tion of the cuff was verified. Two rats were found to have nonfunctioning cuffs; their scores were therefore excluded from the analysis. The analysis of variance and specific comparisons were based on the other eight rats. The rats clearly preferred the nutrient paired flavor [$F(1,7) = 17.35$, $P < .01$] (Table 1).

It seems that the stomach can recognize some components of food and signal their arrival rapidly to the central nervous system, where such messages produce reinforcement. So far, the presence of nutrient sensors in the duodenum, signaling to the brain via the release of cholecystokinin, has been postulated (*4*). The presence of nutrient sensors above the level of the duodenum must also be considered. The mechanism by which the sensors in the stomach transmit their signals to the central nervous system remains to be elucidated.

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References and Notes

1. A Puerto, J. A. Deutsch, F. Molina, P. L. Roll, *Science* **192**, 485 (1976).
2. S. Balagura and H. C. Fibiger, *Psychonom. Sci.* **10**, 373 (1968).
3. J. A. Deutsch and W. T. Hardy, *Behav. Biol.*, in press.
4. J. Gibbs, R. C. Young, G. P. Smith, *J. Comp. Physiol. Psychol.* **56**, 645 (1973).

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Sea Straits and Glacial Periods in the Red Sea

Deuser *et al.* (*1*) compared oxygen isotopes in tests of foraminifera from sediments of the Gulf of Aden with those from the Red Sea. In glaciated periods they found an ^{18}O enrichment of 2 per mil in the Red Sea tests, which corresponds to an excess salinity of 6 to 7 per mil in the Red Sea over the Gulf of Aden. Today this excess salinity is only 3 per mil. Deuser *et al.* concluded that "during the periods of maximum glaciation the climate in the area of the Red Sea was, on the average, considerably drier than today."

This conclusion seems to be in conflict with what is known about flow through sea straits. Deuser *et al.* stated that lowering sea level would reduce the exchange between the Gulf of Aden and the Red Sea. However, the implication of such a reduction would invalidate their conclusion about the paleoclimate of the Red Sea.

The Red Sea is in a state of frictional overmixing such that the exchange through the Strait of Bab al Mandab is limited by critical Froude conditions (*2*). The salinity difference $\Delta s = s_2 - s_1$ between the discharge from the Red Sea, s_2, and the inflow to the Red Sea from the Gulf of Aden, s_1, is related to the bathymetry of the strait and the excess evaporation over the Red Sea according to

$$\Delta s \; \alpha \; q^{2/3} L^{1/3} Y^{-2/3} D^{-4/3}$$

or

$$\frac{q^*}{q} = \left(\frac{\Delta s^*}{\Delta s}\right)^{3/2} \left(\frac{D^*}{D}\right)^2 \left(\frac{Y^*}{Y}\right) \left(\frac{L}{L^*}\right)^{1/2}$$

Here q is the excess evaporation over the Red Sea, and L, D, and Y are the length, depth, and width of the strait. Quantities with asterisks refer to glacial periods, and those without asterisks refer to the present. The salinity (or ^{18}O) differences are thus more sensitive to changes in depth than to changes in the evaporation rate.

For present-day conditions one may characterize the Strait of Bab al Mandab by the parameters (*2*) $L = 160$ km, $Y = 18$ km, $D = 180$ m, $q = 28000$ m^3/sec, and $\Delta s = 0.003$. The sea level lowering at the maximum of the glacial period was 130 m (*3*), and on the average I will conservatively assume a lowering of 80 m. The glacial parameters in the above equation can then be approximated by $L^* = 160$ km, $Y^* = 12$ km, and $D^* = 100$ m. Adopting the estimate $\Delta s^* = 0.007$ of Deuser *et al.*, I obtain

$$q^*/q = 0.73$$

Thus, it seems more likely that during glacial periods the climate of the Red Sea area was similar to or somewhat more humid than that of today.

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References

1. W. G. Deuser, E. H. Ross, L. S. Waterman, *Science* **191**, 1168 (1976).
2. G. Assaf and A. Hecht, *Deep-Sea Res.* **21**, 947 (1974).
3. K. O. Emery, *Sci. Am.* **221**, 106 (September 1969).

6 August 1976

I am grateful to Assaf for applying his model for the water exchange through straits (*1*) to our data in order to check the implications for the Red Sea climate during glacial times (*2*). I am not convinced that the model with its implicit and explicit assumptions and simplifications can do justice to the complexities of nature, but I will not argue about its applicability in this space nor take issue with Assaf's choice of dimensions for the Strait of Bab al Mandab (*3*). However, even if the value of 0.73 for the ratio of glacial to present excess evaporation over the Red Sea were correct, Assaf's conclusion is not valid. An 80-m drop of sea level during glacial times reduced the surface area of the Red Sea by 37 percent (*4*). Therefore, the evaporation had to take place over an area a^* which was only 63 percent of the present surface area a. The climatically significant quantity in the context of our report (*2*) is excess evaporation per unit area of sea surface, e, and not the net influx, q, of water through the Strait of Bab al Mandab. Using Assaf's asterisk notation and his influx ratio of 0.73, I obtain

$$\frac{e^*}{e} = \frac{q^* a}{q a^*} = \frac{0.73}{0.63} = 1.16$$

Thus, whatever the merit of the model calculations, it still seems likely that during glacial periods the climate in the Red Sea was drier than today.

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References and Notes

1. G. Assaf and A. Hecht, *Deep-Sea Res.* **21**, 947 (1974).
2. W. G. Deuser, E. H. Ross, L. S. Waterman, *Science* **191**, 1168 (1976).
3. For the most detailed bathymetric survey of the sill area at the southern end of the Red Sea, see F. Werner and K. Lange, *Geol. Jahrb. Reihe D* **13**, 125 (1975).
4. I calculated this value by planimetry of the areas within the coastline and the 50- and 100-m depth contours on the map of M. Pfannenstiel and G. Giermann [in S. A. Morcos, *Oceanogr. Mar. Biol. Annu. Rev.* **8**, 73 (1970)] and interpolating the 80-m value.
5. Inasmuch as I was responsible for drawing the conclusion in our jointly authored report (*2*) which was questioned by Assaf, I assume responsibility for this reply. Supported by NSF grant OCE73-06586.

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Galilean Satellites: Anomalous Temperatures Disputed

In a recent report, Gross (*1*) argues that the observed infrared brightness temperatures of the Galilean satellites are significantly higher than temperatures calculated on the assumption that these largest satellites of Jupiter are in equilibrium with the incident sunlight. He therefore suggests that their surfaces are being heated above equilibrium values by energetic atomic particles in the Jovian magnetosphere but notes that the observed particle fluxes are about an or-