

increase in age from one end of the chain to the other, they have been attributed to the motion of the Pacific plate over a stationary hot spot, possibly related to a mantle plume (although other explanations are possible). The bend in the chain is then thought to be due to a sudden change in the direction of Pacific motion which can be dated from the monotonic age pattern of the islands at 42–45 Myr. But the geomagnetic reversal frequency also changed significantly at that time. Thus within the errors of dating, the only conspicuous changes in Pacific plate motion and reversal frequency during the last 70–80 million years coincide. Moreover, other tectonic changes took place at the same time in other parts of the world. In the Reykjanes ridge area south of Iceland, for example, the 45 Myr isochron marks the largest change in the direction of motion between Greenland and Europe, a change which gave rise to the generation of numerous small transform faults.

The second magnetic event examined by Vogt was the ending 70–77 Myr ago of the Mercanton interval, a 30–40 Myr period during which there were few or no reversals. At this time, sea-floor spreading first began south of the Rockall Bank in the northeast Atlantic and the Meteor and Corner Rise seamount groups were formed. In addition, there was a major change in the trend of the fracture zones in the central North Atlantic, a reflection of what appears to be the most prominent change in spreading direction between North America and Africa during the whole 180 Myr existence of this ocean basin. Other major plate tectonic changes also took place about 115 Myr ago when the Mercanton interval began and the earlier Keathley sequence of reversals (150–115 Myr) ended.

But if these correlations are manifestations of core–mantle coupling, the problem of precisely how the coupling occurs remains. Vogt clearly favours a return to the idea of mantle-wide convection, the most obvious and traditional physical link between the core–mantle boundary and the near-surface processes. In this case, the geometry of the convection would change from time to time, thereby directly influencing the plate motions above and at the same time changing the boundary conditions at the core–mantle interface and hence the reversal frequency within the core. Whole-mantle convection has not received much support in recent years. Since Wilson's basalt correlations (which are not mentioned by Vogt) were discovered, however, an alternative form of mantle-wide motion has been proposed in the form of mantle plumes. These would seem to offer a connection between core and

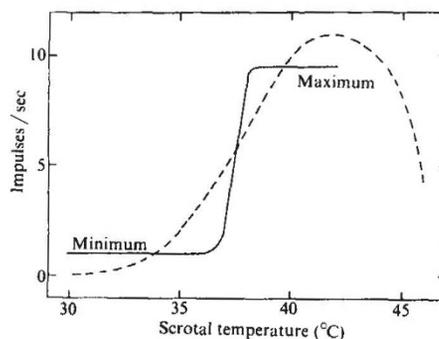
plates which is both more direct and perhaps more attractive to today's earth scientists.

Convergence of information in thermal pathways

from Shin-Ho Chung

NEUROPHYSIOLOGICAL studies of different sensory systems have shown that incoming information undergoes drastic modification as it proceeds along the pathways of the nervous system, the degree of modification increasing as messages proceed centrally. Such hierarchical organisation is a general principle upon which all the nervous system is constructed, and understanding the transformation of information at each level has been the dominant preoccupation of sensory neurophysiologists over the past two decades. Two recent articles by Hellon, Hensel and Schäfer (*J. Physiol., Lond.*, **248**, 349–357; 1975) and Hellon and Mitchell (*ibid.*, 359–376) describe the successive steps taken by the nervous system in processing the information generated by thermoreceptors.

Primary sensory fibres arising from 'cold' and 'warm' receptors in the rat scrotum show action spectra resembling bell-shaped curves when frequency of impulses is plotted against scrotal temperature. The size of each receptive field is about 1 mm². These inputs are integrated by cells in the spinal cord; however, cells in the cord no longer have spot-like receptive fields but are sensitive to temperature changes over the entire extent of the scrotum. Alteration of the response pattern is most clearly seen in the behaviour of cells in the thalamus. Unlike the bell-shaped action spectra of primary afferents, thalamic cells exhibit an on-off pattern of firing (see figure). A cell remains silent until a critical temperature is sensed, after which it fires at its maximal discharge frequency.



Action spectra of 'warm' receptors in the rat scrotum (broken line) and of thalamic neurones (continuous line). From Hellon and Mitchell, *J. Physiol., Lond.*, **248**, 349–357; 1975.

Different cells in the thalamus have different critical temperatures (Hellon and Misra, *J. Physiol., Lond.*, **232**, 389; 1973). Thus, at the expense of spatial discrimination, activities of primary afferents are integrated by the central nervous system and, as thermal assault on the testes intensifies, more neurones are recruited in their defence. This is a sensible physiological arrangement, for the ability to discriminate which side of the scrotum is warmer is unlikely to serve any useful biological purpose.

Language understanding by computer

from Arnold G. Smith

A conference at MIT on June 10–13 entitled "Theoretical Issues in Natural Language Processing" was aimed at scientists working on computer models of language either in order to study the human mind, or with the more pragmatic goal of "teaching computers to speak English".

ATTEMPTS to create computer systems which understand English raise issues which reach deeply into linguistics, computer science, psychology and even philosophy. Earlier work in this field led to the realisation that a reasonable model of language comprehension would require the active use of a potentially vast amount of 'common sense'. Common sense is called upon continually though often unconsciously in making sense of what we hear, but how does one design a computer program to function analogously, organising a large corpus of knowledge so as to have the appropriate facts available at the appropriate moment? Marvin Minsky's concept of frames is the currently fashionable approach to answering this question, although it generated a great deal of controversy at the meeting.

Minsky (from MIT) was there to explain his ideas. He uses the term 'frame' basically in the sense of frame of reference, in the light of which one makes sense of a sentence, a story or a scene. An intelligent person presumably has a very large number of such frames stored away in a richly interconnected structure. At any point one of these frames is in charge of interpreting and interacting with the current environment. It has its own procedures which look for evidence to confirm its relevance to the situation at hand and, when something turns up which is inconsistent with or beyond the scope of the current frame, it has