Koo van der Wal, *The Symphony of Nature. Outline of a Contemporary Natural Philosophy.* Summary

The universe is not only stranger than we imagine, it is stranger than we can imagine. (Sir Arthur Eddington)

Natural science without philosophy is lame, philosophy without natural science is blind. (With a nod to Albert Einstein, *Science, Philosophy and Religion*, A Symposium (1941) )

The gravity of the current ecological crisis is beginning to penetrate ever wider circles. Yet it is still commonly thought that it can be met successfully with the help of appropriate technological measures and economic stimuli. The problems of the environment, then, are seen as a sort of industrial accident of modern society, a situation that has unhappily gotten out of hand, without much being said about the existing order as such. Whereas, it reveals itself ever more clearly as a structural malfunction of the social order itself, in which, to put it another way, it is preprogrammed. This is evident from the inability to get a truly effective environmental policy off the ground. This with an eye, not to such fruits comparatively within reach as the reduction of levels of air and surface water pollution, but such less accessible ones as addressing global warming, decreasing biodiversity, or the exhaustion of raw materials. That current therapies fail to take effect indicates the diagnosis behind them is incorrect.

One of the starting-points of this book is that the dominant idea of nature by which modern society orientates itself is a substantial factor in our vexed relationship with nature. Human activity is, after all, determined to no insignificant extent by how we look at things or by the 'symbolic universe' we work with. That is true of our individual activities, but especially of our collective attitudes and behavior. And our interactions with our natural surroundings – which, as indicated, are closely connected with modern ways of life and thought in general – are no exception.

The way of looking at nature which prevailed in the western world in early modern times is the so-called 'mechanical' or 'Newtonian' worldview. It is an image of a universe totally inanimate, a nature consisting solely of 'dead' things, with no interior dimension, feelings, perception, or aspiration of their own, totally passive, in which something only happens as a result of forces working from outside on the material particles which form the elementary building blocks of nature. Human beings can no longer from their self-experience as conscious, thinking, feeling, willing beings feel themselves akin to such a nature. To (early) modern perception, they are the only active, creative, innovative beings opening up new horizons in an inanimate, inert nature. They are, in other words, strangers in this nature (and so the French biochemist and Nobel Prize winner, Jacques Monod, has said 'man is a zigeuner on the edge of the universe'). We are, to put it another way, of an entirely different order than non-human existence, which Descartes aptly formulated in terms of the dualism of spirit and nature, with thought and extension as their respective basic characteristics.

This 'disenchanted' nature is further a reality without any value, sense, meaning or goal of its own. In this modern conceptual framework, only the human as conscious and rational being has an inherent value or dignity and is on the basis of these qualities the source of attribution of all other value. Because they are characterized by no consciousness or aspiration of their own, natural things elicit only a humanly attributed value or 'price'. Meaning is also something which can only be given by human beings and is inherently alien to nature. And because natural things know no aspirations of

their own (which are always directed to an end), natural process knows no goal. The elimination of teleology from the modern view of nature and the thesis of the absurdity of natural reality, which already begins to glimmer through with Pascal and gradually emerges into the light of day with ever less disguise to reach its culmination in the existential philosophy of Sartre and Camus, are consequences which were ever present in the 'Newtonian' perception of nature.

Perhaps the turn from the pre-modern 'mythic' to the modern perception of reality can most economically be characterized as the uncoupling of reality and ideality. In the pre-modern perspective, the reality subject to experience pointed to an underlying ideal dimension. Or, again, everything has symbolic value, and so this way of regarding reality is also described as 'symbolistic'. In the modern approach, things no longer point to an ideal dimension (which at the same time makes them a reality rich in meaning). The things are now just what they are, pure facticity without referential value. It is on this account, too, that, as we noted, in and of themselves they possess no 'inherent' value – this distinction of fact and value is part of the modern way of seeing things.

