occupied the attention of people such as Lashley in the United States, Konorski in Poland and, notably, Hebb in Canada, but in recent years, learning theory has become more distant from neurophysiology. This is a great pity, but the experiments of Newsome *et al.* and the recent investigations of the neural basis of conditioning in the cerebellum[7] may rekindle interest in the fundamental questions of the neuronal influences of learning.

One feature of the experiment may have contributed greatly to its success. The monkey indicated its response by moving its eyes in the direction of stimulus motion. This is a very natural or, in the terminology of learning theory, 'prepared' response, which may have eliminated the need for a complex decision process between stimulus and response. If we ask what the nature of the decision process might be between MT and eye movement, the answer could be "none". Workers on visual perception and on eye-movement control mechanisms can be likened to two gangs of workmen tunnelling through the nervous system from opposite ends. They will meet soon and, on the evidence so far, they will do so without having to remove obstacles labelled 'perceiving' or 'decision process'. Such simplicity may be peculiar to eye-movement control, or it may be because this is the only stimulus–response system in primates that we understand in such detail. □

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PALAEOCLIMATE

The desert shall rejoice

Wayne M. Wendland

MOJAVE Desert, which lies between Las Vegas and Los Angeles, and includes Death Valley, is the most arid region in North America. But sediments show that more than 8,000 years ago, this area was a massive lake. Detailed studies of the sediments, reported by Enzel and *et al.* elsewhere in this issue (*Nature* **341,** 44–47; 1989), show that the area supported lakes for prolonged periods about 3,600 and 400 years ago, as well. The obvious inference is that the changes indicate significant variations in climate during these periods.

To translate the kind of environmental information used by Enzel *et al.* into reconstructions of the palaeoclimate, it is necessary to find modern analogues that can be related to known weather patterns. Geological, geomorphic, archaeological and botanical evidence have all been used in this way. Although the conclusions from one such exercise can be equivocal, confidence clearly must grow in a climatic reconstruction if independent types of evidence indicate the same conclusion.

How reliable are such reconstructions? Apparently, they are quite good. The location of the main features of atmospheric circulation (the sub-tropical highs, sub-polar lows, jet streams and so on) have remained fairly constant throughout the Holocene (the past 10,000 years), as have their mean intensities and variance. This is not so surprising, as the main components forcing climate — Earth's orbit and the topography and distribution of land masses — have not changed significantly over this period. So modern analogues are reliable guides to the earlier climate, and together these indicate the variability of the Holocene weather.

The CLIMAP and COHMAP projects are prime examples of concerted efforts of research of this type. The participants in

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Aridity in Death Valley, Mojave Desert — a cause for caution.

CLIMAP (*Science* **191**, 1131–1144; 1976) gathered extant data on the concentration of plankton from deep-sea cores of the world's oceans to reconstruct sea-surface temperatures representative of Augusts 18,000 years ago, comparing variations with a modern relationship between plankton and sea-surface temperature. They found that sea-surface temperatures in the high latitude Atlantic and Pacific Oceans were depressed by as much as 4 °C relative to today. Along the west coast of South America and in the central Pacific near the equator, temperatures were up to 6 °C colder. Interestingly, all central oceans exhibited no change at about 20° S latitude.

In a somewhat different approach, a component of the COHMAP project involves reconstructing pollen assemblages for many locations based on general circulation characteristics for various times in the past 18,000 years (see T. Webb, P. J. Bartlein & J. E. Kutzbach in *North America and adjacent oceans during the last glaciation* (eds W. F. Ruddiman & H. E. Wright Jr) 447–462 (Geol. Soc. Am., Boulder, 1987)). The prehistoric general circulation is generated by a numerical circulation model whose boundary conditions are known sea levels and glacial extent for those times. The reconstructed pollen assemblages from the model match the extant record to a remarkable degree, thus verifying the method.

Enzel *et al.* link the existence of the perennial lakes they identify in the Mojave Desert to circulation patterns over the central and eastern Pacific Ocean. The modern analogues they use are eight episodes of increased rainfall since 1894 that led to the formation of ephemeral lakes, lasting 2–18 months, in the terminal basins of the Mojave River. The full climate record, including temperature, pressure, wind and humidity observations for the surface and upper air extends back only four decades, but the authors assume that it represents adequately the variance of the main features of the circulation pattern.

The climate of southern California and the San Bernadino Mountains is essentially mediterranean — warm and dry in summer, wettest in the winter. This is related to the seasonal migration of the polar jet stream, associated surface fronts off the Pacific and the Pacific sub-tropical anticyclone. Times of increased rainfall tend to be linked to an anomalous displacement to the south of these circulation features.

The mean sea-level pressure on the Californian coast tended to be strongly depressed during the wet episodes, and probably forced on-shore flow and moisture over southern California into Mojave. The inference is that similar sea-level pressure patterns persisted during the periods when perennial lakes were found in the Mojave. This is a significant addition to the data for this region and period, and the way it fits into the global pattern of inferred pressures will be fascinating to see. □

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