mind that dominated origin-of-life studies in the early fifties, before most experiments had

If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down (Darwin, 1859:219).

The general assessment of Behe is quite remarkable in this context: “The story of the slow paralysis of research on life’s origin is quite interesting, but space precludes its retelling here. Suffice it to say that at present the field of origin-of-life studies has dissolved into a cacophony of conflicting models, each unconvincing, seriously incomplete, and incompatible with competing models. In private, even most evolutionary biologists will admit that they have no explanation for the beginning of life” (Behe, 2003a:292).

Particularly in respect of what is known as the *molecular basis* of vital phenomena the current scholarly predicament lacks a sound scientific basis. Some of the most prominent biochemistry text books do not even have an index entry *evolution*. Behe lists about thirty editions of standard biochemistry text books with none or almost none *Index Entries* referring to *evolution* (the total number of index entries varies from 100 up to 10 000). In particular he lifts out some examples:

For example, Thomas Devlin of Jefferson University in Philadelphia wrote a biochemistry textbook that was first published by John Wiley & Sons in 1982; new editions followed in 1986 and 1992. The first edition has about 2,500 entries in its index; the second also has 2,500; and the third has 5,000. Of these, the number referring to evolution are zero, zero, and zero, respectively. A textbook by Frank Armstrong of North Carolina State University, published by Oxford University Press, is the only recent book to include an historical chapter reviewing important developments in biochemistry, beginning with the synthesis of urea by Friedrich Wöhler in 1828. The chapter does not mention Darwin or evolution. In three editions Armstrong’s book has found it unnecessary to mention evolution in its index (Behe, 2003:182-183).

Add to this the fact that there exists a journal with the name *Journal of Molecular Evolution (JME)* – established in 1971). The underlying

been done: imagination running wild. Biochemistry has, in fact, revealed a molecular world that stoutly resists explanation by the same theory so long applied at the level of the whole organism. Neither of Darwin’s starting points – the origin of life, and the origin of vision – has been accounted for by his theory. Darwin never imagined the exquisitely profound complexity that exists even at the most basic levels of life” (Behe, 2003:173).

rationale of this journal is to explain how living entities came into existence on the molecular level. Of course this aim is ambiguous, because one may interpret it either to mean that macromolecules as such are alive or that macromolecules belong to the non-living *substratum* of living entities.

Surely molecules and macromolecules are *not* alive – something clearly understood by Simpson, because he considers the phrase *molecular biology* to be inconsistent:

Since biology is the study of life (it would have been more correct to say “living things” – DFMS) and molecules, as such, are not alive, the term “molecular biology” is selfcontradictory (Simpson, 1969:6).⁸

A closer look at the articles that appeared in *JME* reveals that this “selfcontradictory” name did not produce anything substantial. Behe remarks that “*none* of the papers published in *JME* over the entire course of its life as a journal has ever proposed a detailed model by which a complex biochemical system might have been produced in a gradual, step-by-step Darwinian fashion” (Behe, 2003:176). He continues on the same page by formulating a number of relevant questions that should have been addressed in this journal, only to conclude that *none* of these problems in fact have been addressed, “let alone solved”. According to him this strongly indicates that “Darwinism is an inadequate framework for understanding the origin of complex biochemical systems” (Behe, 2003:176). His general concluding is devastating for Darwinian theory: “There has never been a meeting, or a book, or a paper on details of the evolution of complex biochemical systems” (Behe, 2003:179).

3. Continuity and discontinuity between the “living” and the “non-living”

Without any doubt the ontic distance between the physical and the biotical (the non-living and the living) is fully mirrored and matched by the absence of any feasible conjecture about the origination of biochemical systems.

The history of modern biology exhibits multiple alternative approaches, also shown in alternative ways of classifying living entities. Over and against the (above-mentioned) nominalist techniques of classification used in many biology texts, mention is sometimes made of the older and

8 The widespread practice referring to the *origin of life* actually reifies a modal function of reality – treating an *aspect* as if it is a concrete (multi-aspectual) entity.

supposedly outdated *idealistic morphology* of Ray (1627-1705), Linnaeus (1707-1778) and others. There are nonetheless still important 20th century representatives of this idealistic morphology, including E. Dacqué (cf. 1935, 1940, 1948), W. Troll (1949, 1951 and 1973), K. Lothar Wolf (1951) and W. Leinfeller (1966). According to Troll the foundation of comparative morphology is to be found in *ideas* (in the Platonic sense) which serve as ordering “inner articulations of our intuition” by means of which *types* as “Urbildliche Einheiten” (primal image-like units) become the subject of study (cf. Ungerer, 1966:232). Troll partially reaches back to the thinking of J.W. Goethe – the Romantic poet and natural philosopher. In his biological investigations, largely concerned with morphology, Goethe emphasized the character of “Gestalt” – form in an almost Platonic sense – although he shifted the emphasis to the factual side of reality, since he did not see the “Gestalt” as rooted in the law, but rather the law in the “Gestalt”.

