

Science Group of the Anthroposophical Society in Great Britain

Newsletter – September 2010

Contents

Comment: <i>On being fearful of mathematical inexactitude</i>1
Article: <i>Darwin – A Darwinistic Consideration</i>3
Reviews:
<i>On the Fundamentals of Geometry</i> , Lou de Boer.....4
<i>Metamorphosis: Evolution in Action</i> , Andreas Suchan- tke.....5
Publications.....7
Membership/Next issue.....8

Comment

On being fearful of mathematical inexactitude

I write with some trepidation to comment on Lou de Boer's review of Malcolm Stewart's book *Patterns of Eternity* as I'm not a mathematician like him. I attended a lecture by Malcolm a few years back and was keen to see his book. He considers the geometry and number in the Starcut pattern, a square or rectangle with diagonals and lines between side mid-points and corners drawn in. I found it thought provoking and well worth reading. The author makes clear it concerns his personal discovery of geometry and number – by someone who fears advanced mathematics. It is not a definitive thesis, but Lou subjects it to a critique as if it is. Lou has written a mathematical thesis – *On the Fundamentals of Geometry* [see Review p. 4, *Ed*]. It is axiomatic, logical and exact, which is the standpoint from which Lou comments on *Patterns of Eternity*. In particular he questions the significance of the Starcut patterns, why the author makes so much of the ubiquitous occurrence of pi in 3-4-5 triangles and the use of 22/7 to relate diameter and circumference of a circle, which pi does.

On the significance of the Starcut, Lou suggests its ability to generate integer ratios that are irrational numbers is 'only natural', something he considers to be a matter of elementary Euclidean geometry. He says 'every rational length can be constructed in a very simple way' through Euclidean dimensional subdivision of lengths into 'equal distances'.

But there's more to the pattern than being a Euclidean construct: in 1946 Hans Kayser described the Teilungskanon – his context for considering the Starcut pattern – in a booklet entitled *Ein Harmonikalen Teilungs-kanon* (not mentioned by Malcolm Stewart). Though he was into harmonics not mathematics as such, he could see that it arose fundamentally in projective geometry, he drew diagrams showing the special case of a four-point with determining points taken to infinity. Hans Kayser referenced Louis Locher-Ernst but didn't discuss the significance of the pattern in terms of projective geometry.

I meditated on the Teilungskanon/Starcut and realized – obviously to a mathematician – that the proportions it throws up arise from projective transformation. Take determining points of a four-point to infinity, to give a rectangle. Draw a growth measure using a corner and mid-point of the rectangle or using other points created by intersecting bisectors and diagonals. Measures set up include exact integer ratios 1/2, 1/3, 1/4 ... etc. That's neat! It doesn't need Euclidean considerations to generate the ratios – its projective transformation. What do people mean when they say projective geometry isn't metrical?

Particular determining points are used in a transformation to get exact integer ratios of 'length' between points, without measuring. Only the mid-point of sides need to be determined to create the Starcut and, taken with corner points, commence transformations.

Lou castigates the author for discussing an 'elementary fact' that a circle of unit one radius lies in a 3-4-5 triangle, relating it to pi. Lou says critically that pi can't be found in the ratios of the Starcut. That's unfair criticism! The book doesn't say it can. That the book describes how 3,4,5 triangles are found in the Starcut pattern seems to be a valid point of interest. Many examples are given of related circles, for instance pi, 4pi, 9pi and 16pi circles can be found (p. 166). What is Lou's criticism? That this is trivial? It seems Lou doesn't think description and discussion of unusual geometry is worthwhile – only axiomatic argument is valid.

Lou takes issue with the author, citing more 'nonsense', for taking the 'value' of pi as 22/7 to 'solve' a problem. Not so long ago people were able to utilize integer approximations to irrational numbers to achieve exactitude. Malcolm Stewart refers to Egyptian use of pi in the length of a measuring stick and in the diameter of a wheel that rolled out length accurately (p. 69). His account is minimal and hardly convincing. John Neal in his book about metrology, entitled *All Done with Mirrors*, explains how an odometer attributed to Vitruvius worked. The wheel was used to measure distance.

John Neal considers the basis of foot measures that traditionally vary 'in length' throughout the world and suggests they are related to the geoid (pear-shaped) earth form and its varying radius. Investigators and archaeologists find different measures in use worldwide. It seems everywhere has a set of measures related to a basic foot. In the early twentieth century people had given up trying to explain this, since when the science of metrology has been pretty moribund.

In his investigations John Neal compares decimal dimensions of measures found by investigators to find possible integer relations more easily. He finds measures related with particular integer proportions that can be used to deal with irrational pi.

Vitruvius' odometer was described as having a wheel four foot in radius and twelve and a half feet in perimeter, which appears to be a 3.125 pi ratio. 400 revolutions give a 5000 foot mile with a discrepancy of 28 feet. 'But if the shorter Roman foot of 0.96768ft is taken as the wheel radius and the longer Roman foot of 0.973209ft is regarded as the perimeter, the calculation of the mile is perfectly accurate in terms of the longer measure. This is because the 22/7 value of pi has been decreased by the same ratio that the value of the foot used to calculate the perimeter has been increased' (*All Done with Mirrors* p. 69). The Romans, as did everyone else until standardization, had a family of foot measures at their disposal. They enabled irrational pi to be handled and, presumably, much else.

How were ancient 'measures' determined? Maybe they are the outcome of intuitive association with the form of things, particularly the earth; some sort of intuitive projective transformation. They vary, they aren't standard; they arise from a particular association in a place, for particular purposes. Malcolm Stewart gives an interesting description of the layout of fire altars in relation to the Starcut/Teilungskanon pattern and the measures it provides. Presumably the layout aids ritual activity.

Malcolm Stewart argues that a system of number is self-generated by the diagram (p. 165). If integer proportions of straight lines within the Starcut basically arise from projective transformations then so does the number system, something I find interesting.

