RÉSUMÉ

Long shadow

VOLCANIC eruptions may cast a shadow over marine plankton, says A. E. Strong (*J. geophys. Res.* **98**, 985–987; 1993). In 1982, after the explosive eruption of El Chichón in Mexico, satellite monitoring of the colour of the Arabian Sea showed that the regular summer phytoplankton bloom was much smaller than in previous years. The southwest monsoon that year was also unusually weak. Strong suggests that the dense pall of volcanic aerosol, cutting out sunlight, could have had a twofold effect on plankton: cooler land temperatures could have caused the weaker monsoon, with knock-on effects on ocean currents and nutrient supply; and the reduction in sunlight could have directly affected photosynthesis. In July 1991, Mount Pinatubo hurled still larger quantities of aerosol into the stratosphere. The consequences of that eruption on plankton are not yet clear.

Monster mash

STARBURST or monster — this was the choice offered two years ago B. J. Jarvis and J. Melnick, discussing the violent nucleus of the galaxy M87. Where those astronomers favoured a compromise — a bit of both — J. Braine and T. Wikland plump for just the latter (*Astr. Astrophys.* **267**, L47–L50; 1993). The earlier authors had found spectroscopic evidence of a dense cluster of hot young stars in the galactic core. But Braine and Wikland looked for the molecular gas from which the stars would have formed, and found none. This rather undermines the idea that molecular gas both provides the unseen mass known to be pulling the galaxy's stellar population into the core, and fuels its brilliant radiation. Instead, the case for a massive black hole, the monster, at the galactic centre seems stronger than ever.

Boring defeat

A TEAM at CIBA–GEIGY report successful field trials on maize expressing a synthetic gene for part of an insecticidal δ-endotoxin from *Bacillus thuringiensis* (M. G. Koziel *et al. Bio/Technology* **11**, 194–200; 1993). Transgenic plants were produced by micoroprojectile bombardment. Hybrids with commercial lines were then created, and were tested in Illinois for resistance to the European corn borer, a severe pest in the mid-west of the United States. Each of the transgenic hybrids was subjected to the attentions of 2,400 larvae over a period of eight weeks, but shrugged off the challenge of both the first- and the second-generation insect infestations. In passing, the authors remark that pest resistance to δ-endotoxins in plants may evolve in time — this is a topic which R.M. May discusses in News and Views next week.

NEUROBIOLOGY

Theories on the brain

Charles F. Stevens

WE still do not have what could be called a theory of the brain. But the upsurge of interactions between theorists and experimentalists, as manifested at a meeting* late last year, offers the optimist hope that one is on the way.

The interests of the 18 participants — about half of them theorists and half experimentalists — reflected the current state of brain theory, although not necessarily what it should be: cortical function took centre stage, with hardly any mention of theories about structure of neuronal circuits, and the emphasis was on the visual system. The theoretical approaches (as represented at the meeting) fall into four distinct but somewhat overlapping groups. The first is artificial neural networks. Here there was presentation of an analysis of motion detection using a standard network approach, with the additional feature of an executive network that decides which elements of the motion detector deserve attention (T. Sejnowski, Salk Institute), and description of a network that constructs a three-dimensional representation of an image from a few particular views with an interpolation technique that is related to the morphing used to create dramatic special effects in motion pictures such as *Terminator II* (T. Poggio, MIT).

The second category involves relating neural architectures to particular jobs the brain must accomplish, as exemplified by analyses of pattern recognition in terms of requirements of neural architecture (D. Van Essen and C. Anderson, Washington University; S. Ullman, Weizmann Institute; D. Mumford, Harvard); Van Essen and Anderson also use a neural network as an existence proof for the feasibility of their proposed architecture. Here the stress is on the importance of architectures that use feedback from higher to lower levels, as opposed to the strict hierarchical architectures favoured by some earlier workers, with relation of theory to the forward and backward neural pathways that interconnect various cortical areas involved in vision.

The third type of theories are those centred on some unifying notion. Hence the proposal (W. Singer, Max Planck Institute for Brain Science, Frankfurt) that the existence of synchronized firing across populations of neurons is a neglected but important organizing principle of neural information processing, and the argument (H. Barlow, University of Cambridge) that the cortex compares its input with stored models of previous inputs and separately processes the consequences of the match with the 'new' (that is, the aspects of the input that do not match the model). There is too the attraction of focusing on attention and temporary memory as possible key features necessary for our awareness of sensory events (C. Koch, Caltech; F. Crick, Salk Institute).

The final theoretical approach (my own, 1/18 of all theories) makes use of standard continuous mathematics to describe the computations carried out by cortex: truth to tell, most participants were not enthusiastic about the argument that the properties of synapses and the structure of neuronal circuits lead naturally to a mathematical formalism much like that used by the field theorists in physics.

Clearly, though, there are some distinct challenges for experimentalists in all this, not least in looking at selective attention and the necessity of routeing information selectively from one place to another. As Van Essen put it, "How can we write our name with our hand, our foot or our nose?". Some central motor program can be routed to various parts of the motor system, but the experimentalists have failed to provide a mechanism to accomplish this. Most of the proposals for how attention and information routeing might be achieved — other computations the brain must carry out require this as well — involve multiplication of one signal by another. But, again, the experimentalists have yet to demonstrate how this is achieved in any specific cases.

Then there is the question of how many neurons are necessary to carry out a particular task, an issue which arises in several contexts. How widely distributed are our representations, and how sharply tuned are the receptive fields of cortical neurons? If only a few neurons at higher levels of the visual system are involved in representing the image of grandmother, say, then neuronal noise becomes a serious problem. But making the connections needed to recognize a complex image (grandmother in a red hat) that is represented by large and only partially overlapping neuronal populations (grandmother versus red versus hat) presents, as Barlow stressed, an even more serious problem. The experimentalists have the tools to find out how many neurons are actually involved in simple representations — equivalently, how broadly tuned the receptive fields are at higher levels of the visual system, for example. The answer will be

** Large Scale Neuronal Theories of the Brain*, Idyllwild, California, 9–13 December 1992. Proceedings to be published later this year by MIT Press.