In idealist morphology a primal leaf or primal plant is designed containing certain basic typological characteristics. Zimmerman engages in a dialogue with this idealist morphology in his *Evolution und Naturphilosophie* (Berlin 1968). He points out that Troll continues to believe that morphology determines the possibility of the descent and not the other way around: “It is not the descent which is decisive in morphology, but rather the opposite: morphology has to decide about the possibility if descent”. It may be noted that it is possible to hold that the problems of the natural system should serve as the foundation of any possible theory of descent without being a supporter of idealist morphology. Portmann, for example, comments that “few biologists still consider that systematics is the foundation of evolutionary theory, that this is the certain, that which we know, while evolutionary theory is what we suspect” (Portmann, 1965:10).

On a more fundamental level the problems of classification may be extended to include the distinction between the non-living and the living. However, in order to understand the full complexity of what is at stake the idea of multi-aspectual things should be accounted for. In fact, most 20th century trends within the discipline of biology do not distinguish between concrete, many-sided entities and the various aspects within which these entities function. Consequently they do not acknowledge the fundamental *modal* (functional) nature of the physical and biotic aspects of reality. They also do not realize that these (and other) aspects remain a functional *condition* for the existence of concrete entities. What is of importance in this regard is the basic distinction between the modal aspects and the

dimension of entities. Yet the predominant *reifying* mode of speech in biological literature, constantly referring to ‘life’ as if it is an entity (for example when biologists speak of the “origin of life” or the “history of life”) runs into difficulties the moment it is confronted with what we know about living things.

The first important question should be phrased as follows: is any living thing *fully alive*, i.e. *living* in its totality and in all its parts?

Of course this question presupposes an insight into another issue – namely the problem of specifying what may be considered to be *genuine parts* of a living entity. It can be argued that the *whole-parts relation* is derived from the core meaning of the spatial aspect (see Strauss, 2002). Therefore this relation will take on an *analogical character* within post-spatial aspects. A spatial whole is *homogenous* – every part is of the *same nature* – like different parts of a line. Even in the case of physical entities, their parts may be similar, as observed from the fact that a part of salt is still salt (with a NaCl chemical structure). By contrast, a *biotical whole* is *heterogenous*, for although a part of a horse is a “horse-part”, it is nonetheless not a horse (see Oeing-Hanoff, 1976:306). It must be acknowledged, however, that from a *biotic* perspective, the different organs of a horse all exhibit the organic feature of being integrated into the living organism of the *horse*. For this reason, the heart of a horse differs from that of a cow. Although the different organs of a horse differ amongst themselves and from similar organs found in other animals, they nonetheless all share the same biotic property of being (part-) organs of a horse. This feature therefore represents, within the *heterogenous* biotic whole-parts relation, an element of *homogeneity*.

In terms of the question regarding the true parts of a living entity, it is clear that the living organism of a living entity indeed evinces such an organic whole-parts relation. Holistic approaches employ the idea of integrated organic parts in this regard, designated in German as “Glieder”. Nonetheless, this does not exhaust the *complexity* of what is at stake, because every organ of a living entity is constituted by a complex arrangement of atoms, molecules and macro-molecules – and the latter are certainly not *alive*.

Therefore, it cannot be denied that, within living things, non-living entities are also present, namely, atoms, molecules and macro-molecules. The conclusion is inevitable: a living entity appears to be at once a “mixture” of the “living” and the “non-living”. In other words, it is not alive through-and-through – it seems to be “alive” and “non-living” at the same time!

The predominant Neo-Darwinian tradition, with its mentioned physicalist inclination, opts for a view in which the biotic side of living entities is completely reduced to the interaction between atoms, molecules and macro-molecules. Vitalistic, holistic and organismic approaches, by contrast, do acknowledge what is sometimes referred to as the irreducibility of “life” – without realizing that this is still a *reifying* mode of speech, talking about “life” as if it is a *thing*, instead of merely being one amongst many *aspects* of living entities.