When I looked at *On the Fundamentals of Geometry* I stalled in the preface where Lou writes: 'This book is written for mathematicians, philosophers and theoretical physicists who want a sound fundamental for geometry'. The mathematics is a specialism not suitable for everyone. A reader 'should have a basic knowledge of algebra and linear algebra: any undergraduate courses should be sufficient'. That's saying the likes of me shouldn't try and read it. However I read on to try and grasp what it was about. I found the following in the first section: *What is geometry?*

In ancient times, geometry was the study of physical space.

It was used to predict the positions of the stars, to demarcate pieces of land, and to build houses and temples. It was concerned with points, lines, planes etc.

This is a modern materialistic viewpoint. Surely ancient constructs were devised to facilitate spiritual activity, natural growth and change, in ways we hardly appreciate, before times when materialist needs dominated. Traditional layouts of old churches with their similarities to ancient built forms retain some ancient principles.

Long before the Pythagoreans studied right integer triangles they appear in ancient constructs. The centre of Stonehenge has four stones in a rectangular 5,12,13 layout. At this latitude midsummer sunrise and sunset are aligned in directions at right angles to the most northerly and southerly moonsets, as designated by the sides of the rectangle; see *Sun, Moon and Stonehenge* by Robin Heath. Robin Heath also describes how at Carnac in Brittany stones, at Le Manio are laid out with respect to right integer triangles, see www.astro-archaeology.org. At this latitude a stone alignment in an east-west direction lies along the hypotenuse of a 3,4,5 triangle. The alignment from a stone at the right angle corner is directed to the midsummer solstice sunrise. Other stones in the complex are laid out in right integer triangles to give an alignment to midwinter solstice sunrise. Other right integer triangles give 'lunation triangles' identified by Robin Heath as integrating solar and lunar cycles calendrically.

Was such geometry incorporated to predict alignment or did it arise from experience of subtle resonance? People knew where the solstice sunrise was before they erected the stones – so why set up alignments? The site was chosen to enable integer 3,4,5 resonance that occurs there.

Arguably, the ancients experienced places and their alignments etherically, sensually, and wished to utilize the influences. They didn't calculate directions or layouts. They experienced resonant etheric qualities and could accentuate and exploit them with built form laid out in integer relationships. Geometry arose from intuitive experience of etheric resonance in space. It's a construct of the mind. Measures were experienced sensually and used to determine proportions of built form. Later standard, Euclidean, measures were devised and used to meet a need to build to standards.

Lou pursues a materialistic objective in *On the Fundamentals of Geometry*: '... an important question still is: which concrete geometrical space best fits our physical space?' How can such exactitude be squared with experience of geometry and number in the cosmos? The recently published *Signature of the Celestial Spheres* by Hartmut Warm, an English translation of the German original by Rudolf Steiner Press, describes how nothing is exact, though the ideal forms created with link lines connecting locations of selected cosmic events, conjunctions

or whatever, appear as approximations to the relative motions of cosmic bodies. The sophistication of patterns and their number are amazing. Yet Hartmut Warm portrays cosmic geometrical order approximately, it is not exact.

The word fundamental in Lou's book title is contentious. What does it mean? He castigates Malcolm Stewart for saying 'the vesica piscis is the root/womb of all geometry' and asks 'how about incidence or cross ratio?' The term cross ratio doesn't appear in Lou's book, the word 'incidence' is discussed in an introductory section (p. 4), and not used, 'containing' being preferred. Why criticize Malcolm Stewart for using the vesica piscis as a starting point for his geometry, sacred geometry, which is just as valid as choosing axioms?

Lou states: 'Projective geometry is more fundamental than other geometries that can be derived from it' (p. 4). He also points out 'there is no reason to prefer one [set of consistent axioms] over another. In fact the word 'prefer' has no formal mathematical meaning' (p. 4). That means geometry involving choice, a living facility, can't be described mathematically! Lou sets out to present 'a new system of axioms from which geometry can be developed' (p. 2). His systematic algebraic approach, involving reasoning in terms of equality (= sign), concerns exactitude only. What is the point of a geometry that is intended to be systematic and exact when the living physical world is not exact?

Nature cannot be described exactly, whether it be physical form or irrational constants like pi. Somehow a living thing can change its associations intuitively and create different outcomes and use them to determine physical growth and change. Living experience is most basic, reasoning follows as an option.

Is an axiomatic exact approach to mathematics and geometry the fundamental way forward? Surely not, experience of geometry is more basic. Rudolf Steiner's experience of the point having dual aspects wasn't discerned rationally.

The e-book *On the Fundamentals of Geometry* offers a limited axiomatic and algebraic viewpoint and is intended to be inaccessible to most people. The book *Patterns of Eternity* is accessible to all and I got a lot out of it. Thank you Malcolm Stewart and Floris Books for publishing a book that considers geometry and its symbolism in relation to the natural world, which cannot be described in terms of exact dimensions. It addresses the need for a fundamental conceptualization of geometry and number that is accessible to all.

Pat Toms

Article

Darwin – A Darwinistic Consideration

This year being the 201st anniversary of the births of Charles Darwin and Abraham Lincoln on the same day, it may not quite produce the same forest of books and articles as last year. Among last year's luxurious growth, I would recommend very strongly Iain McCalman's *Darwin's Armada* (pubs. Simon and Schuster), for a vivid elucidation, quite unconsciously of course, of Rudolf Steiner's mysterious indications about Darwin. But I do not intend to review the book here beyond that recommendation.

It seems to me that arguments about Darwin, pro and contra, have long since passed the point of scientific assessment and discussion, and perhaps never were at this point, from 1859 or even long before!

