tonic hyperpolarization of the jaw-closer masseteric motoneuron in the decerebrate cat, associated with asynchronous activation of cutaneous trigeminal afferents, is accompanied by an increase in synaptic activity (*12*). Hyperpolarization of jaw-closer motoneurons induced by this pattern of stimulation of mucosal afferents is accomplished by a postsynaptic inhibitory mechanism, in which the synapses that mediate the inhibitory postsynaptic potential are located in the region of the soma (*4, 12*).

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Pontine Reticular Formation Neurons and Motor Activity

The conclusion of Siegel and McGinty (*1*) that "activity in pontine reticular formation neurons is more closely related to motor output than to sensory input" is correct but incomplete. They overlook an obvious hypothesis which explains their findings, namely, that the pontine reticular formation (PRF) unit activity is related to eye movement. There is an extensive body of work which shows that the PRF contains the neural mechanisms for producing conjugate slow and rapid horizontal eye movements. This conclusion is based on analysis of PRF lesions in humans (*2*) and animals (*3*), on gross potential changes associated with rapid eye movements in the PRF (*4*), on stimulation studies of the PRF (*5*), and on the analysis of the activity of single nerve cells in the PRF of the alert cat, rabbit, and monkey (*6*). Henn and I (*7*) have shown that PRF cells which fire before and during rapid eye movements code the necessary activity to induce these eye movements. This activity is organized according to a polar coordinate system with individual cells coding a representation of overall amplitude of eye movement, of direction of eye movement, and the components of eye movement in the pulling planes of the individual eye muscles. "Blink" units are also found in the PRF and are probably similar to the units that Siegel and McGinty describe as "flinch" units.

Other areas of the brainstem including the vestibular nuclei (*8*), the prepositus nucleus, and the adjacent medullary reticular formation (*9*) are also known to have cells whose activity is related to eye movements. These regions project to neck motoneurons. Consequently, individual units might be expected which would fire in association with head movement.

In short, Siegel and McGinty appear to have reaffirmed previous work which shows that motor activity is widely represented in PRF neurons. What they apparently failed to realize is that this activity is predominantly related to eye movement. Representation of head movement in some PRF neurons might also be expected, as shown in figure 1D of their report; and perhaps that is a new finding. However, before accepting this conclusion, one would have to be certain that the cats were not looking at the body part they were grooming.

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Activity in cat pontine reticular formation (PRF) cells is not, as Cohen suggests, "predominantly related to eye movement." We tested for eye movement relations in every cell we encountered, polygraphically recording and visually observing eye movements while monitoring unit discharge. We also tested for unit activity correlated with eye blinks elicited by corneal stimulation in all cells. A number of cells related to eye movement were observed, but histological analysis localized these cells to the region of the abducens nucleus, in agreement with previous studies in the cat (*1*). The gigantocellular tegmental field (FTG) units that we identified as head movement cells, the most common cell type, all showed intense discharge without any eye movement. Conversely, rapid eye movements (REM) and maintained eye positions in both the horizontal and vertical planes without accompanying unit discharge were observed in each of these cells. Since head movements tend to be associated with eye movements these cells do show a general correlation with eye movements. Cells specifically related to eye movement may exist in the PRF (*2*), but clearly they are not the predominant cell type in the FTG area, which comprises most of the PRF.

Several other findings illustrate the lack of relationship between unit activity in most FTG cells and eye movement. (i) During adaptation to head restraint, FTG unit firing decrement correlated closely with decrease in neck electromyogram (*3, 4*), not electrooculogram (EOG). (ii) Most cells habituated to rapid head acceleration in conjunction with changes in neck muscle tone. However, EOG response to such stimulation does not habituate. (iii) Operant conditioning of increased firing rate in those FTG cells which appeared to discharge in relation to head movement was accompanied by repetitive head movements. In no case did we observe a conditioned increase in unit firing correlated only with increased eye movements. (iv) During REM sleep many of these cells discharge in long intense bursts. This firing does not result from increased numbers of eye movements (*5, 6*). (v) Many FTG cells were found to be entirely unrelated to head or eye movement. We have observed cells which discharge in close relationship to directionally specific tongue movements. Other cells exhibited activity related to facial musculature and to specific postures (*4*). It would be difficult to reconcile such findings with the claim that FTG cells relate predominantly to eye movement.

In monkeys, eye movement cells are not uniformly distributed throughout the PRF, but tend to be restricted to dorsomedial regions (*7*). Similarly, neurons related to vestibular nystagmus in the cat are not distributed throughout the PRF, but rather are sharply localized to dorsomedial regions, especially the area caudal to the abducens nucleus (*2*). While some connections exist (*8*), horseradish peroxidase studies have not revealed a major projection from the FTG region to the oculomotor nuclei (*9*).

Stimulation in the PRF produces com-

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plex head and body movements in the unrestrained cat and monkey. Only in restrained animals does the stimulation effect appear to be restricted to eye movement (*10*). Lesions in this area produce gross deficits in posture and head movements, as well as disturbing eye movements (*11*).