No one can deny the *unity* (“oneness”) of living things – the unity in the multiplicity of their organic functioning. The phrase “organic functioning” entails the existence of a multiplicity of organic activities. In our everyday experience, this is intimately connected to an awareness of the biotic process of growth (differentiation and integration), maturation, ageing and dying.

As an aspect of reality, life pertains to the *how* of entities and not to their concrete *what*. In addition we must emphasize the fact that vital phenomena are always connected to *living entities*, which cannot, as entities, be totally enclosed in the biotic aspect of reality. Particularly in the vitalist tradition – which sees life as independent variations of an immaterial *vital force* – this becomes a problem. That the biotic aspect of living entities cannot be appreciated in isolation, i.e. separated from the inter-modal coherence in which it is fitted, is confirmed by the analogies intrinsic to the structure of the biotic aspect. Even the expression *life force* (*vital force*), which is so often chosen by vitalism (but remarkably enough, has been replaced with other terms like *Gestaltungsfaktor* or *Zentralinstanz* in the second half of the 20th century), can never indicate or typify the alleged *separated existence* of the biotic aspect – simply because it unmistakably represents a *physical analogy* within the modal structure of the biotic aspect. The term *force* finds its original, i.e. non-analogical, modal home in the physical aspect of energy operation.

4. The classification of living entities

The traditional theoretical understanding of reality (the experiential world) generally lacks a proper account of the modal aspect as irreducible functional points of entry to our experience and explanation of the world. For that reason we have to appreciate modal aspects not merely as *modes of being*, but also as *modes of explanation*. The distinctness of the dimension of aspects and entities, on the law side of reality reflected in the distinctness of (unspecified) universal modal laws and (specified) type laws, apparently led to an emphasis on the dimension of entities at the cost

of keeping in mind what the implications of the dimension of modal aspects are for a meaningful classification of entities.

Diverse special sciences are demarcated by distinct modal points of entry to reality. In order to locate any modal point of entry it has to be distinguished from other aspects. For that reason more than one aspect is required in order to identify some or other specific modality. Another obvious implication is that the answer to the question regarding the nature of any special science always exceeds the confines of the discipline concerned. For example, the definitions of plant science and animal science do not belong to these disciplines themselves. Saying that “plant science is a study of plants” does not say anything about plants, for this definition is solely focused on the discipline investigating plants. But let us retreat one more step and ask the question: what is a plant? (or: what is an animal?). A first reaction may be to say that only botany as an academic discipline can tell us what a plant really is. But is this the case?

Suppose there has never been a botanist and for the first time someone commences with a scholarly investigation of the nature of plants. How does that person know what a plant is if there is no textbook on plant science? Are there any guarantees that our first botanist indeed investigates plants? If there is no plant scholar who can tell her what *plant-ness* is, what would prevent our first botanist from investigating physical entities or animals while being under the impression that they are plants?!

Clearly, without a *prior knowledge* of the nature of plants, not even a (first) botanist will be able to study plants – and this prior knowledge does not have any other basis than our everyday, pre-scientific acquaintance with the world we experience. In other words, ultimately not even the discipline of plant science can operate by negating our non-scientific knowledge about the world.

The basic experiential awareness of the difference between physical things, plants and animals is correlated with the irreducibility of the relevant aspects, namely the physical, biotic and sensory modes of reality. The implication of a non-reductionistic ontology is that any given entity is *either* this *or* that – it is *either* physical (non-living) *or* biotic (alive), it is *either* alive (biotic) *or* *sensory* (a sentient creature), with no “in-between”. For example, the speculative story concerning a long process of abiogenesis (a-biotic evolution), allegedly stretching over millions of years and aimed at accounting for the emergence of the first truly living entity (in reified mode referred to as the “origin of life”), actually camouflages the critical point of embarrassment underlying the entire argument. At

every moment of this on-going process, one can ask the meaningful and decisive question: is the “developing” constellation alive or non-living? Obviously, the answer can only be an affirmation or denial. Nonetheless, the truly critical point is condensed into that unique, abrupt moment in which the transition is assumed to take place: at the previous moment, the constellation is non-living, and at the next moment, it is alive. The millions of years are irrelevant – what is required is an account of that decisive abrupt moment. A possible escape route is to take recourse to a physicalistic view that asserts that living entities are “nothing but” a complex interaction of physical-chemical elements and processes. Yet, as soon as this view is advanced, the ‘problem’ evaporates, for then the “non-living” constellation was an interacting physical-chemical system all along, i.e. already ‘alive’! It reminds one of the way in which Simpson ‘explains’ large gaps in the paleontological record by claiming that if we really recovered all the intermediate forms, it would be clear that there are no gaps. Thus, instead of explaining the gaps, he simply *denies* that they exist (see Simpson, 1961:359 ff.).