Mention the word 'Darwin' to someone and try to observe the response, the vibration or resonance in your listener, and I

seriously question whether that response will be chiefly intellectually based; but rather based on quite other factors. Perhaps in this matter, one could copy Darwin himself, whose ability to record instances, to assemble them in results and abstract conclusions from them, is surely unparalleled? One can also note that among those of an anthroposophical persuasion, another name might produce a rather similar resonance or response, namely that of Goethe.

Maybe we are not dealing solely with scientific issues? Maybe we could employ the same inductive procedure with reactions to both names?

It seems to me interesting to pursue, rather after the manner of a Naturalist, certain comparisons between the work, surroundings, milieu and disposition in life of these two giants of scientific development, but to leave for the most part the 'conclusions', if any, to speak for themselves.

Firstly, in the case of how they describe themselves as scientists and human beings, we are aware of a contrast. Goethe uses for example, the oft quoted sentiments of the poet in his self descriptions. Investigation of nature is he says, a kind of communion, a living with and within a kind of being, he says: a Goddess even who not only brought forth the human being as a life form, but also speaks in and through her child the human being in his scientific activity. The condition for communion of the human and nature is *harmony*. In the person, in whom a natural harmony rings out and vibrates, wholeness is alive, and out of this wholeness springs the voice of the human being in science; which is actually the voice of nature herself in the act of knowing herself. To support this view of himself as a harmonious son of nature we have the testimony of those who knew him. Even as a child we are told of the huge expectations that were recognised around him: his talent, his hugely diversified interests, his passionate love for the products both of nature and of the mind, and the inward poise of his being.

It is very interesting to place this alongside descriptions and self descriptions of Darwin throughout his life.

Whereas we read in young Goethe of his resolute self-education in a vast array of disciplines, in Darwin we read of a boy at Shrewsbury school for whom much of his education was a blank, tedious rote learning of Latin which he gladly forgot. His interests were heavily drawn to the world of nature as collector and tabulator, one who delighted in a certain way in noting, arranging and organising. We read about his love of shooting, an activity he apparently enjoyed for a considerable period, and of course we may forget that a lot of his investigations throughout his life would have involved killing specimens.

When we read about Darwin the young man, we read about a man of aesthetic senses as well as the mind of a collector, but if we are honest we could not call him an entirely happy individual maybe? Someone who was uncertain of himself, whose father seemed to expect not much of him, until the great opportunity of *The Beagle* made a man of him, a man who had seen the world.

If we take him at his word, he describes his mind and mental processes as a 'kind of machine which could process and grind out fact after fact; arrange them and organise them into abstract ideas'.

He also remarks late in life, that this activity had been accompanied by a steady loss of aesthetic tastes. His appreciation of Shakespeare, music and poetry all declined in a way he much deplored. In reading his biography we also note in him outbursts of anger and even a delight in images of war. There is a kind of image of an eternal war among creatures posited in parts of the *Origin*, and certain events on the Beagle voyage excite his almost military streak.

Rather than harmony, poise and genius, we read about the continual illness of Charles and his endless efforts to overcome digestive disorders. In short, life seems like a struggle for him. It is very interesting to compare our two 'specimens' in the cultural history of humanity on other 'heads' also (to use Darwin's favourite expression).

For example when we consider Goethe as an individual, no-one refers us to his ancestors, his family or his descendants. Around him instead, we find the royal family of Weimar, and the Duke whose personal recognition of Goethe is the secret of his freedom to create his works and ideas in leisure. We read of virtually every thinker recognising in Goethe, genius, as completely individual.

They seem to recognise something of a very high order; an inner something which seems to be his guide and true self so to speak. We hear nothing about children but about originality and spiritual offspring; creations which have formed very little in the worlds of government or economics, but a great deal of powerful influence in the minds and hearts of people, spiritually.

On the other hand, with Darwin we are referred at once to his family. The work of his grandfather Erasmus was in many ways (in Goethe's own time) the first attempt to state an evolutionary theory of creation. We read about the close links with the Wedgwood family and of the very close family life of the Darwins. Not only does Charles seemingly inherit Erasmus' ideas, but his whole voyage was financed by his father Robert, and Charles' financial independence throughout life is really the outcome of this family inheritance.

As to children we read about the large Darwin family: of Charles doting on his children while simultaneously noting and recording their responses like a dispassionate observer. We read about his poor little Annie, whose illness and death in Great Malvern so shook Charles, but while the faithful Emma was about to be delivered of another child!

It is very also instructive to compare in this regard, our two heroes with regard to their relationships to women. In Goethe's case we can also of course use his descriptions of female characters in his plays. What we notice is that for Goethe, love between the sexes has something of a spiritual character. A man feels himself lifted up beyond himself by a woman, enhanced and even in a sense spiritualised. We see this in his own relationships, but also in the relations within figures like Egmont, or indeed Faust. There is in a word something holy for Goethe in this question. His ideals are in a way summed up in a figure like Iphigenie. Self contained yet loving as a kind of ideal woman: but open (like Gretchen) to deceit from the baser aspects of the world, self interest and materialism. Goethe's conception of woman is of a whole with other regions of his thought.

With Darwin, we feel the immense devotion and loyalty of his Christian wife Emma. But we see how a spiritual rift grows between them, a region of silence and non-comprehension, but covered over in devotion to the family. Maybe there is a kind of tragedy? The conception and birth of the Darwinian theory coincides with the deaths of two of Darwin's children. It is as if the ideas are born in pain and tragic loss, and illness and the onset of doubt.

And yet the clan lives on! If we trace the names Darwin, Galton and Wedgwood in Britain, in scientific, government or economic life, we will find them well represented. How many Goethes would one find in the corresponding place? It is now of interest to examine certain details of the theories of both men, one in particular. As we know, the main interest of both scientifically concerns the origin and development of creatures and of living forms in general.

It might seem to some that a difference existed between the Darwinian and Goethean views over the question of marrying reason and observation on the one hand, with imagination on the other. This might seem to be the crucial point. But closer examination shows something interesting. As is well known, Goethe produced his remarkable theory of the *Metamorphosis of Plants* in the form of poem. He describes in poetic form the continual metamorphosis through development and intensification of the idea of the plant form as it expresses itself in the changing natural forms visible to the senses.

