

BOOKS & ARTS

The search for novelty

Evo-devo is not the first attempt to understand how evolutionary innovations arise.

From Embryology to Evo-Devo: A History of Developmental Evolution

edited by Manfred Laubichler & Jane Maienschein

MIT Press: 2007. 569 pp. \$55, £33.95

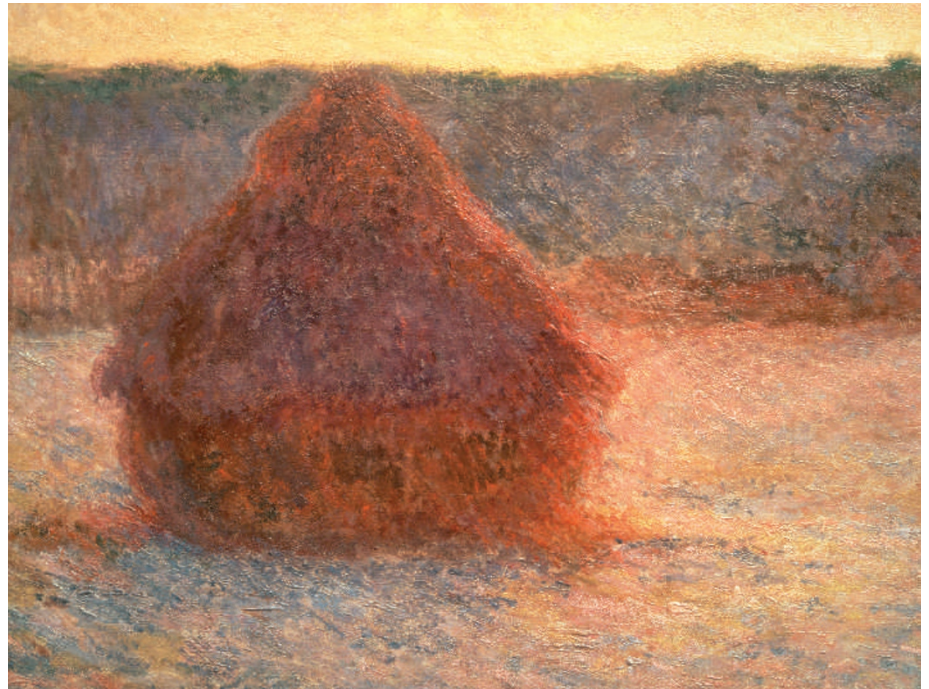
Wallace Arthur

Those of us lucky enough to have become, by whatever route, students of the interdisciplinary field of 'evo-devo' have a sense of history in the making — a feeling that a new synthesis is being born in biology, even if the birth is painfully slow. Indeed, many would say it is a rebirth: of comparative embryology in the age of the gene. The original birth, at the hands of Karl Ernst von Baer and Ernst Haeckel in the nineteenth century, and its late-twentieth-century equivalent, with Stephen Jay Gould's book *Ontogeny and Phylogeny* and the discovery of the homeobox, are connected by much intermediate work. This is made clear in *From Embryology to Evo-Devo*, edited by Manfred Laubichler and Jane Maienschein. The book tells the history of this work, which has not been told prominently enough before.

Both the book and its title derive from a pair of linked events: a seminar held at Woods Hole, Massachusetts, in 2001, and a workshop in 2002 organized by the Dibner Institute. These gatherings were mostly attended by historians of science, but also included a few practitioners of evo-devo. In the book's final chapter, one of the latter, Günter Wagner, describes this mix memorably as "birds and ornithologists together".

My first reaction to the book's title was that evo-devo has many roots, of which embryology is just one. But as Laubichler and Maienschein explain in their introductory chapter, "embryology and evo-devo are merely historical markers for the late nineteenth and the early twenty-first century, respectively". In fact, this first chapter is essential reading, as it outlines the structure of the book, which would otherwise be somewhat inscrutable. To my mind the flow is a bit odd: to have the first section defined by a block of historical time (the early twentieth century) but the other two sections defined in different (non-chronological) ways seems rather strained. So I view the book overall as something of a haystack, but it does contain many valuable needles.

My problem here is that a book of 16 chapters, some consisting of more than 50 pages (too long!), by assorted authors, is too big to do



Prize Monet: finding the roots of evo-devo can be like searching for a needle in a haystack.

justice to in a short review. So I will concentrate on a few things that struck me as important recurring themes.

First, history is more complex than scientists often think, and consists of the interactions of a multitude of figures, not just those who show up repeatedly in the popular literature. I found the chapters on less-well-known figures particularly interesting, such as Alan Love's chapter on Dwight Davis and William Gregory. Although Davis was a morphologist and Gregory a palaeontologist, they were both interested in the origin of evolutionary novelties. And William Wimsatt provides an excellent comparison of the very different backgrounds of Rupert Riedl and Lancelot Law Whyte. He contrasts this with the similarities of their focal area, the 'internal' side of evolution (Riedl's concept of 'burden' and Whyte's 'internal selection').

Second, Haeckel's idea of recapitulation — the fleeting occurrence in embryos of 'advanced' animals of certain features of their ancestors — is not dead, despite many reports to the contrary. This point is made at some length by Frederick Churchill, who distinguishes between strong and weak versions of recapitulation. He notes that there are inter-

mediates between them, and that they have changed over time, with the weak version becoming "even milder". Churchill concludes that only the strong version of recapitulation met "a natural death", and I think he is right. It all hinges on what is meant by 'recapitulation'. If it means 'repeats exactly' then of course it is false. On the other hand, if it means that the ontogenies of derived animals often retain features of the ontogeny of an extinct ancestor (as in the case of gill clefts in mammalian embryos), it is self-evidently true, but is more a statistical pattern than an inviolable law.