This vision of things – and that is our concern here – has far-reaching consequences for modern ways of interacting with nature. The picture of a nature of dead, blind, inert things, without interiority and activity of their own, as this has strongly marked the thought and conduct of modern culture since the rise of early modern physics and philosophy (Galileo, Newton, Descartes, et al.), has in this way become an important factor in the disturbance of our relationship with nature. For, seen through the lenses of the 'Newtonian' or 'mechanized' worldview, nature was reduced from a living web of fellow-creatures to an inventory of useful resources which human beings can exploit as they best see fit. That is to say, there can only be a truly sustainable relationship with nature if we orientate ourselves, not only in our individual, but especially in our collective activities, according to another image of nature.

Now, it is a surprising turn of events that in the natural and life sciences of the past four or five decades there are fascinating developments taking place that open entirely new windows on nature – developments which, incidentally, have been prepared for in various ways. A good approach to this new perspective on nature which is unfolding here, is offered by general systems theory. A system is a structure of interdependent components which is characterized by a shared form of organization and manner of functioning. A system is thus by definition more than the sum of its parts on account of the fact that the ways of behaving and of being of those parts are determined by their place and function in the whole. That is the case with artificial systems, such as an automobile engine in which the parts have been designed based on the idea and function of the engine as a whole: the propulsion of the vehicle.

But natural entities can also be considered systems in the sense defined, with, as exemplary case, an organism which consists of a multiplicity of component systems (genes, cells, tissues, organs, the hormonal system, etc.). All these component systems of the organism are, as far as both their form and their manner of functioning are concerned, only intelligible when seen from the whole. A system is anything but an aggregate, where the whole is indeed no more than the sum of its parts and comprehensible on the basis of the parts that make it up ('seen from bottom up'). In a system, by contrast, the parts are mutually dependent upon each other but furthermore upon the organizational pattern of the whole. Systems therefore require a relational and holistic way of considering them: 'from top down'.

Now, it appears inescapable that most, if not all, natural phenomena have the characteristics of systems. Consequently, their properties are closely bound up with the way in which they are

organized. These properties are, in short, not so much characteristics of the component parts as of the system as a whole ('systematic properties').

A multiplicity of types of systems exist, accompanied by their various sorts of properties. There are open and closed systems, respectively with and without external interactions with their environment. One further distinguishes stable and unstable systems, existing respectively in a state of equilibrium or more or less far from such a state. Systems can have a static or a dynamically developing order. They can be distinguished as those in which the processes are reversible and those characterized by an irreversible developmental direction or 'arrow of time'. A further important distinction is that between linear and nonlinear systems. The first are characterized by a proportional relationship between 'input' and 'output', cause and effect. In other words: small cause, small effect; large cause, large effect. The processes transpire here along gradual lines, without alterations or gaps. Nonlinear systems, by contrast, are characterized by a disproportional relationship between cause and effect. For example, they possess a buffer capacity for disturbances, by which these can be absorbed for a certain time, and so escape detection. If, however, a limit of what it can bear is crossed, then something slight can make the system abruptly behave in an entirely divergent fashion or collapse altogether. Nonlinear systems are in this way characterized by critical thresholds or breakpoints whereupon they begin to exhibit a more or less strongly divergent behavior. Last but not least, systems exhibit widely different degrees of complexity.

Advances in the natural and life sciences have now made it seem likely that the open, nonlinear, complexly organized non-stable system is the 'normal case' in nature. That is to say, that it is highly unlikely that in reality any completely closed, stable, reversible, systems characterized by a perfect equilibrium exist, except as an idealized situation. But the early modern physics of Galileo and Newton, that formed the source of inspiration for the mechanized image of nature, are characterized by a closed, stable, linear, etc. model. In this way, that physical paradigm thinks of (the whole of) nature in terms of what turns out to be something peripheral.

Here, an image of nature begins to emerge as scarcely a realm of passivity (where all activity and order comes from outside), of uniformity, static order, etc., but revealing itself to be dynamic, multiform, richly varied, even creative. And it appears, as we shall consider, to possess the capacity for self-organization or self-ordering. Forms of teleological thinking even begin to enter anew the way of looking at nature.