It is well known that Goethe spent long periods studying the classifications of plants of Linnaeus as preparation for this.

But similarly, in Lichfield, so did Erasmus Darwin! And Erasmus, himself rather a polymath and poet (I recommend the excellent biography by Desmond King-Hele) produces a book on plant life in poetic form, attempting to convey imaginatively the development of plant life, entitled the *Loves of the Plants*.

So in both cases we have, apparently, a blend of the artistic and scientific in nature study. But it is most instructive to compare the *type* of imagination active in both cases.

Rather than weary the point, let us look at something which is called 'fertilisation' in plants and is supposed to be the vegetative counterpart of sexual reproduction in animals. We can refer to a passage in *Man as Symphony of the Creative Word* for a fair account of Goethe's *mood* and *intention* in this matter.

There Rudolf Steiner points out what seems so obvious, that the formation of a seed by pollination is *not* equivalent to the fertilisation of egg by sperm. For after all the seed has to be placed in the *earth* in order to grow, and *this* is the obvious parallel to the meeting of egg and sperm. In short pollination in plants produces the seed but does not plant it!

The creation of the seed is something connected to the cosmos, while the placing of a seed in earth concerns fertilisation of the *mother* in the form of the *earth*.

Steiner emphasises how revolted Goethe was by the idea of plants copulating like animals or even people. This is a question of inner *feeling* mainly. The imagination of Goethe repelled this idea of sexuality in plants. It approached reality differently.

By contrast in Erasmus Darwin's *Loves of the Plants* we find the opposite. Rather dry facts of science are, shall we say, 'sexed up' in order to present plant life 'imaginatively' so to speak, but in an almost saucy or slightly salacious way. Pollination described in terms of courtship, allure and seduction. We sort of feel we enter two different mentalities here. Two different soul intentions maybe?

It is interesting also to note that the Darwin crest is that of 3 scallop shells, similar to that out of which Venus rose from the foam.

It is generally considered that Erasmus chose this to say that 'life emerged from a natural process or "filament" from which every living form descends' and not as believed in the huge cathedral in whose shadow he lived for part of his life by a divine 'fiat'.

It is remarkable to find that Erasmus Darwin and Josiah Wedgwood and others were instrumental founders of the remarkably named Lunar Society of Birmingham, devoted to advances in science and technology across a wide spectrum. So named, it is said, because the meetings were at full moon, when the light for travel was supposedly at its best. Maybe that was the reason, or is destiny telling us something?

(Others believe that the 'filament source of life' has its origin in South America.)

We note that towards the end of his life Charles Darwin tended away from the idea of mere natural selection, as the primary motive force of development, (an idea derived from the economic theories of Malthus and maybe very descriptive of the behaviour of those dragon-like creatures called multinational corporations and businesses) towards the notion of sexual selection. It seems he no longer believed only in the eternal competition and war of each creature for himself against all comers, but in the power of allure and love to attract suitable mates etc., and ensure survival of its type. It is interesting to look at the life of the Darwin family in this light.

When we are confronted by these contrasting theories, Goethean or Darwinian, it might be good for us to consult also the resonances in ourselves or in our fellow human, and not to confine ourselves only to theory.

After all, these two men are like centres of natural phenomena, which we can faithfully record and tabulate. We need to place these phenomena side by side and allow them to speak to us. To try then to grasp the essential type of each; both as they reproduce themselves in offspring, and as they evolve within themselves.

Stephen Moore-Bridger

Reviews

On the Fundamentals of Geometry by Lodewijk A. D. de Boer. MathArt Publishing, Rotterdam, 2009. vi + 66 pages, 36 figures. ISBN: 978-90-815063-1-1. Available as PDF document at <http://www.mathart.nl>.

Content: Preliminaries, axiom system, ordered set, lower and upper bound, meet and join, duality, intervals, dimension theorem, modular lattice, Fano space, projective maps, homologies, field of scalars, vector space, Pappus' proposition, bibliography, index.

About the book: This book written by the Dutch author Lou de Boer deals with the basics of projective geometry. A new axiom system is presented, which is based on the mathematical disciplines of order theory and lattice theory, and it is shown that this system is equivalent with the existing definitions. Beyond this, the book offers surprising insights into the connection of algebra and geometry.

In the first part, the axiom system is developed. A projective space is defined as a set, together with a dimension function and an order relation. Whereas the dimension function distinguishes the different elements of the space – points, lines, planes etc. – the order relation describes the fact that, for example, a point lies in a line, or in other words, that the line contains the point. This relation replaces the incidence relation and makes the space into an ordered set in the sense of order theory.

An element is said to be a lower bound of two other elements if it is contained in both, and it is said to be an upper bound if it contains both. Now it is required that every two elements have exactly one greatest lower bound – the meet – and one least upper bound – the join. This central axiom makes the space into a lattice in the sense of lattice theory, and meet and join appear as essentially algebraic operations. Two further axioms concerning sufficiency and composition allow the proof of the dimension theorem, and one last axiom about cardinality completes the definition of the projective space.

Projective maps are introduced as maps that preserve the operations of meet and join and consequently also the order relation. A detailed description is given for the perspectivities as well as for the homologies, these are the projective maps leaving one point and one hyperplane invariant.

The second part contains the detailed proof, that the new axiom system is equivalent with the standard definition, according to which a projective space is understood as lattice of linear subspaces of a vector space. For this purpose, a field of scalars and then a vector space over this field is constructed. This is done in a purely geometric way, basing only on the axioms. The role of the 'scalars' is taken over by the homologies, leaving one particular point and one particular hyperplane invariant. With a choice of an addition, the group of these homologies is expanded to a field which in general does not have to be commutative.