What used to be known as a ‘kingdom’ (and later, in terms of inclusive language, as a ‘realm’) is directed at the scope of a category of entities conforming to a general *type law*. To the extent in which modern biology (and related disciplines, such as genetics, biochemistry and biophysics) explores the micro-dimensions of living entities, the traditional and familiar classification merely distinguishing between things, plants and animals appears to be unsatisfactory. For example, a group of *Amoeboid* animals, the *Acrasiales* (the sole order within the class of cellular slime molds known as *Acrasieae*), were previously classified as plants. Conversely, the *Euglenoids*, usually classified as plants, are considered to be (protozoan) animals by other zoologists. There are also living entities (amongst unicellular flagellates) that display features normally differentiating plants and animals. Chlorophyll, usually a characteristic of plants, is found in *Euglena* (one-celled living entities). Yet, at the same time they move and absorb food like animals.

It seems as if one way out of this problem is to introduce a more refined classification of realms (‘kingdoms’). The following five ‘kingdoms’ feature in this regard: “*Monera* (bacteria, blue-green algae); *Protista* (protozoa, chrysophytes); *Fungi* (slime molds, true fungi); *Plantae* (algae and higher plants); and *Animalia* (multicellular animals)” (see Bock, 1989:102). Currently, regarding the most basic levels of living entities, preference is given to the distinction between *Prokaryotes* and *Eukaryotes*. The former are living entities without a nucleus, mostly

unicellular and lacking organelles bound by membranes, whereas *Eukaryotes*, that can be uni- or multicellular, have a well-defined nucleus (owing to an embracing membrane) and a large number of sub-cellular organelles.

Plant cells are identified by their direct use of light energy or owing to the fact that they are parts of a living entity using light energy. They have a cell wall (of cellulose – absent in the case of *Animals*, *Fungi* and *Protists*), and within their green parts, they have plastids (particularly chloroplasts). As an alternative to a two-domain classification, Carl Woese proposes a three-domain system: *Eukaryota*, *Bacteria*, and *Archaea*.

However, investigating these distinctions soon makes it clear that, in terms of modal functions, the basic range of categories (classifications) pertain to living entities actively (subjectively) functioning (in addition to the aspects of number, space, movement, and the physical) within the biotic aspect. Only animals and humans, as sentient creatures, also subjectively function within the sensory mode.

In the absence of a clear distinction between modal functions and concretely existing (and functioning) entities, modern biology does not have a univocal idea of a realm ('kingdom') at its disposal. For this reason, it proceeds in respect of living things by ultimately making classifications merely *within* the context of biotically qualified entities! This explains why comparisons and distinctions on this level remain bound to vital (i.e. biotic) functions of living things without ever referring to the *modal meaning* of what is structurally presupposed, namely the biotic function of reality. Instead, one reads about structural comparisons (always with presupposed similarities in the background). For example, in spite of the absence of a well-defined nucleus, *Prokaryotic* DNA basically functions in the same way as *Eukaryotic* DNA. Modal properties only surface with respect to the aspects of number and space – counting sub-cellular organelles, noting differences in size and so on. But without alternative qualifying functions, the assumed biotic domains (realms/'kingdoms') simply do not transcend the scope of living things (biotic things).

Stafleu attempts to justify the current classification by distinguishing between alternative foundational functions ("secondary characteristics") – such as the arithmetical (*Prokaryotes*), the spatial (*Eukaryotes*, colonies and tissues), and the kinetic (differentiated organisms) (Stafleu, 2002:186-188). Yet even these distinctions do not transcend the qualifying role of the biotic aspect, and at most may serve to arrive at sub-categories (genotypes rather than radical types) within the realm of biotically qualified entities.

His emphasis on the modal universality of the irreversible biotic time order of fertilization (conception), germination, growth, reproduction, ageing and death (Stafleu, 2002:173), simply underscores the uniform scope of the biotically qualified realm of living entities. Within the micro-dimensions, we merely encounter living entities displaying either plant-like (biotically qualified) or animal-like (sensorily qualified) features. The inability of current biological scholarship to clearly distinguish between biotically qualified features and sensory features – underlying the distinction between the realms of plants and animals, appears primarily to testify to our lack of criteria and not to the basic and limited options provided by two irreducible modal functions available for serving as qualifying functions of distinct realms of entities – plants and animals.

