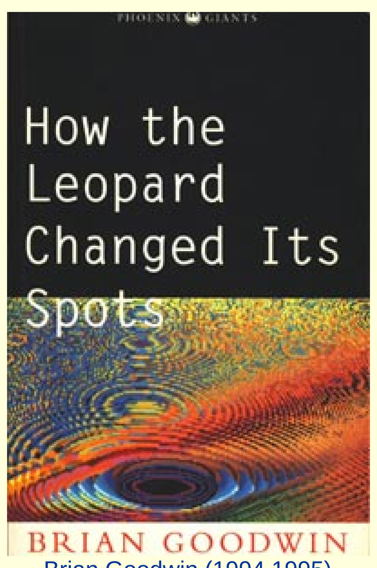
How the Leopard Changed Its Spots

"Clearly something is missing from biology !"

a review *by* Gert Korthof

updated 1 Sep 2014 (first published: 1 Jan 1998)



Brian Goodwin (1994,1995)
How the Leopard Changed Its Spots

Brian Goodwin is highly critical of neo-Darwinism, without being creationist. His book is valuable for Darwinists as well as for creationists, because it shows how a scientist who rejects the *sufficiency* of Darwinism, tries to improve Darwinism in a scientific way.

Goodwin is a critic of evolution, who analyses the shortcomings of Darwinism; who wants to improve the theory of evolution and actually proposes improvements. He goes deep into Darwinist assumptions, and puts his finger on what are unjustified simplifications in the theory of the development of an organism.

The paradigm of design: The eye

A good example is the eye. "How could random mutations gradually build up such a complex organ like the eye ?" is the question Goodwin asks himself. As did almost every creationist. Creationists concluded design, Goodwin suggests that the development of eyes in evolution is not improbable at all. The basic process of animal morphogenesis lead in a perfectly natural way to the fundamental structure of the eye. (p147). Goodwin studied mathematics and embryology. He knows what he is talking about. He knows that embryology has insights in the development of organs quite different from the Darwinist toolbox of random mutations and natural selection. Embryologists begin to understand how organs develop and what is necessary to modify an organ. They know that there is more than genes and gene-products (1). There are morphogenetic fields, which add a spatial and temporal dimension to the development of forms. They help to understand what forms are possible, what forms are stable and probable and what forms are unstable and improbable. This kind of information we need, because in evolution anything can happen, any form could emerge. We need to know more about which forms are improbable to happen; we need to know about constraints on forms. That will give us a theory which is able to explain and predict new forms in evolution. Exactly that is missing in current evolutionary biology.

What is wrong with Darwinism?

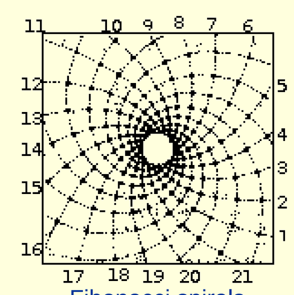
1. Darwin transformed biology from a rational science that sought intrinsic principles of biological order, into an historical science in which virtually any form is possible (p. 132)
2. neo-Darwinism added genetic reductionism, but organisms cannot be reduced to the properties of their genes (p3).
3. current evolutionary biology fails to explain the origin of novelties because the absence of a theory of morphogenesis.
4. Darwin's theory works for small-scale aspects of evolution, but there is no significant support for gradual accumulation of small hereditary mutations adding up to large-scale aspects of evolution.

The last point is exactly the same criticism that creationists like Denton and Johnson have. The difference is, that Goodwin understands that we need a theory of morphogenesis to explain macro-evolution. Goodwin does not doubt that all organisms share a common ancestor. He does not reject evolution. He rejects the claim that neo-Darwinism is sufficient. Creationists reject the theory of evolution, but the difference is that they don't want a *scientific* solution for a scientific problem. If they reject also the fact of evolution, then they have no need for an alternative theory at all. Therefore the search for a better scientific theory discriminates scientists from creationists.
Contrary to the title of the book, Goodwin does not explain how the leopard got its spots. There is an explanation with a computer model how the alg *Acetabularia* got its whorls. It is one of the most detailed examples of Goodwin's method of explaining forms in biology. The book is well illustrated with drawings and color images.

How are the Fibonacci patterns produced?

4 Sep 2014

In Chapter 5, 'The evolution of generic forms', Goodwin discusses the patterns of leaves on the plant stem (phyllotaxis). There are three main types of phyllotaxis. Over 80% of the 250,000 species of higher plant have the spiral arrangement. (Goodwin does not give the source of these facts, as far as I can see). The famous Fibonacci pattern (1,1,2,3,5,8,13,21,34, ...) produces a spiral pattern. The surprising fact that the pattern of leaves on a plant conforms to a mathematical formula requires explanation (2). The explanation Goodwin favors is self-organization with a minor role for genes. The self-organization comes in the form of a mathematical model of self-organization of a physical process (Douady and Couder). The model predicts (the frequencies of) the main three types of phyllotaxis in plants (3). Moreover, the model predicts that the three main patterns found in nature by fine-tuning the parameters of the model. Since the predictions of the model match precisely what we find in nature, there is a strong suggestion that the model is correct. Furthermore, since there are obviously no genes involved in the physical Douady-Couder model, and physical forces are the only causes in operation, the suggestion is that genes do not and cannot have an important role in the morphogenesis in the biological world. And consequently, if there are no genes involved, natural selection can do nothing. Goodwin claims that all phyllotaxis patterns are selectively neutral. "All may serve well enough for light-gathering by leaves" (p.119).