The part of the 'vectors' is taken over by the points not laying in the particular hyperplane. Also, for these points an addition is declared, and they are shown to form a vector space over the above field – the dimension of this space being equal to the maximum value of the dimension function. The book closes with the surprising fact that the field of scalars is commutative only if the proposition of Pappus holds. This is an impressive example of the deep connection of algebra and geometry.

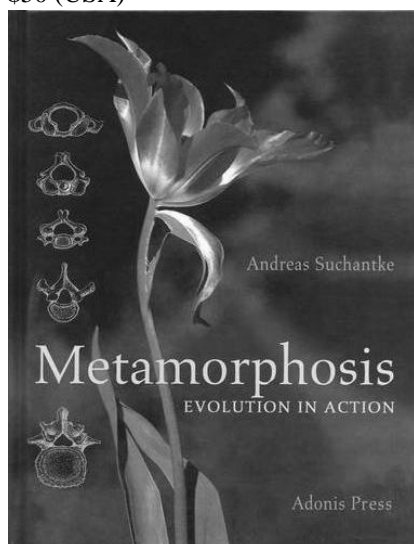
This new development of geometry deserves attention for several reasons: it may be called phenomenological or intuitive because the axioms are immediately accepted to be true in our real projective world. By treating points, lines, planes etc. on an equal footing, the one-sided position starting only from points is avoided. The symmetric formulation of the axioms takes into account the principle of duality right from the beginning. The idea of an interval – all elements with the same lower and upper bound – allows the uniform description of the classical geometries such as the range of points, the pencil of lines etc. Finally the approach applies for spaces of arbitrary dimension as well as for finite geometries over finite fields: the Fano space is mentioned several times.

The book is carefully structured, some proofs are left as exercises for the reader, and numerous figures make the understanding easier. For everyone who likes to understand the fundamentals of geometry from a different perspective, this work is an enrichment and can be highly recommended.

About the author: Lou de Boer, born 1947, studied mathematics and music in Amsterdam. From 1971 to 1986 he taught mathematics at a gymnasium in the same city and from 1986 to 1993 he was a consultant at the Dutch telephone company in Den Haag. At present he lives in Rotterdam and works as an independent researcher in the fields of philosophy, mathematics and physics.

Matthias Lerchmüller

Metamorphosis: Evolution in Action by Andreas Suchantke. Translated by Norman Skillen. Adonis Press, 2009, 324 pp. \$50 (USA)



My first impression on receiving the review copy of *Metamorphosis* was 'What a beautiful book!' and the discovery that it had been printed in China went some way toward erasing recent impressions of the quality of goods from that country. It is coffee-table sized and the pictures, most of them by the author, are an education in themselves; but as we shall see, *Metamorphosis* is

definitely not a coffee-table book.

Andreas Suchantke, who was born in Switzerland in 1933, taught life sciences at the Rudolf Steiner School in Zurich and worked extensively in teacher training. Apart from teaching, his life's work has been the development of an ecological understanding of landscapes and traditional cultures, and he has published books on tropical South America, South and East Africa, and Israel and Palestine.

In his new book he shows how the fundamental principles implicit in Goethe's scientific work, together with the insights gained from a lifetime of studying nature's ways, lead to a far-reaching understanding of the evolution and interrelatedness of all that lives on Earth. In so doing he acknowledges his debt to Rudolf Steiner, and it seems appropriate to allow Steiner to give us a starting point with a few words on the subject of Goethe:

"For him, art and science sprang from a single source. Whereas the scientist immerses himself in the depths of reality in order to be able to express its impelling forces in the form of thoughts, the artist seeks by imagination to embody the same forces in his material.... "In the works of man, as in those of nature, what most deserves consideration is the intentions," says Goethe. Everywhere he sought, not only what is given to the senses in the external world, but the tendency through which it has come to exist.... In nature's own formations she gets "into specific forms as into a blind alley"; one must go back to what was to have come about if the tendency had been able to unfold without hindrance.... Not what nature has created, but according to what principle it has created, is the important question. And then this principle is to be worked out as befits its own nature, not as this has occurred in the single form subject to a thousand natural contingencies. The artist has to "evolve the noble out of the common, the beautiful out of the misshapen.""¹

In contemplating the forms of plants and animals, Goethe perceived a principle of metamorphosis that enabled him to see each organism as a unity of interrelated parts. He expressed his thoughts on plant and animal morphology in such a way as to suggest principles of growth and being that might apply to the whole process of nature. He saw the development of the plant as a series of alternating expansions and contractions: seed, leaves, calyx, corolla, stamens and pistil, fruit, and, again, seed. To ask for a physical cause for the expansions and contractions is, as Steiner pointed out, to stand the matter on its head:

'Nothing is to be presupposed which causes the expansion and contraction; on the contrary, everything else is the result of this expansion and contraction. It causes a progressive metamorphosis from stage to stage. People are simply unable to grasp the concept in its very own intuitive form, but demand that it shall be the result of an external process. They are able to conceive expansion and contraction only as caused, not as causing. Goethe does not look upon expansion and contraction as if they were the results of inorganic processes taking place within the plant, but considers them as the manner in which the entelechy, the principle, takes form.'

People who believe that nature consists of nothing but particles, waves and space feel the need for a mechanism for such processes. I speak with the voice of personal experience when I say that it is very hard, even for those of us who are intuitively drawn to Goethe's view of nature, to get out of the mechanistic habit. Goethe's way of expressing things has the cognate disadvantages of provoking facile ridicule from the scientific intelligentsia and receiving uncritical acceptance by

the half-baked dilettanti. Suchantke's book shows that a contemplative biology drawing on the fundamental concepts of Goethean science and imbued with reverence for the living Earth can produce a consistently illuminating picture of life in all its amazing abundance and multiplicity.

