required to confirm the initial results and address questions such as those raised here. Cop-1 is not available for general use; it remains an investigative agent. Future supplies of a uniform, standardized Cop-1 preparation are not assured, and it is not clear when this agent will again become available for further testing. There are rumours of a 'black-market' in Cop-1. If so, it is important to recognize that there can be no assurance of source, quality, therapeutic effectiveness or safety with such preparations. □

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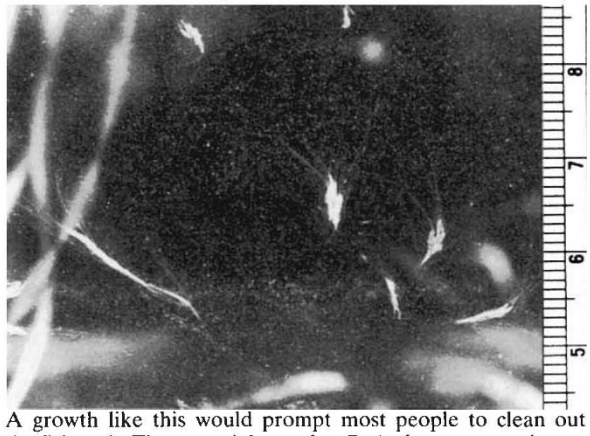
**Cell motility**

# Good things from slime

*T.J. Mitchison*

DURING the past few years, visitors to the Schliwa–Euteneuer laboratory in the University of California at Berkeley have been entertained by the gradual spread of a large freshwater amoeba over the available bench space. This organism, which resembles a large piece of slime, first appeared on the sides of a fish-tank (see figure) and has since colonized large numbers of petri-dishes. Currently this amoeba has become the main research focus for members of the laboratory who are interested in the rapidly developing field of intracellular motility. This example of zoological opportunism seemed initially to be an amiable eccentricity, reminiscent of an earlier era of cell biology. But recent developments in understanding transport processes that occur in the amoeba demonstrate that a shrewd choice of experimental organism, however unprepossessing, can lead to important general insights, one of which Koonce, Schliwa and coworkers report on page 737 of this issue[1].



A growth like this would prompt most people to clean out the fish tank. The syncytial amoeba, *Reticulomyxa*, growing on the side of an aquarium. The scale is in centimetres. (Courtesy of M. Schliwa.)

The amoeba (*Reticulomyxa*) grows as a large syncytium that can reach several centimetres in diameter. Like other syncytial organisms (*Allogromia, Physarum*), *Reticulomyxa* faces a more difficult problem than smaller cells in keeping different regions of its cytoplasm in constant communication with each other, and distributing food and waste materials appropriately. Similar problems are faced by highly asymmetrical cells in animals, notably neurons. *Reticulomyxa* appears to have coped by specializing its peripheral cytoplasm for microtubule-based intracellular transport. The fine processes that radiate out from the centre of the organism are very active in bidirectional organelle transport along microtubules[2]. The recent isolation of kinesin, a molecule capable of moving particles along microtubules[3], has opened up such organelle movement along microtubules to molecular analysis.

Kinesin, an ATPase that 'walks' unidirectionally along the microtubule lattice, may drive anterograde transport in axons where all microtubules are aligned with their 'plus' ends away from the cell body[4,5]. Another motor with quite different properties, mediating transport in the opposite direction, seems to exist in axons[6]. The motor for organelle transport in *Reticulomyxa* seems pharmacologically distinct from kinesin, and there are intriguing suggestions that, in contrast to axons, transport along the microtubule in opposite directions may involve the same or very similar motors, with directionality controlled by phosphorylation[7]. The development of an excellent lysed-cell system in *Reticulomyxa*[8] should help answer the important question of how transport direction is specified in the physiological context.

The fine processes in *Reticulomyxa* (see figure) are also very active in splaying out and zipping together, leading to a novel type of spreading motility. Generally, the movement of cells on their substratum is driven by actin-based systems, but *Reticulomyxa* lacks the fine actin-rich lamellipodia that most cells use to crawl, and its ultrastructure is dominated by microtubules. Previously, microtubules have usually been considered to participate in cell movement only by polymerizing at a leading edge (see, for example, ref. 9), but the splaying and zipping in *Reticulomyxa* seems much too rapid to involve new microtubule assembly. In their work reported in this issue[1], Koonce *et al.* demonstrate that bundled microtubules in *Reticulomyxa* processes can actively slide past each other *in vitro*, and they suggest that this sliding drives the motility of the processes *in vivo*. As the authors point out, sliding forces acting on tethered microtubules have long been known to drive ciliary beating, but theirs is the first demonstration of motility resulting from the active sliding of one microtubule past another, a process that could be involved in many other types of motility.

Although Koonce *et al.* have not yet identified the motor responsible for sliding, they exclude actin, and the pharmacology suggests a relationship to the motor that drives organelle transport. The bundles splay apart at both ends, and it is not clear which microtubules are bound to the motor, and which are being moved. Thus, the question of directionality of the sliding motor cannot yet be addressed as it has been in ciliary axonemes[10].

If indeed the same, or very similar, motors do turn out to move organelles in both directions, as well as microtubules past one another, it will be extremely interesting to learn how these processes are discriminated and controlled. The authors are currently engaged in isolating microtubule-dependent motor proteins from *Reticulomyxa*, using the affinity of these proteins to microtubules. The best things from slime may be yet to come. □

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