create their own conduits in the form of vertical, chimney-like columns. Only the formation of sea-ice during the winter would prevent further upwards growth of the columns.

To our knowledge, the Ikka columns represent a phenomenon unique in the world. The now inactive tufa towers found at the shores of Mono Lake9,10 and Pyramid Lake5—8, in the western United States, may represent structures formed in a similar way to the Ikka columns, but in non-marine environments. The high scientific and aesthetic value of the Ikka columns make them appropriate for international protection.

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Saccades without eye movements

When reading text, human subjects use a pattern of eye movements consisting of fast saccadic movements and fixations1. We have found a subject who cannot make eye movements. Her visual perception is surprisingly normal and she is able to read at high speeds. She uses movements of the head to compensate for the absence of eye movements. Her head movements during reading have a saccadic character and show many of the features that characterize eye movements.

Our subject, AI, is a 21-year-old female university undergraduate. As a result of an apparently congenital, extraocular muscular fibrosis resulting in ophthalmoplegia, AI has had no eye movements since birth. However, she reports no major visual problems associated with her deficit and receives no extra assistance, either with reading or writing, in her studies.

The presence of an optokinetic nystagmus (OKN) response is often taken as an indication of the presence of any residual eye-movement function2. We used a sensitive eye-movement recorder3 to track her eyes during fixation and when presented with a large-field sinusoidal grating. The only eye movements that we recorded were very restricted drift movements (±0.5 deg at most) which were not linked to the stimulus motion. Normal subjects showed a standard OKN response to this stimulus which is consistent with slow but not abnormal reading4. This impressive reading speed is supported by movements of her head (Fig.

**Figure 1** Recordings of head and eye movements. a, Head movements from AI (left) and eye movements from a control subject (right) during text reading recorded using a head-mounted search coil. Gaze position was sampled at 40 Hz. The horizontal eye or head displacement (left is down) is plotted against time. The slight overshoot in the eye-movement records is due to lens distortion5. AI is considerably slower overall and her head stability is not as good as that of the control subject. There seems to be a small, high-frequency tremor, probably reflecting the inherent instability of the head over the eye. b, The distribution of fixation durations and head movement sizes during single-sentence reading. Records were divided into fixation and movement periods on the basis of a velocity exceeding 10 deg s\(^{-1}\) over a 125-ms period. This eliminates the small-tremor head movements during fixation but allows for the detection of the onset of larger movements. AI’s head movements are characteristic of normal eye-movement during reading. c, AI’s head movements while viewing pictures, taken from the study of picture scanning by Yarbus4. The pictures were viewed for 20 s and head position was sampled at 100 Hz.
Site of particle selection in a bivalve mollusc

Bivalve molluscs form dense populations that exert profound effects on the particle loads and phytoplankton composition of coastal waters. It has long been known that bivalves can select among different particle types, including selecting against those of poor nutritional value, but because of difficulties in observing particle transport processes in the pallial cavity in vivo, the mechanism of selection was not known. We now use a combination of video endoscopy and flow cytometry to show that oysters can select living particles from non-living detritus on the gills. Our methods could aid the study of suspension feeding in many animal groups.

Oysters dominate estuarine bivalve assemblages throughout the world and form dense reefs that may strongly affect the seston of estuaries. To determine whether oysters can select among the mixture of living and non-living particles, we studied the western North Atlantic (Crassostrea virginica) and the Pacific (C. gigas) oysters. We observed particle transport directly using a surgical endoscope, and with the aid of a micromanipulator we positioned a sampling pipette to sample particles from ciliated transport tracts. We distinguished and counted particle types using flow cytometry.

We fed the oysters a mixture of two equally sized but qualitatively different particle types, the red-coloured microalga Rhodomonas lens, and ground dead leaves and stems of the cord grass Spartina alterniflora. The S. alterniflora had been lying above the highest extent of the tide for at least four months and presumably was less nutritious than the living microalgal cells. Spartina spp. salt marshes line the fringes of most eastern North American estuaries and Spartina spp. detritus is an important component of the seston.

Oysters have a plicated, heterorhabdic gill with principal and ordinary filaments that allow transport of particles dorsally or ventrally on the gill. Particles may be moved dorsally on the gill to a ciliated tract that drives particles anteriorly in a slurry. Alternatively,

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**Figure 1** Feeding selectivity by oysters. **a**, Frame from video of the ventral ciliated tract of C. gigas, showing concentration of beige S. alterniflora detrital particles. **b**, Dorsal ciliated tract, showing concentration of red R. lens algal particles. **c**, Flow cytometric plot for C. virginica showing relative abundances of R. lens (red) and S. alterniflora detrital particles (blue) in the ventral margin, and **d**, from the dorsal tract. C. virginica (Friday Harbor Laboratories) and C. gigas (Southampton College Marine Laboratory) were exposed in a static chamber to 10^10–10^11 cells per litre, roughly equally distributed between live R. lens and detrital S. alterniflora particles. Particles were sampled after equilibration (30 min). Pseudofaeces were sampled and disaggregated for analysis. Particles were analysed by flow cytometry (Becton Dickinson FACScan bench-top flow cytometer) using detectors for forward scatter, side scatter, chlorophyll (fluorescence >650 nm), and phycoerythrin (fluorescence 560–590 nm). Heterogeneity among sorting efficiencies was significant (Kruskal-Wallis test, P<0.05), showing positive selection for R. lens in the dorsal tract and enrichment of detrital particles in the ventral tract and pseudofaeces.