From the beginning, Suchantke emphasizes the need to escape from the idea of a fixed spatial form (space-gestalt):

'We must learn to think in terms of development, to engage in the transformation of our conceptual systems in accordance with a deeper, dynamic understanding of the sphere of life. It was Goethe who first demonstrated that a method seeking to unravel the secrets of living processes must not be applied to, but rather must take its lead from its object of study, and thus... develop organically. This process should encompass all aspects of the development of the living organism under consideration and recreate them as fully as possible in imagination—quite a tall order! In the introduction to his botanical studies, Goethe formulates it as follows: "In introducing a science of morphology, we must avoid speaking in terms of what is fixed. If we use the word Gestalt [form] at all, we ought to have in mind only an abstract idea or concept, or something that is held fast but for an instant."'

The principles of metamorphosis apply not only to the development of the individual plant but also to the evolution of species, in which the retention of juvenile characteristics into adulthood (neoteny), and the changing relationships to the environment known as internalization and externalization play important parts in generating a stream of continuous change. In describing these and other time-gestalts, the author says,

'Our guiding principle will be Goethe's words to the effect that, "when we study forms, organic ones in particular, nowhere do we find permanence, nowhere repose or completion.... For no sooner has something been formed than it is immediately transformed, and if we wish to achieve a living perception of nature, we must strive to keep ourselves as mobile and flexible as the examples she herself provides.'" 'What follows, therefore, will also be concerned with breaking through from the organism's sense-perceptible, external form or space-gestalt to the process of its formation, which is an expression of its time-gestalt. This can only be perceived when we actively reconstruct it in our imagination: an inner process which enables us to experience and describe its formative movements.'

Metamorphosis should not be read like a textbook; it asks the reader to entertain the possibility of inner transformation in which the imagination becomes an organ of perception, thus giving the title a double meaning that its author undoubtedly intended.

It would be impossible to convey the immense richness of Suchantke's book in the few pages of a review, so I'll give a brief impression of its contents and concentrate on just one aspect of the author's thinking. After giving a vivid account of some of the transformatory processes of nature, he tackles the difficult question of the functioning of the archetype in the evolutionary process. He goes on to clarify the concepts of metamorphosis with a discussion of Goethe's perception of the relation between the bones of the spine and those of the skull, but he doesn't limit himself to the human skeleton. Salamanders, foxes, moles, bats, hummingbirds, and even cacti are drawn into the discussion, which ends with the perception of polar tendencies that produce both round, immobile, protective structures such as the skull, and mobile, articulated, linear structures like the arms and legs.

Chapter 3 deals with the forms of leaves, showing their relatedness to other parts of the plant and to its functioning

within the environment. The theme of sphere and radius, already developed in relation to the vertebral nature of the skeleton, reappears here. 'The leaf, we must agree with Goethe, is the "true Proteus." From top to bottom the plant is all leaf.'

From leaf to flower is a transformation that naturally takes us into Chapter 4, which deals with the polarity of the two structures and the extraordinary correlations between colour and form. Of particular note is the section on the evolutionary potential of the blossoms, in which Goethe's ideal of intensification reaches a high point.

Chapter 5 reviews the functioning of metamorphosis and reminds us that we, as readers, are invited to take part in a process of transformation. Next comes a chapter on the various forms of metamorphosis in the plant kingdom, in which the ideas of the previous chapters are profusely illustrated and developed.

In Chapter 7 the principles of polarity and threefold organization are illustrated by the growth of plants from the unity of the seed into the structure of root, leaf, and blossom, the subtlety of which cannot altogether be conveyed by a simple spatial picture. Of great interest is Suchantke's commentary on the description Rudolf Steiner gives in his autobiography of the gradual development of his perception of the threefold nature of the human being.

Chapter 8 is an extended tour de force that demonstrates how polarity and threefoldness are expressed in different ways throughout the animal kingdom. The photographs and drawings are breathtaking.

Chapter 9 brings us back to the archetype. Different groups of creatures emphasize different aspects of the threefold organization and, when viewed together at a moment in time, can be seen as forming a gestalt, momentarily frozen in space. When the gestalt is regarded as 'only fixed for a moment' and 'about to undergo transformation' we enter 'the realm of formation and transformation, of development on the different levels of ontogeny (development of the single individual) and phylogeny (development of the ancestral group, evolution).' 'In this way,' Suchantke states emphatically, 'the archetype comes to be understood as the initiator of evolution, which is as much as to say as evolution itself.' This is important enough to repeat in different words: 'The archetype may thus be construed as the prime source of evolutionary impulses and at the same time, the inner line, or, rather, the time-gestalt of the whole of evolution, revealing facets of itself in the various species, genera, and families of organisms. Its full compass is only to be revealed through contemplation of the whole or through the fact that at every stage of evolution it inclines towards polarization and ultimately toward clear, tri-structured order.'

It seems to me that Chapter 9 is the fulcrum of the book, the point at which the final intent becomes clear: 'The environment is internalized, and that which later on lights up as the inner content of consciousness is the inside, or spiritual content of nature, internalized and raised to the level of consciousness. Internalization of the external world, steady gain in inner richness and complexity—this is the leitmotiv in the evolution of deuterostomes, the line in the animal kingdom that leads to the human being.'

Two further chapters deal with the evolutionary processes of the endo- (inner) skeleton, characteristic of vertebrates, and the exo- (outer) skeleton of the insect world, and finally bring us to the embodiment of the archetype in the human being, in whom evolution 'has not only expressed itself in the physical form of a single species, but at the same time has become conscious of itself.' Evolution does not stop here, however. The capacities of consciousness can be intensified but

'...there is a vast discrepancy between what we actually achieve and the goals we aspire to, goals which should in principle have been attainable. This is a feeling that can arise in connection with any activity: it could have been better, we should really do it again more thoroughly! The importance of this experience cannot be overestimated because it induces the future and is an expression of the developmental potential of the Self, probably its most important attribute.

All this only makes sense... if the Self, as the bearer of this developmental resolve, has the possibility of further existence beyond its present life; if, indeed, what it has begun in this life can be carried on in subsequent ones...

