Perturbing events in the Galaxy

Gerry Gilmore

The Galaxy and the Solar System. Edited by Roman Smoluchowski, John N. Bahcall and Mildred S. Matthews. *University of Arizona Press: 1986. Pp.483. $29.95.*

FEW, if any, dinosaurs will read this review. It is also well established that the biological extinction at the Cretaceous — Tertiary boundary about 65 Myr ago coincided with a period of increased impact cratering on the Earth. Presumably these phenomena are related, though the cause and effect relationship between a comet hitting Earth and the extinction of species is not yet clear. Nevertheless, astronomical events apparently have a direct effect on biological evolution on Earth. It is of obvious (self-) interest to understand why large comets occasionally hit the Earth, and to predict when the next such event will occur. One clue to this came with the announcement in 1984 of a periodicity of about 30Myr in the record of biological extinctions. Such a periodicity and its consequences dominate this collection of review articles, despite the somewhat misleadingly general title.

The current model for the origin of comets is that they are perturbed from a large cloud, about 100,000 times the diameter of the Earth's orbit, which contains about 10^{11} comets in its outer parts and perhaps 10^{13} in its dense inner core. These comets are stirred gravitationally by stars and giant clouds of interstellar molecules passing at random, and some of them fall close to the Sun (and to us). So was the dinosaurs' fate due to a random event? Not if such extinctions are periodic.

Periodicity of extinctions requires periodic gravitational perturbation of the comet cloud, which can be accounted for only by the orbit of the Sun in the Galaxy, or by the orbit of a companion planet or star round the Sun. The prospect of a solar companion — soon named 'Nemesis', or the 'Death Star' — controlling the fate of life on Earth led, in 1984, to a burst of interest in the popular press, and a rash of speculation on the matter.

Now that the dust has settled a little, Roman Smoluchowski and his colleagues have put together a well-presented collection of reviews giving the data, the models and their predictions, as well as several good accounts of the properties of the interstellar medium near the Sun. It is now clear that the variations in both the galactic tide and in the probability that the Solar System will pass very near a massive cloud in the interstellar medium, as the Sun orbits around in the Galaxy, are too small to affect significantly the number of comets perturbed towards the Earth by interstellar clouds or by the variable galactic tide. So could a solar companion — planet or star — cause a comet shower of sufficient intensity to guarantee a large impact on the Earth? Given the low probability of such an impact, several billion comets would be required. One or more per day would cross the Earth's orbit, providing an entertaining spectacle at least.

A tenth planet seems unable to account for this. Reasonably detailed dynamical modelling shows that the comet showers it caused would be too long-lasting and of too low contrast to the background rate. Thus we are left with Nemesis. Apparently this could do the job, but only if it were allowed extremely contrived properties, not least among which is the instability of its orbit. If the Sun has a companion, it is just about to lose it for ever. The dinosaurs were indeed unlucky to live when they did.

There is, too, the question of periodicity in the record of biological extinctions. New statistical analyses and re-investigation of the precision of the stratigraphical dating have now been completed. There are well-established and reliably dated impact events and biological extinctions at ~ 35 Myr and ~ 65 Myr ago, so that cometary impacts do indeed seem to cause mass extinctions. But earlier events are less well-dated, and the claimed periodicity, on which the validity of the companion-star model relied, is not statistically significant. In consequence of this, the exhaustive and repetitive discussion of the relevant arguments in this volume becomes of mostly historical interest. While it makes fascinating reading, the book is more appropriate for a long journey than as a text or reference work.

All in all there is little evidence that the Sun has a companion 'Death Star'. But it does seem likely that the dinosaurs were treated to a spectacular warning of their impending demise as several billion comets arrived — even if these were, as seems most likely, a consequence of the random passage of a now-distant star. □

Gerry Gilmore is at the Institute of Astronomy, University of Cambridge, The Observatories, Madingley Road, Cambridge CB3 0HA, UK.

Better reception

Gordon L.E. Koch

Fundamentals of Receptor Molecular Biology. By Donald F.H. Wallach. *Dekker:1987. Pp.398. North America $85, elsewhere $102.*

ALTHOUGH one might not agree with all his pronouncements, one has to admit that Amstrad boss Alan Sugar's CTC (cut the crap) philosophy has made the products of the microelectronics revolution more widely accessible. So it is encouraging that similar ideas appear to be taking a hold in several areas of scientific publishing.

The CTC way of doing things is evident in the increasing use of a format in which large and complex subjects are broken down into bite-sized sections, each of which can be encapsulated in a single definitive statement. The experimental basis of the statement is then presented, together with an extensive bibliography to satisfy the demands of the more committed reader. The great merit of this approach is that the book can be read at several levels, or, perhaps more significantly, its scope assessed at a glance. It is particularly useful when dealing with subjects that require the coalescence of a variety of separate but interrelated disciplines under a single umbrella, such as molecular biology; indeed, the outstanding example of the success of this approach in recent times must be *Molecular Biology of the Cell*.

Wallach's stated intention in this book was to bring together accounts of a variety of disciplines bearing on the interactions between cells, especially at the molecular level. The bite-sized approach was therefore particularly appropriate, and an added concession to CTC is the use of a simple and, presumably, inexpensive print. It is this that has probably allowed the author to include some very contemporary studies on receptors. In general terms the book is a very satisfactory description of the key areas relating to receptor function. A particularly impressive feature is the extensive bibliography, which is a useful starting point for those wishing to delve into such specialist areas as hormone action, neurotransmitters and immune defence.

The general format of the book is as follows: it introduces the concept of information transfer between cells, examines the involvement of the cellular genetics systems in responses to information transfer, moves on to the role of the plasma membrane and then examines a number of systems such as the hypothalamus, pituitary, thyroid, pancreas, GI tract, steroid hormones, neurotransmitters, phagocytosis and the immune system in some detail, from the special perspective of intercellular information transfer. I thoroughly enjoyed reading *Fundamentals of Receptor Molecular Biology*, and learned much about subjects with which I thought I was quite familiar. □

Gordon L.E. Koch is a member of the scientific staff at the MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK.