Chapter 17
Web Text Box 1

How Paramecium engages reverse gear

Paramecium, although it is a single celled organism, is a fast-swimming predator. Its surface is covered with hundreds of cilia that are arranged in rows that lie obliquely to the cell axis. Cilia beat with their effective stroke oriented towards the rear, propelling the cell forwards in a spiral motion. The beating of the individual cilia is coordinated to produce “metachronal waves” that pass from the front of the animal to the rear, rather like the wind passing across a corn field. *Paramecium* needs millisecond-to-millisecond control of its cilia as it swims through pondweed in search of prey. One reflex, the “avoiding reaction” was first described almost a century ago. When a *Paramecium* is swimming forwards the internal calcium concentration is kept low, at about 100 nmol liter^{-1}. When the front of the animal bumps into an object, the plasma membrane depolarizes, opening voltage-gated calcium channels in the cilia all the way down the animal. The influx of calcium ions raises the intracellular calcium concentration and this in turn causes the cilia to swing through 180^{o} so that the effective stroke is now directed towards the anterior. This causes the *Paramecium* to reverse a few body lengths, taking it out of contact with the object with which it collided. Calcium is now pumped out of the cell and the internal calcium concentration falls back to 100 nmol liter^{-1}. The cilia now swing back to their original position and forward swimming is resumed.