... the continuity of the individual spirit through a series of physical incarnations is the precondition for the quantum leap from biological to mental/spiritual evolution.'

This is how Suchantke ends his book, and some readers may feel that although the evolution of human consciousness has been in his crosshairs from the beginning, his conclusion is rather brief and facile. If, however, we say that the further development of the human soul and spirit is a subject that demands another whole book, we must recognize that other whole books have already been written, notably by Rudolf Steiner, whose intimations about the future of this incarnation of our planet make rather uncomfortable reading. This is not surprising since any realistic survey of the past has the same effect.

Metamorphosis will undoubtedly be both a comfort and a challenge to students of anthroposophy, and may well be a source of inspiration to people who have never heard of Rudolf Steiner. Whether it will have any influence within the scientific community is a different question, one of the problems being the rather partisan tone that the author adopts in speaking of Darwin, his supporters, and modern biological science. Speaking of the idea of the struggle for existence, Suchantke says, 'It is often forgotten that this idea was no hard-won conclusion of Darwin's, but was lifted from a completely different realm of discourse and applied to nature. He adopted it from Thomas Malthus, whose book *An Essay on the Principle of Population* attempted to address the effect of world-wide population growth.' This is rather like saying that Niels Bohr filched the idea of quanta from Max Planck and applied it in a different context. Darwin never made any secret of his indebtedness to many of his predecessors, including Malthus, and it's worth noting that Loren Eiseley, in his masterly *Darwin's Century*,² puts the matter much more fairly, seeing the gradual evolution of Darwin's ideas as a process—dare I say, as a time-gestalt—rather than suggesting that he simply plucked a ripe fruit from someone else's tree. There are more examples of this tendency. Although T. H. Huxley may be 'notorious' among anthroposophists and creationists, in other circles 'famous' would seem more appropriate—but this is something that could easily be corrected and there is another far deeper problem that is simply in the nature of the enterprise.

Suchantke goes to great lengths to characterize the archetype and its all-pervasive functioning, but it remains a concept that is very hard to get hold of, partly because, like Proteus, it is always changing its form and partly, perhaps, because it isn't a concept. Proteus had been given the gift of prophecy, but on being questioned he assumed different shapes and eluded his questioners. The archetype does not merely 'know' the future; it brings all kinds of different futures about in constantly changing ways and we may well be excused for feeling that we still don't know what it 'really' is. We see what it achieves, but something in us wants to know how it works and where it

comes from. These may be unanswerable or even meaningless questions, but we can't help asking them, and it may be helpful to look at evolution from a different angle, for which the study of Steiner's *Outline of Esoteric Science* would be a good starting point.

How does Suchantke's description of the organic development of a vehicle for human consciousness relate to Steiner's account of the work of the hierarchies, in which the human being has been present from the very beginning? And if we want to know what the driving force for evolution is, we could profitably study *The Driving Force of Spiritual Powers in World History*,³ a course of lectures which, among many other things, gives the clue to the emergence of the archetype in the form it took in the Middle Ages. As Suchantke indicates, the very idea of the archetype is likely to promote an acute negative reaction on the part of a modern biologist, even when it is given a new context and a new understanding, and it will take either a catastrophe or a long evolutionary process to change this situation. Nevertheless, *Metamorphosis* has the ring of truth and will amply repay the contemplative reader.

Keith Francis

1. Rudolf Steiner, *Goethe the Scientist*, Olin D. Wannamaker, trans., (Anthroposophic Press, New York, 1950), p.104 Ibid. p. 69
2. Loren Eiseley, *Darwin's Century: Evolution and the Men Who Discovered It* (Anchor Books, New York, 1958)..
3. Rudolf Steiner, *The Driving Force of Spiritual Powers in World History*, seven lectures given in Dornach, 11 to 23 March, 1923 (Steiner Book Centre, Toronto, 1972).

Publications

In Context, The Newsletter of the Nature Institute

No. 23, Spring 2010: Main articles: The drama of milkweed pollination, *Craig Holdrege*. Context matters – the epigenetics revolution, *Steve Talbott*.

Editor: Steve Talbott. Single copies of *In Context* are available free of charge while the supply lasts. Contact details: The Nature Institute, 20 May Hill Road, Ghent, NY 12075. Tel: +1 518 672-0116. Fax: +1 518 672 4270. Email: info (at) nature-institute.org. Web: <http://natureinstitute.org>.

The Nature Institute's online *NetFuture* newsletter is available at <http://netfuture.org>.

Elemente der Naturwissenschaft

No. 92, 2010: Form und Bewegung und die Entstehung von Neuerungen in der Evolution – Teil I, *Susanna Kümmell*. Some general remarks on crystallization in the presence of additives, *Günter Reiter & Jean-Georges Barth*. Beobachtungen bei der Kupferchloridkristallisation: vom 'Eiweiß-Vorbild' zum 'Kupferchlorid-Nachbild', *Francois Schweizer, Jens-Otto Andersen & Jens Laursen*. Reh und Fuchs im Vergleich – Teil 2: Dem Jäger auf der Spur, *Pablo Grassi*. Steiners frühe Ideen zur Entwicklung, *Renatus Ziegler*.

Editorial board: Johannes Wirz (editor-in-chief), Birgit Althaler (editorial assistant), Ruth Richter, Johannes Kühl, Barbara Schmocker.

Subscription enquiries to: Wochenschrift 'Das Goetheanum', Abo-Service, Postfach, CH-4143 Dornach 1, Switzerland. Email: abo (at) goetheanum.ch. Fax: +41 61 706 4465.

Editorial enquiries to: Naturwissenschaftliche Sektion am Goetheanum, Elemente der Naturwissenschaft, Postfach, CH-4143 Dornach 1, Switzerland. Tel. +41 61 706 4210. Fax +41 61 706 4215. E-mail: science (at) goetheanum.ch.