Fibonacci spirals
with 13 clockwise spirals
and 21 counterclockwise spirals (p. 116)
See for more images: here on this website.

However, I think he jumps too easily from the physical-mathematical Douady-Couder model to the biological reality. He does not discuss the question whether one really can compare the behaviour of cells in a growing tip of a plant with magnetic drops in a fluid? The predictions of the physical model are truly amazing, however, to solve The Fibonacci Mystery one needs knowledge of the mechanism how real plants produce those patterns. Later he discusses the role of genes and the interesting effects on phyllotaxis of mutations of those genes. Goodwin concludes that genes only modify the details of the patterns that nature produces for free.

> "Darwin shifted the focus of biology significantly by describing it as an historical science ... But now the new developments in mathematics and the sciences of complexity have revealed ways of reconciling these traditions and linking biology again to the exact sciences. Genes don't control; they co-operate in producing variations on generic themes." (p.128)

But, the properties of the cells, and the environment of the cells are determined by genes, so the outcome must at least be indirectly determined by genes. And I would like to see experimental proof of "All may serve well enough for light-gathering by leaves". No matter, what the outcome is, Goodwin has stimulated thinking and further research about autonomous self-organization independent of genes and natural selection. And that is a good thing.

"How the Leopard Changed Its Spots"
by **Brian Goodwin.**
Phoenix
1994,1995
233 pages.
illustrated

New paperback edition with new preface Princeton University Press, 2001. Info

About the author:

Brian Goodwin studied biology at McGill University, Montreal. He came to Britain on a Rhodes Scholarship to Oxford where he read mathematics. He took his PhD at Edinburgh, having researched in embryology with the eminent biologist C.H. Waddington. He has been Professor of Biology at the Open University since 1983.

Brian Goodwin published with Gerry Webster:
Form and Transformation : Generative and Relational Principles in Biology, Cambridge Univ Pr , Hardcover - 287 pages, 1996.

Darwin's theory of evolution by natural selection fails to explain the forms of organisms because it focuses on inheritance and survival, not on how organisms are generated. This book argues that biology needs a theory of biological form, and that this must be based on a generative theory of organisms as developing and transforming entities of a distinctive type (fields). A number of examples are presented and used to explain the logical relationships of biological forms that underlie biological classification schemes, based upon the properties of complex dynamic systems.

Notes

1. We needed embryologists (developmental biologists) like Walter Gehring to prove that 'morphogens', 'morphogenetic fields' and 'positional information' are neither mystical nor mathematical principles, but can be explained by genes and gene-products. See: *Master Control Genes in Development and Evolution. The Homeobox Story*, page 35, 87. See also: Enrico Coen: *The Art of Genes. How organisms make themselves.*
2. See my review of William Dembski on this site for how an Intelligent Design poponent –after I pointed it out to him– claims that the Fibonacci series must be explained by Intelligent Design!
3. However, it is not easy to check whether the predictions of the model accurately reflect the frequencies of different natural phyllotaxis forms, because there is no table with all predicted and natural phyllotaxis forms. If one cannot compare them, one cannot see how accurate the model is. Does the model predict patterns that do not occur in nature? Are there forms in nature not predicted by the model? It seems from figure 5.8 that there are some 13 different outcomes with different frequencies (?)

Further Reading:

- Ricard Sole and Brian Goodwin (2000) *Signs of Life: How Complexity Pervades Biology*. Review: Scientists' Bookshelf Sept/Oct 2001 of American Scientist.
- See for a discussion of the relation between developmental biology and The neo-Darwinian Synthesis the review of Smocovitis' book on this site.
- Goodwin's home site
- Brian Goodwin (2009) 'Beyond the Darwinian paradigm: Understanding Biological Forms', pp 299-312 in: Michael Ruse (ed), Joseph Travis (ed), 2009, *Evolution. The First Four Billion Years*. A recent very useful overview of his ideas.
- Wallace Arthur (2000) *The Origin of Animal Body Plans : A Study in Evolutionary Developmental Biology* Cambridge Univ. Press, Paperback, - 352 pages. See: my review.
  - Book description: The neo-Darwinist body of evolutionary theory occupies a dominant position in biological thought but it lacks a component dealing with individual development, or ontogeny. This lack is particularly conspicuous in relation to attempts to explain the evolutionary origin of the 35 or so animal body plans, and of the developmental trajectories that generate them.
- Philip Ball (2001) *The self-made tapestry. Pattern formation in nature*.
  The idea that natural selection cannot create every form in nature is also found in this beautifully illustrated book. The alternative explanation of form is by physical, mechanical and mathematical laws (very much like Brian Goodwin did). (see the first chapter of the book).
- The idea that mutation and natural selection are not the only explanation in evolution can also be found in: Graham Taylor, Adrian Thomas (2014) *Evolutionary Biomechanics. Selection, Phylogeny, and Constraint*, Oxford University Press.
- ScienceDaily: Why the leopard got its spots October 20, 2010
- Nowadays [2014] there are several useful and beautiful **Fibonacci Phyllotaxis Pattern Generators** on the internet (search via google). Some do not work on iPad or Linux.
- PhiTaxis: Fibonacci digital simulation of spiral Phyllotaxis is a well illustrated webpage about Fiboancci in nature.