Third, and most important in my view, the origin of novelty is becoming one of the major themes of evo-devo. Attention is shifting from the retention of the old (as in recapitulation) to the creation of the new (be it an eye, a leg, a feather or even a whole body plan). Both the historical and the current importance of novelty emerge repeatedly in the book.

How do novelties arise? We can't yet agree on a definition for them, let alone answer this fundamental question. But we can see the nature of the challenge ahead. Wagner points out that there is a growing connection between microevolutionary (intraspecific) evo-devo and quantitative genetics (where intraspecific

variation is analysed in terms of quantitative trait loci). This connection is a positive thing, although it is perhaps limited in scope because it may not solve what many perceive as the *raison d'être* of evo-devo. As Wagner says: "One of the main sources of intellectual excitement in devo-evo (*sic*) is the prospect of understanding major evolutionary transformations." Whether these end up being unique events or long-term accumulations of the mundane remains to be seen, but either answer will be exciting in its own way.

Overall, then, the book is a mixed bag, but

contains many important contributions to the past, present and possible future of evo-devo. It is definitely a reference book rather than something to read from cover to cover. Its 'haystack' nature is off-putting at first, but the best strategy is to dive in (with the aid of the short introductory chapter) and see what you can find — including those needles that space has not permitted me to discuss. ■

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A singular view of ageing

Ageing of the Genome: The Dual Role of DNA in Life and Death

by Jan Vijg

Oxford University Press: 2007. 372 pp.
£70, \$114.50 (hbk); £32.50, \$65 (pbk)

Linda Partridge

There is no shortage of theories of ageing. Confronted by the terrifying realization of mortality, human ingenuity has created an interesting array of explanations, including toxins produced by gut bacteria (curable by eating yoghurt) and reduced secretions from the testicles (curable by transplants of testicular tissue from monkeys). There is now general

agreement that ageing is caused by the accumulation of damage. Key issues are the exact types of damage responsible for functional impairment and death, and the processes that generate this damage and protect against it. Jan Vijg's excellent book *Ageing of the Genome* makes no concession of equal space for the many candidates subject to current scrutiny. Rather, it critically examines the case for one — somatic mutation.

First formulated in the 1950s, this theory suggests a key role in ageing for the accumulation of random alterations to DNA in somatic tissues (all tissues other than the reproductive germline cells). DNA is being constantly bom-

barded with chemical and physical challenges that induce random alterations, including structural damage and changes in nucleotide sequence and organization. But unlike other biomolecules, such as proteins and lipids, the damaged DNA cannot be simply broken down completely and remade, because it holds unique information. Instead, cellular pathways detect alterations and, contingent on the type of cell and the nature of the changes, this variously leads to DNA repair, arrest of the cell cycle (preventing cell division), cellular senescence or death, or toleration of the change. In some cell types, some forms of DNA alterations accumulate with age, with evidence for genomic hotspots and considerable variation between individuals. Cancer is a clear case where DNA alterations can give rise to age-related pathology; their role in other aspects of functional decline is less clear, with the exception of mutations in DNA within mitochondria, the organelles that power cells. As well as leading to ageing directly, DNA alterations could lead to ageing as a result of cellular defence mechanisms, such as selective cell death, although there is little evidence for this.

Vijg gives a clear and thoughtful account of this complex, and potentially confusing, body of work and its limitations: little work has been done on non-dividing cells; most evidence has come from cells in dishes rather than in tissues; measuring DNA alterations is difficult; a net change in levels of DNA alterations can be attributable to several different events including

EXHIBITION

A painful pleasure

Three bodies writhe in agony. Their limbs are distorted, their features unrecognizable, their entrails burst out. The *Crucifixion* triptych by Francis Bacon (the central panel of which is shown here) had no religious meaning for the painter, for whom the work was simply about the expression of extreme sensation. In Tiepolo's painting of the martyrdom of Saint Agatha, the young woman's ecstatic gaze is thrown heavenwards as she awaits the blow of her tormenter's sword. These two paintings are the artistic highlights of the exhibition *Schmerz (Pain)*, which runs until 5 August at the Medical History Museum of Humboldt University and the neighbouring Hamburger Bahnhof Museum in Berlin.

The exhibition brings together artistic and medical views of pain. Opposite Bacon's *Crucifixion* is a glass cabinet containing pathological preparations of organs. Under the title 'The pleasure of

pain', Tiepolo's *Agatha* is displayed along with forensic photographs showing fatal accidents that occurred during masochistic sex. The borders between art and documentation begin to blur, which makes the exhibits all the more disturbing. Video interviews with people who self-mutilate, by German film director Valenska Griesebach, could easily be from the files of a psychiatrist. And what differentiates a display in a vitrine from a pathology lab or an art installation?

The exhibition aims to show pain in all its forms, rather than to understand it, and plays with superficial similarities between different depictions. A video by Bruce Naumanns in which a violin string is repeatedly plucked appears next to chattering patch-clamp recordings in the only exhibit that gives a nod to neurophysiological research on pain. That's not enough to justify



the exhibition's claim to build a bridge between science and art. Rather, wandering through this labyrinth of abominations, the question that comes most

immediately to mind is why Christianity really needed to glorify this most ugly of all human sensations into the pinnacle of mystical experience. **Stefan Klein**