

into observed evolutionary changes in limb features, such as digit number. The story includes some interesting considerations from the morphological evolution of limb components, but to get the complementary view from a palaeontological perspective, readers also should take a look at Jennifer Clack's new book, *Gaining Ground* (Indiana University Press).

In the final chapters, Wilkins discusses some interesting but poorly understood problems that continue to pose conundrums. These include morphogenesis, metazoan origins and the relationship between microevolution and macroevolution. The latter question is about whether the processes seen on the microevolutionary scale are commensurate with the large effects seen on the macroevolutionary scale. The gap is narrowing as the roles of mutations that have large effects are becoming better understood, and this synthesis will be as important as any in evo-devo.

The book has relatively few weaknesses. In general, it has too few citations, so some major contributors are not mentioned. Wilkins unfortunately gives some comfort to the concept of 'functional homology', which is an unhelpful confounding of the definition of homology with criteria for its recognition. And the discussion of the discrete phases of Hox expression, so crucial in tetrapod limb development, cries out for a figure. But these deficiencies are of minor consequence — this is a splendid book. Wilkins has produced a lively, readable and thoughtful work that will help readers to see the discipline with new rigour and provide a source for stimulating discussions in evo-devo courses. ■

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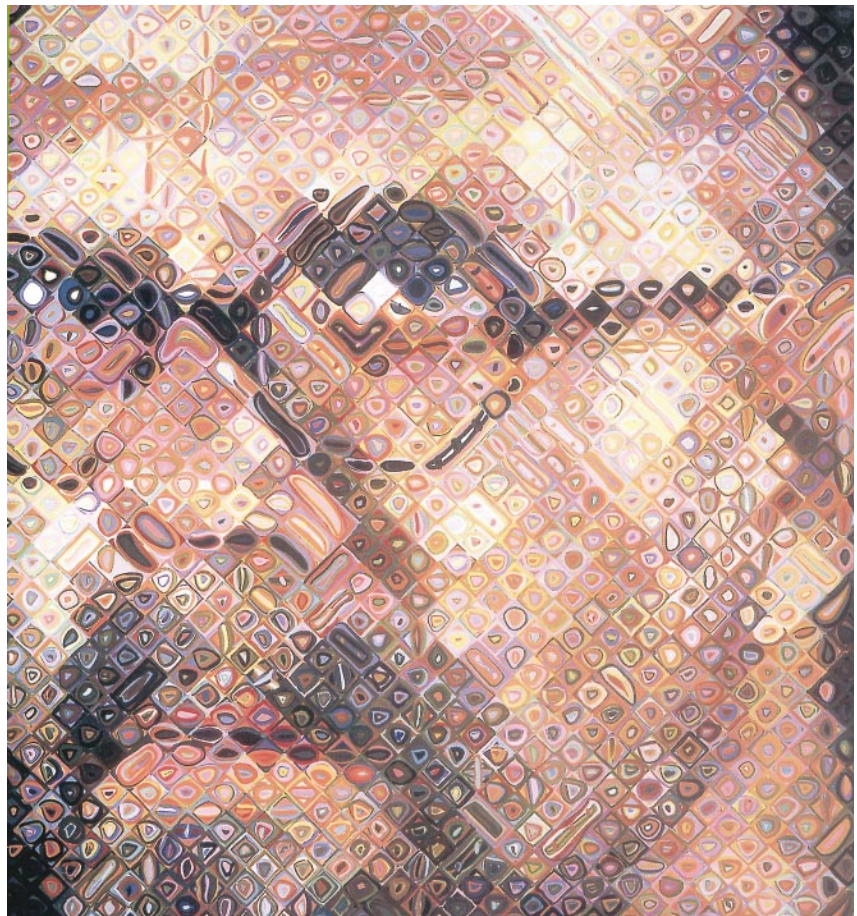
Trying to make sense of art

Vision and Art: The Biology of Seeing

by Margaret Livingstone
Harry N. Abrams: 2002. 208 pp. \$45

Semir Zeki

Artists differ hugely in their styles and creations, and their art appeals to some and not to others — which is another way of saying that one of the characteristics of art is its richness and variety. This no doubt reflects the variability in the organ that creates and appreciates art, the brain. Yet no one has been able to relate the variability in artistic creativity and appreciation to any given brain structure or process, partly because no one knows the neural processes underlying



Seeing the big picture: blocks of different colours are viewed together in Chuck Close's *Self-Portrait*.

the creative impulse or brain variability. And yet these differences in brain organization, whatever they may turn out to be, are superimposed on a common plan that is characteristic of all brains. It is this common organization that allows us to communicate through art and about art without using the written or spoken word.

This simple message, not by any means a new one, is worth repeating. Its repetition in this extensively illustrated book by Margaret Livingstone, and in the foreword by David Hubel, is to be welcomed. The book may provide yet another stimulus for neurobiologists of vision to study more closely what artists produce, and to use art in trying to further our understanding of the principles underlying the organization of the visual brain. Visual artists are, in a sense, neurobiologists of vision, studying the potential and capacity of the visual brain with techniques that are unique to them. This book illustrates that point well.

Livingstone uses one of the most conspicuous features of the organization of the visual brain — the functional specialization of different areas within it for processing different attributes of the visual scene, such as motion, colour, form and faces — to explain how we can account perceptually for much

that we see in paintings. Not surprisingly, there is more in the book about the colour, motion and depth systems than about the form system, because they are better understood in neurobiological terms. The many illustrations clarify some of the points very well. For example, page 34 provides a convincing answer to the often-asked question of how the colour-blindness that results from cerebral lesions differs from inherited retinal colour-blindness.

