relatively late learnt one to build consistent models" or "this was, however, formulated not before 1855 by Virchow" are not uncommon. Futhermore, it is nothing less than a disgrace that there are so many errors in the rendering of German words into English — cybernetics as cybernetic, trypsin as trypsine, function as funktion, genome as genom among many other examples.

So, have the authors of *Biophysics* given us the definitive statement that we have been awaiting? Sadly, the book is too flawed to be acceptable in itself. If we try to forget the often appalling English, we cannot forgive the almost perverse way in which the authors have been allowed to exaggerate or ignore aspects of the subject in such an arbitrary fashion.

In this review I have drawn attention to the shortcomings of the book; unhappily, *Biophysics* falls a long way short of my hopes. It is, nevertheless, a remarkable achievement. The book contains a wealth of information, much of which is presented outstandingly well. It does indeed provide a definition of the scope of biophysics such as we have not had before — and the authors' work will be of the most inestimable benefit to their successors who seek to write a balanced and comprehensive text either for undergraduates or for research workers in biophysics. □

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Seeing heresy in its true colours

J.D. Mollon

A Cybernetic Approach to Colour Perception.
By N.C. Paritsis and D.J. Stewart.
Gordon & Breach: 1983. Pp.167. $29.50.

COLOUR vision attracts more than its fair share of books by amateurs, by eccentrics and by outright cranks. All of us — except the rare individuals who are completely colour blind — daily experience a vivid and elaborate range of hue sensations; and perhaps it is this subjective immediacy of colour, and the evident structure of our internal palette, that leads so many gallant amateurs to advance theories of colour vision.

But those who review books on colour vision have good reason not to dismiss too lightly the writings of newcomers to the field. The reason is George Palmer. Definitely an amateur and definitely eccentric, Palmer in 1777 published his *Theory of Colours and Vision* in which he correctly suggested that all our sensations of hue depended on just three kinds of retinal receptor and that the sensation of white arose when all three types of receptor particle were thrown into motion. In later monographs this prescient but mysterious man suggested that colour blindness resulted from the impairment of one or more of the receptor types and that complementary colour after-images arose from differential fatigue of the three types. All this, some 25 years before Thomas Young gave his celebrated Bakerian lecture and commended the trichromatic theory to the Royal Society.

Nevertheless, despite the sobering example of George Palmer, I must be direct and declare that the present book is amateur, is distinctly eccentric and can be safely passed over by specialists in the field.

The early chapters of *A Cybernetic Approach to Colour Perception* offer a pedestrian history of colour science and an introduction to model neurones. The authors then proceed to the first part of their theoretical work: the spectral sensitivities of Lateral Geniculate cells are quantitatively reconstructed from transformations of the spectral sensitivity curves of the photoreceptors. By allowing themselves some elaborate transformations, the authors obtain some very good fits to the classical electrophysiological records of De Valois. But the precision they attempt is quite inappropriate in view of the photoreceptor data with which they begin. To obtain spectral sensitivity curves for the receptors, they average together the densitometric measurements that Rushton disowned in 1964 and the early microspectrophotometric data, for macaques and man, published in 1964. They ignore species differences, and they give no details of the corrections (if any) that they have made for absorption by lens and macular pigment and for variation in the retinal region that is stimulated.

The second part of Paritsis and Stewart's theory is qualitative. They propose the existence of single cortical cells that are specific for the seven hues — red, orange, yellow, green, blue, indigo, violet — that Newton's assistant distinguished in the spectrum. Mutually inhibitory connections exist between the neurones specific for different hues. To account for colour constancy and contrast phenomena, the authors postulate a small number of special cells, called "adaptors", that collect information about average luminance and average chromaticity across the visual field; the adaptors feed forward and adjust the sensitivities of more central units that are specific to the colour of stimuli in a local retinal region.

There is the germ of a good idea here. But the authors finally hang themselves when (p. 119) they use reciprocal inhibition between pairs of central neurones to explain why grey or white is seen when lights of complementary colour are mixed. It is a tenet of modern colour theory that the results of colour mixing can entirely be explained in terms of the quantum catches in the three classes of retinal cone. If two lights are of different spectral composition but produce the same set of quantum catches, then they will look alike to the observer. Complementary lights are simply lights that, when mixed in the correct proportion, yield the same set of quantum catches as does white light. At all subsequent stages the neural signals are the same as those produced by white light and, within the context of the authors' theory, *none* of the seven types of central hue-coding neurone will be active. It is always good that there should be those who question the basic dogmas of any scientific field; but here it is clear (see p. 120) that the authors do not realize the seriousness of their heresy and are either confused or ambivalent in their espousal of it.

If my judgement of this book is harsh, the authors may take comfort in the spectacular error of one eighteenth-century reviewer. Most journals ignored George Palmer's monograph of 1777, but one review did appear in the *Monthly Catalogue* for that year. It runs to a single line, and is reproduced below.

Art. 49. *Theory of Colours and Vision.* By G. Palmer. 8vo. 1s. Leacroft. 1777.
A *visionary* theory without any *colour* of truth or probability.

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