As has been said, a system is substantially determined by its pattern of organization (its configuration, structure, or form). This determines in its turn the properties of the system and its way of behaving. So, atomic structure determines chemical property, and atoms can, for example, on the basis of similar structural characteristics be ordered in groups with analogous properties, as is the case with the periodical table of elements. Molecules, as configurations of atoms, possess, in comparison with those atoms, entirely new properties. For example, on the molecular level the phenomenon of chirality (from the Greek for 'hand', 'cheir') appears, their right- or left-handedness or formation of mirror images, a property that does not occur on the atomic level. In molecules the component atoms can be ordered spatially in mirror images and consequently possess different physical properties (as is the case with sugars with laevo- and dextro-rotary forms). In this case of what is called stereoisomerism, the chemical composition of the molecules is the same, while their physical characteristics differ in one or more respects, in relation to their spatial orientation. These properties cannot be reduced to those of the component atoms, but are a matter of the way in which they are ordered according to a given pattern.

What becomes apparent here is the fact that nature exhibits a series of levels of ascending structural complexity. In other words, a picture of nature as a system of systems with an increasingly higher degree of organization and order. Here, an old conception of reality comes into view in a new way, that of a 'Great Chain of Being', a chain of forms of being with ever new properties. That leads to the thesis that the organizational pattern of things can be regarded as a basic characteristic of reality.

In line with this, the variety of configurations can be held to account for the multiplicity of natural phenomena and their quite distinct properties and ways of behaving. This has a number of implications.

First, the variety of patterns of organization just mentioned with their accompanying properties means that nature consists of a ladder of forms of being that differ qualitatively and are *not reducible to each other*. In contrast to the adage of classical physics, '*Natura saltus non facit'*, 'nature does not make jumps', it does that all the time. There is no continuity, but discontinuity, between the levels of complexity and organization. At the crossing of certain threshold values of complex organization, 'emergent' new sorts of entities with new properties appear, which cannot be derived from the properties of phenomena of the immediately preceding level. But that means that there is not one sort of phenomena, as is *de facto* the case in the Newtonian universe. If, however, not everything is of the same sort, the reductionism or strategy of wanting to understand higher-order phenomena by reducing them to phenomena of lower order, is a radically inadequate approach. In other words, the new image of nature is antireductionist in principle.

Second, and immediately connected with what has just been said, it does not make so much sense, thinking in terms of complex systems and their constituent configurations, to search for the ultimate 'building blocks' of matter and of natural phenomena in general ('box of blocks- ' or 'Lego-thinking'), in any case, not in order to understand higher-order phenomena and processes with their help. After all, it is not things or elementary 'building blocks' which determine systems, but on the contrary structures which determine things, which however are no longer things in the everyday sense, but sooner the nodes in a web of relations.

But, as third implication, if there is not only one sort of facts and processes that are in fact rearrangements of elementary 'building blocks', if, to put it another way, not everything is 'more of the same' (as is the case in the Newtonian universe), then the new, unexpected, and unpredictable is a basic characteristic of the new image of nature. And if, further, not all events are of the same sort, then the same regularities do not apply on all levels, either. It is true that the higher levels repose upon the lower, and the regularities of the lower level continue to work on the higher (for example, the laws of physics and chemistry apply to organisms, too). But they are insufficient adequately to account for the new properties and behaviors that go together with the new patterns of organization. The higher-order systems take up the phenomena of lower levels in new relationships and direct their functioning from within higher principles of organization. To put it another way, the regularities of the lower level are 'over-formed' by those of the higher. Thus, causality does not have only one aspect, that of the more basic level, but various. Or: nature knows a hierarchy of forms of causality in which the higher comprehend the lower.

But, if the processes of lower order within systems with a higher degree of organization are directed by the regularities of that higher level, then it makes sense in many contexts to consider the functioning of the lower-order processes in the light of that higher level. There is in this way not only a causality from 'bottom up', but at least as importantly a 'downward causation', too, as is well illustrated by what is called 'multi-level systems biology'.