Although the text should be accessible to many readers, the parts that relate to the cortex are rather simplistic and ultimately misleading. Many today would not agree with the effort to partition the whole of the visual apparatus, of visual perception and of visual art, into two subdivisions of the brain, the 'what' and the 'where' systems. It is hard, for example, to accept the supposition that cubism is extreme in its spatial imprecision because it is exclusively the product of the spatially imprecise 'what' system. Cubism constitutes a deliberate effort to de-emphasize unique points of view and unique viewing conditions. It almost certainly taps deeply into many of the specialized systems, including the frontal lobes.

It is also unfortunate that not all of the illustrations chosen to make physiological

points are perceptually convincing. This makes the book less compelling than it would otherwise have been. I do not see the poppies in the Monet painting reproduced on page 152 as moving or changing position, nor can I detect an illusory motion in the ice floes on page 161. There are several such examples in the book of a conflict between what the text says and what the visual brain experiences.

The coverage itself also sometimes causes problems. It is not easy, for example, to accept the proposition that one's gaze is drawn to the face or eyes in a painting because these are painted in greater detail than the surroundings. There are many counter-examples, unfortunately not given here, where the face is very sketchily drawn but still constitutes the immediate focus of attention. The reason for this is simple. The face carries more information and, correspondingly, the brain has devoted a specialized area to the processing and perception of faces.

There are, happily, many other illustrations that are perceptually much more convincing. Prominent among these are the many visual illusions, some well known and others less so, that are scattered throughout the book. Collectively, these should give the visual scientist a great deal of interesting material to think about. Above all, I hope that through works such as these, visual scientists will come to realize what a rich resource they are provided with by artists who exploit the potential of the visual brain in their creations. Such material is well worth studying scientifically. ■

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A rounded view of Faraday

Faraday: The Life
by James Hamilton
HarperCollins: 2002. 448 pp. £25

Jacqueline Reynolds & Charles Tanford

In the introduction to his monumental work on the life of Isaac Newton, *Never at Rest* (Cambridge University Press, 1981), Richard Westfall asserted his desire to avoid a detailed factual essay on newtonian science. He chose instead to make Newton himself, the scientist and the man, the central character in the drama of his unfolding life. Treading this fine line between yet another account of well-known scientific discoveries and providing a portrait of the individual who made such discoveries is a difficult path, which Westfall negotiated with great skill.

Hamilton's life of Michael Faraday is of

this genre. It is a portrayal of Faraday from his early days as an enthusiastic, observant young man through to his declining years — a man living actively through the intellectual and industrial explosion of the Victorian age. His friends and associates included not only other scientists, but many of the artists and literati of the day. All the influences of the time and the intellectual developments in Britain and mainland Europe were part and parcel of Faraday's life. The 'drama', as Westfall would have it, unfolds through the medium of his correspondence, laboratory notebooks and writings that were intended only for his own use (which today we might categorize as diaries, although they were far more extensive than that commonplace word suggests).

The strength of this book lies in the carefully constructed characters surrounding Faraday: the not always admirable Humphry Davy and his appalling wife; the young men who were part of Faraday's youthful ventures into science; his supportive but non-intellectual wife; unusual women such as Mary Somerville and Ada Lovelace, with whom Faraday had intellectual and emotional encounters. Faraday himself becomes a more real and sympathetic individual in this book than in some other accounts that concentrate primarily on his science or his unusual religious background as a member of the fundamentalist Sandemanian sect.

Hamilton reiterates and provides support for Faraday's formal devotion to the strict rules of this sect, as described by other writers (notably Geoffrey Cantor), but here Faraday's day-by-day activities reveal another side of him. As a young man on his European tour with Davy, he is described as a "*bon viveur*, enjoying good food and wine"; 35 years later he still enjoyed regular visits to the theatre.

Less satisfying is the presentation of



Bon viveur: Michael Faraday had strict religious beliefs, but also enjoyed good food and wine.

Faraday's prodigious achievements in the areas of analytical chemistry, electricity and magnetism, optics and organic chemistry. To have matched the more detailed and insightful essays on this subject that exist elsewhere in the Faraday literature would have required a much longer book and perhaps greater familiarity with these specific scientific areas. Hamilton's descriptions of experiments and their outcomes are marvelously pictorial and often humorous, relying heavily on Faraday's own notebooks — the reader might almost have been there through the course of numerous explosions and emanations of noxious fumes. But Hamilton, whose earlier work includes a biography of the landscape painter J. M. W. Turner, is less sure-footed when placing Faraday's achievements in a historical perspective.

That said, there are plenty of 'scientific essays', but it is hard to find a sympathetic and intriguing account of the life of a great scientist. If people and their peculiarities interest you less than the science, this is probably not the book for you. But if you enjoy having the great and the good from the distant past brought back to life (warts and all), then this is recommended reading. ■

Jacqueline Reynolds and Charles Tanford are at Tarlswood, Back Lane, Easingwold, York YO61 3BG, UK.

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The temperature of everything

A Matter of Degrees: What Temperature Reveals About the Past and Future of Our Species, Planet, and Universe
by Gino Segre
Viking: 2002. 320 pp. \$24.95

Vaclav Smil

Book publishing, like designer clothes and the most-cited scientific articles, follows fashion. Generic-topic books are now definitely in. The recipe is simple: pick an object or an idea and examine it from just about any conceivable angle. The result is a crop of books that includes volumes on dust and on longitude, on fire and on childhood, on salt and on excrement (yes, the title of the translation from the French original is a four-letter word). And, although not quite identical, the pitch of these books is clearly similar — they aspire to be science 'lite', accessible to the masses and hence fashionably promoted. *A Matter of Degrees* is one of the latest additions to this popular genre; the thread, in the author's words, is temperature.

As an incorrigible interdisciplinarian I am generally positively predisposed towards these amoebic topics. So why am I not