Eye and head movements are normally coordinated and therefore it should not be surprising that eye movement relations have been found in cells related to head and other movements. Indeed, as Bizzi *et al.* (*12*) have pointed out, neck muscles are activated prior to eye muscles in coordinated movements. Neck muscle activation can also be detected in head-restrained animals. Most studies of eye movement relations in PRF cells have been performed in head-restrained animals. Therefore, correlations between activity in head movement cells and EOG in these preparations might speciously suggest that these cells were triggering eye movements. Conclusions from studies that examine the relationship of unit discharge to only one isolated behavior must be cautiously interpreted and cannot confirm general conclusions about the cells' functional role.

We have now examined a large portion of the medial brainstem reticular formation in unrestrained, behaving cats in a variety of behavioral situations and find cells related to specific movements throughout this area. The correlations between PRF activity and habituation and conditioning processes (*13*), pain and escape behavior (*14*), treadmill stepping (*15*), REM sleep (*3, 6, 16*), and eye movements can be viewed as a consequence of the involvement of these movements in a variety of behaviors.

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Nautiloid Uroliths Composed of Phosphatic Hydrogel

Although it has been known for more than a century that nautiloid uroliths are composed chemically of phosphate of calcium with lesser amounts of magnesium, the true nature of this inorganic bioprecipitate was not known (*1*). We have investigated by x-ray diffraction the characteristics of these concrements, have related the nature of this inorganic substance to a theory governing the crystallization of phosphatic hydrogels, and have suggested a possible relation between these uroliths and "conodont pearls" described by Glenister *et al.* (*2*).

It was surmised that the uroliths might be francolite (carbonate fluorapatite) inasmuch as this is the crystallochemical nature of marine phosphorites (*3*) and the shells of inarticulate brachiopods (*4, 5*). However, no interference maxima were observed in an attempt to obtain a powder-diffraction pattern by x-rays (*6*). Furthermore, the chemical composition was found to be inconsistent with that of francolite, the carbon dioxide and fluorine being too low (*7*).

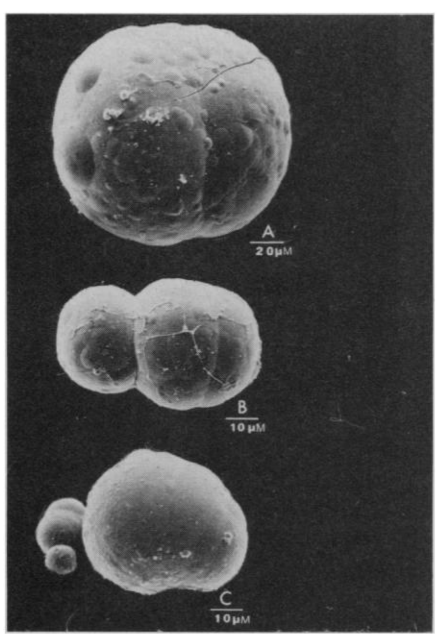

Fig. 1. Scanning electron photomicrographs of *Nautilus* concrements. Specimens A and B are from *N. macromphalus* from New Caledonia; specimen C is from *N. pompilius* from Fiji.

A similar amorphous, calcium-phosphate hydrogel was reported as a component of gizzard plates of a gastropod (*Scaphander lignarius*), but this was complicated by the presence of another crystalline phase (fluorite), and the water content was not determined (*8*). Lowenstam (*5*) subsequently found the gizzard plates of another species (*S. interruptus*) to produce no pattern prior to heating, after which the pattern of whitlockite was obtained.

Prior experience with phosphatic hydrogels had indicated that some of them, at least, could be induced to crystallize by heating them—thus reducing the water content—and thereby bringing them into consistency with a kinetic hypothesis for crystallization which proposes that an energy barrier exists that is directly dependent on the product of some functions of the cationic and anionic concentrations, but is inversely proportional to some function of the hydrogen concentration per volumetric unit (*9*). This hypothesis, to be sure, contains no clue concerning the crystal structure that will form; we had supposed that it might be dahllite.

When a small sample of pink spherules from *Nautilus pompilius* was heated for 24 hours at 600°C, it lost 21 percent of its weight and turned dark gray—presumably through carbonization of organic matter. The x-ray diffraction pattern of this heated substance was then found to be virtually identical with patterns of two analyzed samples of whitlockite (*10*). This result is consistent with the relatively high magnesium content of the nautiloid spherules (*12*).

Naturally occurring, amorphous, phosphatic substances seem to be unknown among fossilized materials. From the sizes and shapes (Fig. 1), the small nautiloid concrements described here might have counterparts as "conodont pearls" (*2*) within older sedimentary formations. Glenister *et al.* (*2*) were able to show merely a stratigraphic association with conodonts, aside from similarities in chemical composition. Their suggested relation to conodonts fails to account for the rarity or absence of