5. An alternative view

While nominalism proceeds from the assumption of a structureless continuum (each organism is wholly unique and cannot be forced into some or other universal ontic form), idealistic morphology accepts “primal types” (e.g. a primal leaf, a primal plant, or a primal animal) which serve as genuine platonic models with reference to which any empirically observed living thing or fossil has to be judged.

The idea of a type law that holds, as a typical total structure, as the law for the entities subject to it, represents a structural theory that aims at overcoming the one-sidedness in both a realistic (idealistic) and nominalistic approach. The structureless continuity of a nominalistic view simply does not allow for relatively constant structural types. Just as a modal-physical law cannot be identified with any subject function or concrete subject, the structural types of plants and animals cannot be identified with particular concrete plants or animals. However, entity structures are types that are embedded in the cosmic dimension of time, still finding their correlate in the succession of transient individual living creatures that appear on the paleontological horizon during the course of the earth’s history. The psychic-sensitive qualifying function of animals is expressed in their total life orientation. As mentioned, Portmann typifies animals aptly when he says that they are instinctually-secured and milieu-bound (Portmann, 1990:79).

The relational problem regarding the coherence between the physical constituents and the living organism of a living entity obtains a new context when it is positioned within the scope of Dooyeweerd’s theory of enkaptic interlacements. The physical-chemical “structuredness” of the constitutive physical components of living things is foundational for their

enkaptic (i.e. biotically directed) functions.⁹ When this perspective is accepted, the task of organic chemistry can be seen to be foundational for biochemistry in a similar way. Biochemistry ought to focus on the disclosed enkaptic functions of the material structures that are investigated by organic chemistry. This foundational relationship confirms the close interweaving of the structure and functions of the physical constituents of living things. Today it is virtually universal that biochemists do not restrict themselves to an analysis and study of the biotically directed functions of macromolecular material structures, for they are mainly concerned with the structural configuration of these constituents themselves.

Within the context of the ordered (centered) structure of the cell, we find – seen from a biotic angle – the different organs (organelles) of the cell that are parts of a living whole. Because the cell embraces non-living material ingredients as well as the organic functioning present within it, we cannot simply say that these organelles are parts of the cell. In order to explain the vital biotic functions occurring within the cell, the term cell-organism is preferable. In other words, the different organs in the cell are all parts of the cell-organism. But since the different organelles in the cell have their foundation in the physical-chemical constituents, the totality structure of the cell embraces both the living cell-organism and the non-living material constituents present within the cell. This is an example of a unilateral enkaptic foundational relationship.

Consequently, the cell organism is a specific biotically qualified layer that can only exist on the basis of enkaptically bound physical-chemical constituents. Because these physical-chemical entities are not biotically qualified, but still function in the living cell, we are obliged to make a threefold distinction in order to give an account of the complex interlacement found in the structure of the living cell. Firstly, there are the physical-chemically qualified constituents that as such represent enkaptic structural wholes. Secondly, we find the cell's living organism that is biotically qualified and that can only function on the basis of the enkaptically bound building material. Thirdly, we find the cell body as encompassing whole which enkaptically embraces both above-mentioned parts. We need the distinction between concept and idea in order to explain the apparent ambiguity in this context.

The idea of enkapsis is used as a substitute for the whole-parts relationship, but we still refer to *part* structures! Within the framework of

9 The term *enkapsis* intends to account for interlacements in which what is intertwined maintain their internal sphere of operation.

the theory of enkaptic interlacements, the spatial whole-parts relation is no longer employed in a conceptual sense, but in the sense of an idea usage, referring beyond the limits of the spatial aspect to the structural integrity of enkaptically interwoven entities. Without a concept-transcending use of modal spatial terms, the idea of an enkaptic structural whole cannot be explained in a non-contradictory way (cf. also Zylstra, 1992:126 ff.).

At the same time the basic claims of a non-reductionist ontology succeeds in giving a satisfactory account of the unbridgeable gap between the non-living and the living, without being trapped in the fantasies of (Neo-)Darwinian speculations without any foothold in the current state of affairs.

It is actually sad to see that in spite of the total lack of any sound account of the assumed origination of the first living entity Neo-Darwinists still firmly hold on to their ultimate (pre-scientific) *faith* in a transition fully lacking any scientific basis – reminding us of the (above-mentioned) modesty of the Neo-Darwinist scholar (co-responsible for the *New Synthesis*), John, Burdon, Sanderson Haldane, who said: “Evolution’s not the problem. Life is.”

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