visual cell shows a particular preference for a given direction of movement, the deeper tectal cell responds best to a sound source moving in that direction. The columnar overlap of different sensory modalities has recently been re-examined (Dräger and Hubel, *Nature*, **253**, 203; 1975; *J. Neurophysiol.*, **38**, 690; 1975; Stein *et al.*, *Science*, **189**, 224; 1975). In both the cat and mouse, the map of the visual space is topographically coincident with the somatosensory representation of the animal's body. In the mouse, protruding whiskers cover the major part of the visual field. A tectal cell responding to gentle tapping of a whisker lies below a visual cell looking at that whisker. In those parts of the tectum involved in the visual field where no whiskers are in the way, somatosensory responses at deep levels are elicited from other parts of the body. For instance, inferior visual fields where the mouse may see its own paw are associated with tactile fields on the paw. The output of the tectum is then somehow coupled to the motor system such that the animal brings the source of stimuli into its central visual field. This has been demonstrated by directly stimulating different parts of the tectum electrically (Schiller and Stryker, *J. Neurophysiol.*, **35**, 915; 1972).

The hierarchical organisation of nerve cells, as found in the mammalian tectum, is the general principle on which all nervous systems are constructed. At each successive level, incoming messages are further processed, and the stimulus features to which a neurone will respond become more specified. Elucidating the rules whereby important features of the external world are extracted and recombined by the nervous system has been one of the fundamental problems in neurobiology. It is toward this aim that a group of neurobiologists are gradually building up the basic 'wiring diagram' of the tectum. What developmental mechanisms ensure the formation of such an exquisitely ordered structure are likely to remain unknown for a long time. □

A hundred years ago

WE have received an address by Prof. R. H. Thurston, C.E., delivered to the graduating class of the Stevens Institute of Technology (U.S.). It is entitled "The Mechanical Engineer, his Preparation and his Work," and contains some excellent advice, useful not only to young engineers, but to all who have been trained to other mechanical professions. The Stevens Institute, though what we would call a technical college, affords a good general scientific training, with a fair admixture of literary culture, and the object of Prof. Thurston's address is to show that the more complete is the culture of an engineer, the greater is likely to be his professional success.

from *Nature*, **13**, 16; Nov. 4, 1875

Host selection by a parasitic mite

from F. E. G. Cox

MANY parasites make use of chemical signals to identify suitable hosts but in few cases have either the nature or the sequence of these signals been characterised. Arthropods usually exhibit a two-stage pattern of behaviour in which they first search for their hosts and then orientate themselves with respect to chemical stimuli emanating therefrom. Most studies on host finding have been based on insects such as mosquitoes that attack man (see for example Gillies and Wilkes, *Nature*, **252**, 388; 1974) but in this issue of *Nature* (page 788) Egan, Barth and Hanson describe how a mite that parasitises cockroaches locates and identifies its host. These authors used simple two-choice preferential tests and the attractant substances were applied to paper disks under controlled conditions. In all, the responses of 12,000 mites were examined. In itself, this study has little practical application in the immediate future, but it opens up possibilities of analysing the factors that cause mites to attack man and his domesticated animals and the development of methods of protection against these ectoparasites and the diseases they transmit.

The mite used was *Proctolaelaps nauphoetae* which is specific to and gregarious on the cockroach *Nauphoeta cinerea*. *P. nauphoetae* is first attracted to faecal materials and the sorts of things that occur in cockroach nests, such as pieces of limbs and rotting organic material. The identification and orientation towards such materials is likely to bring the mites to a cockroach nest, and it was confirmed that they can recognise nest "markers" because they preferentially seek out individuals that have been living in colonies, in contrast to those of the same species that have been living alone, and they are also attracted to non-host species that have been placed in host colonies.

Having come into the proximity of a cockroach colony, a second level of attraction enables the mites to identify cockroaches belonging to the same family as the host and to avoid others. The attractant consists of the expectorants which are spread over the body during grooming. The mite has then to determine whether or not the cockroach is the appropriate host species. The actual substance that is used was isolated by placing paper disks in the colony and extracting the attractant from them. The authors tentatively identify this substance as a poly-amino sugar and call it "nauphoetamine". The identification of "nauphoetamine" by the mite is the final stage of the host-finding behaviour but it is important to note that chemical stimuli are involved in the first two stages: the recognition of the proximity of any kind of colonial cockroaches by faecal and detritus stimuli, and direct orientation to expectorants which brings the mite to a particular group of coackroaches which might or might not be the correct host species.

The fact that the mites show three separate levels of discrimination and that one at least of the attractants can be isolated means that it should be possible to attract mites away from potential hosts or towards pest species if biological control is the aim. Even if these studies do not lead to any further progress in the manipulation of mites they will be of general interest to parasitologists in several areas where host finding and identification are poorly understood and at present, in the case of warm blooded animals, often simply attributed to host temperature. □

Is submicrominiature small enough?

from Andrew Holmes-Siedle

SOLID-state science has made it possible to put all the circuits of a computer onto a piece of silicon no larger than a postage stamp (say 1cm² in area). It is reasonable to ask how much further one should try to go. Should we now put the computer onto a pinhead or put a faster, more versatile computer with much more storage onto the same square centimetre? The idea has its attractions because we are never short of information to process (visual information flows in on us at more than 10 million bits per second, for example), and it saves energy if we cut down the amount of purified electronic material needed to make the circuits.

Two authoritative surveys on the ultimate limits to the density of electronic functions on a wafer of electronic material have appeared recently. One, by J. T. Wallmark (*Institute of Physics Conf. Ser.* No. 25, 133; 1975), starts from the practical necessities of integrated-circuit technology and, through original calculations, reaches quantitative conclusions. The other, by R. W. Keyes of IBM Research Centre (*Proc. IEEE*, **63**, 740; 1975) starts from some basic laws of device physics, collects results of many other workers and produces a set of conceptual tools rather