In the same way, systems on various levels of organization have their own times and rhythms. We know the 'chemical clock' where processes exhibit their own specific oscillating changes in time (for example, the well-known Belousov–Zhabotinsky reaction). These 'times and rhythms of their own' go together with the organizational forms of the systems concerned, or with their self-organizing capacities. In an analogous way, organisms have their own times and rhythms, too, a built-in 'biological clock'. And, on the social level, economic systems seem to have their specific times and rhythms as well.

These more general insights with respect to a new natural philosophy are then worked out further in the book where the phenomena of life, consciousness, and ecological systems are concerned. Life is in the perspective assumed here a completely natural phenomenon, in contrast to the situation in the Newtonian picture of nature, where it is an exceptional phenomenon in the midst of a reality of lifeless things to which the attempt is constantly made to trace and reduce it. Life, then, can be seen as an emergent phenomenon that appear when a critical threshold of complex organization is crossed with respect to highly complex proteins. An organism is distinctly a manifestation of an open, complex, nonlinear, non-stable system. Characteristic of organic being is that organisms are *metabolic* systems (with an etymological accent on 'change' and 'exchange'), that they are in a permanent relationship of interchange with the world outside them, that there is a constant in- and efflux of material taking place. The stuff, an ever-changing stuff of life, is merely the material *whereupon* life realizes itself. In other words, life is an active process that sustains itself by an unremitting interchange of and from that substratum. In short, the identity of an organism is that of a form the continuity of which must be ever actively realized anew. Thus, self-organization is here, too (and, indeed, here pre-eminently) a key to understanding the phenomenon, life.

That means that, as has already been said, an organism has its own temporal mode (the 'biological clock'), as well as its own form of causality, whereby physical and chemical processes are taken up into a new relation via 'downward causation'. That life is a self-organizing phenomenon has, not in the last place, implications for the understanding of evolution. While, in the vision of Darwin and the neodarwinians, evolution is a matter of mutations having taken place by chance then being sifted by natural selection – life, in other words, *coming to be* adapted to the surroundings (a still entirely mechanistic way of looking at things) – in the vision of evolution being defended here, it is a matter of life actively organizing itself *and the surroundings*, whereby natural selection only plays a rôle in the second instance.

Immediately together with this fact that life obeys internal principles of order of its own hangs the fact that with life a dimension of interiority and subjectivity appears on the world stage. In other words, it has an inside, which is expressed, among other things, in the capacity for experience, self-expression, enjoyment of play, etc. No less characteristic of life is that all forms of life inhabit a world of significances of which they take advantage. For these reasons they can, to varying degrees, be regarded as subjects of behavior and not merely as objects which passively undergo the influences of their surroundings.

Consciousness, too, is an emergent phenomenon in the ways of looking at thing for which a case is made here, namely, where more complexly organized organisms are concerned, in particular those with a central nervous system. And it is also the case with consciousness that (to a greater or lesser extent) it can direct lower-order processes in the organism by way of 'downward causation'. This offers a basis for a defence of some form of freedom of the will. And, because consciousness, c.q., the mental and psychological, is a system-characteristic of integral aspect of an organism structured and

organized in a certain way, this leads to a non-dualistic conception of the interrelationship of 'soul' and 'body'.

If, however, consciousness, c.q. the mental, is an emergent phenomenon of nature, if mind as much as life is given in the natural reality and no phenomenon alien to nature (as it must be in the mechanized image of the world), then – a very important implication – this means that human beings with all their qualities can be a part of nature, certainly in their own very specific way, but that is equally true of all natural phenomena.

After this first exposition of the new image of nature delineating itself here, follow, in a second round, a number of observations adding to its depth. There, fundamental characteristics of the new perspective on nature are subjected to a closer inspection, such things as self-organization, emergence, order from chaos, types of causality (among others, Popper's theory of propensity), forms of finality, the tension-rich relationship between dynamism and stability in nature, the context-bound condition of all phenomena, even the laws of nature, the rôle of symmetry breaking in the coming to be of patterns, etc.