Cost: Annual subscription (2 issues, including postage): €20.- / CHF 32.-. Single issues: €12.- / CHF 18.- ISSN 0422-9630.

A list of the contents of back issues is available at <http://www.science.anth.org.uk/eleminde.htm>.

Mathematisch-Physikalisch Korrespondenz

No. 240, Spring 2010: Malen aus der Farbe, *Marianne Möri-Kretschmer*. Der Satz des Menelaos, *Heinz Fuhrer*. Eine algebraische Notation für die synthetische projektive Geometrie, *Gerhard Hermans*. Selected topics in three-dimensional synthetic projective geometry – Chapter 17: The five-dimensional linear manifold of linear complexes, *Renatus Ziegler*.

No. 241, Summer 2010: Beispiele für Wegkurven bei Wachstumskurven, *Ingrid Hartmann*. The Dalton temperature scale, *Paul C. Marx*. Die Physik der Elementarteilchen und die Erinnerung der vorigen Runden der Erdevolution, *Konrad Rudnicki*. Selected topics in three-dimensional synthetic projective geometry – Chapter 18: Fundamental complexes, *Renatus Ziegler*.

Subscriptions are SFr 50/€30 per year.

Edited by Prof. Dr. Peter Gschwind, Mathematisch-Physikalisches Institut, Benedikt Hugiweg 18, CH-4143 Dornach, Switzerland. Tel: +41 61 701 5968. Email: p.p.gschwind@intergga.ch.

Jupiter – Astronomy, Mathematics and Anthroposophy

Volume 4(2), April 2010: The Experience of the stars as a path of initiation, *John Meeks*. Negative Materie in der Sonne und den Fixsternen sowie die Bedeutung der Beziehung von Licht und Materie für die Naturerkenntnis, *Thomas Schmidt*. Cosmos between matter and light, *Oliver Conradt*. Leo de La Houssaye, *Ermengarde de la Houssaye-Lievegoed*. Jean-Louis Gaensburger, *Claudine Vignon*.

Editor-in-Chief: Oliver Conradt, Section for Mathematics and Astronomy, Goetheanum, Postfach. CH-4143 Dornach/Switzerland. Tel: +41 (0)61 7064220, Fax: +41 (0)61 7064223, Email: mas@goetheanum.org.

Publisher: Verlag am Goetheanum, Postfach 131, CH-4143 Dornach, Switzerland. Subscription: Annual subscription € 30.- / CHF 50.- ISSN 1661-8750.

Wasserzeichen

Nr. 32 (2010): Main article: Zur Erweiterung unserer Untersuchungsmethoden, *Christian Liess*, *Christine Picariello* & *Manfred Schleyer*.

Plus shorter items of news and on the Flow Research Institute's work, conferences, publications and funding.

Price €3.00 per issue. Free to sponsors.

Editors, Georg Nitsche & Andreas Wilkens, Institut für Strömungswissenschaften, Stutzhofweg 11, D-79737 Herrisried, Germany, Tel: +49 (0)77 64 9333 0, Fax +49 (0)77 64 9333 22. Email: sekretariat@stroemungsinstitut.de. Internet: www.stroemungsinstitut.de.

Meetings

Research Group

Saturday 2 October 2010, 10 a.m. to 4/5.00 pm at The Christian Community, 23 Chapel Street, Buckfastleigh, Devon TQ11 0AQ

Programme: Alex Murrell the Tesla coil; Gordon Woolard, Phenomena of projection and section; Study session on Rudolf Steiner's *Origins of Natural Science* led by Henry Goulden.

Almut Woolard has kindly offered to cater for us again. Contributions are invited to cover costs. The Science Group will cover hire of meeting rooms and facilities. Accommodation is available for £12 to £15 for a guest room (limited availability; please book in advance) or £5 per person for a mattress and duvet. Bedding and towels provided.

RSVP stating if you need accommodation to PaulRC (at) btinternet.com or: Paul Courtney, Ground floor flat, 1 Surrenden Road, Brighton, UK BN1 6PA; or: +44 (0)1273 557080. Directions and location maps available. The nearest railway station is Totnes which is a 35-40 minute (7 mile) bus ride from Buckfastleigh. Newton Abbot has more trains but is further away. Please phone Gordon Woolard on 01364 644241 after 16 August, or at gordon.geometry@gmail.com for further information on trains.

UK Group of the Science Section

The Science Section for members of the School of Spiritual Science who are taking responsibility for the scientific work has been meeting twice a year in autumn and spring.

The next meeting will be at Elmfield School on Saturday 30th October 2010. There will be a free-rendering of lesson 18 by Nick Thomas.

We are asked to bring all our questions on the theme of evolution to this meeting as this will be the sole theme of the day.

The roles of chairman and secretary of this section group are nearly due for rotation and so nominations for either of these posts are heartily invited before the meeting.

The question of the representation once or twice a year in Dornach of the UK group of the Science Section has not been settled. Mike Friedeberg has been encouraged to consider this for next year, and Johannes Kühl also spoke with Judyth Sassoon who will consider this.

If you are interested in attending, but do not normally receive notification of Section meetings, please contact Alex Murrell, Wychwood, Wynstone's Drive, Brookthorpe, Glos. GL4 0UN. Tel: 01452 812094. Email: alexandermurrell@hotmail.com.

Membership

The Group has 56 subscribers. The membership subscription is £5 (UK), £6 (Europe) or £7 (elsewhere).

Next Issue

This newsletter is issued to members in March and September each year. Copy for the next issue should reach the editor at the address below by 20th February 2011.

Dr David J. Heaf, Hafan, Cae Llwyd, Llanystumdwy, Cricieth, Gwynedd, LL52 0SG, UK. Tel/Fax: +44 (0)1766 523181. Email: david@dheaf.plus.com

Science Group web site: <http://www.science.anth.org.uk/>