In the context of the image of nature sketched here, the concept of the intrinsic worth of natural entities can be given a new content (which, as has been said, cannot be accommodated within the Newtonian image of nature). If we accept that an extraordinary worth and deservedness of protection are characteristic of persons on the grounds of such qualities as consciousness, self-awareness, sensitivity to suffering, the possession of a world of experience of their own, the capacity for purposeful creative activity with a goal in sight, in the perspective defended here, these are no characteristics that are unique to being human. But they can be found in nature over a broad front, most clearly, of course, where higher animals such as anthropoid apes, elephants, dolphins, etc., are concerned, which have self-consciousness, higher emotions, language, forms of subtle intelligence, and such like. But we find interiority, subjectivity, experience, and forms of intelligence in various gradations on lower levels of life. In all these cases we can speak in terms of 'a good of their own' that makes them (again, in gradations) worthy of respect and protection.

In following chapters, the social reality is considered from the perspective of the image of nature sketched here and a number of related epistemological questions discussed. In this way a plausible case is made for it being illuminating to consider what goes on in society in the light of that image of nature: this reality, too, has a process character, there, too, we find the principle of self-organization, and new forms of social order are emergent from chaos, and, for example, information appears as a self-enriching process.

The new concept of nature also leads to interesting questions with respect to epistemology. If nature is a system insusceptible of isolation which is always bringing forth new forms of order, then a 'theory of everything', something still aspired to by prominent scientists and scholars, is an impossible undertaking. We know only, to speak with David Bohm, the "unfolded order" of reality, not the "enfolded order" with all its potentialities. Further: if human intelligence is a product of nature as answer to the challenges of the situation here on earth, then the consequence is, that it is only suited to a limited extent to phenomena that lie outside the 'band width' of our powers of imagination (concerning which, see the motto above with a nod to Haldane, in a form often attributed to Eddington). That leads to a considerable degree of modesty with respect to the scope of human thought.

In conclusion: the book here presented distinguishes in human intellectual and cultural history three images of nature or reality, seen ideal-typically, to wit, the pre-modern-mythic, the classic-modern

'Newtonian', and the post-classical image of nature currently delineating itself. As, in the words of the Dutch historian, Jan Romein, modern culture is the great exception in the landscape of cultures, so is its accompanying classic-modern image of nature in the midst of ways of considering nature.

The post-classical image of nature proposed here resumes a number of motifs from the pre-modern one, rehabilitating them in this way. Here, one can think of the self-ordering and active-dynamic character of nature, of such phenomena as life, consciousness, subjectivity, and meaning, which are inscribed in natural reality as such. One may further think of the idea of 'the Great Chain of Being', or '*scala naturae'*, and yet further of the idea that natural reality is embroidered on a mathematical canvas (but not that of static mathematics à la Euclid, but of conceptually flexible mathematics corresponding to a dynamic universe), or, again, of the idea that beauty as much as intelligibility is an objective characteristic of reality. Or, indeed, of the idea of an ideal dimension of reality, by which the classic-modern uncoupling of reality and ideality is at least partially reversed.

For, this rehabilitation can only be a partial one. With and in modern culture we have passed through the Enlightenment, which properly effected a number of corrections to the naïve, all-too-human pre-modern understanding of reality. At the same time, with the development of a new perspective on nature, the realization dawns ever more strongly that the flat, uniform, Newtonian image of reality, devoid of transcendence, left us with a constricted and impoverished image of reality and self. We come to be ever more strongly aware that we live in a rich and deep universe with a variety of dimensions, which are, however, not all accessible in the same degree. About the dimension(s) beyond, can only be spoken, if at all, by means of symbols, figures, and parables.

Someone who was deeply aware that reality ultimately has a symbolic or parabolic character, was Goethe, but we find the same conviction shared by many philosophers and scientists such as Jaspers, Einstein, Heisenberg, and Dürr, among others. For this reason, the book closes with a poem by Goethe, which ends with the words, "Zum Erstaunen bin ich da." I am here to be astonished. But was not wonderment or astonishment the source of all philosophy and science according to Plato and Aristotle? Nature, at any rate, gives us every occasion for it.