This Week's Citation Classic

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Buckley I K & Porter K R. Cytoplasmic fibrils in living cultured cells: a light and electron microscope study. *Protoplasma* **64**:349-80, 1967.
[Biological Laboratories, Harvard University, Cambridge, MA]

Electron microscopy of cultured rat embryo fibroblasts showed that cytoplasmic filaments and microtubules are intimately associated with components known to be highly motile in the living cells. Seemingly immobile cortical filament bundles appear to be involved in the stabilization of cellular attachment sites. [The *SCI®indicates*at this paper has been cited over 185 times since 1967.]

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"in 1963, as an experimental pathologist interested in the biology and pathology of living cells, I went from Australia to California on an Eleanor Roosevelt Fellowship to work in Charles M. Pomerat's laboratory. Keen to learn the techniques of tissue culture and cine microscopy for which Pomerat was so well known, I wanted to study the dynamic behavior of the endoplasmic reticulum in living cells. In the process, I became fascinated by the variety and complexity of cellular movements, a fascination which has remained ever since. The work on movements of the endoplasmic reticulum led to correspondence with Keith Porter, then professor of biology at Harvard University.

"A year later when my fellowship had come to an end I had the good fortune to spend ten months working in Porter's laboratory where, surrounded by an extraordinarily stimulating group of cell biologists, I found myself in a uniquely favorable environment for studying cells and their movements. With the excellent facilities and technical support staff in Porter's laboratory it was possible, even as a complete novice, to learn the basic elements of electron microscopy and still continue the light microsc opic studies of living cells. Our aim was to assess which fine structural elements of the cytoplasmic ground substance are most intimately associated with the cell's moving parts. Here we were fortunate in our cell model, the cultured fibroblast, because being very thinly spread on the cover glass, the glutaraldehyde promptly fixed all its cytoplasmic elements and these were then clearly displayed within sections made parallel to the cell's plane of attachment. Consequently, we could show that everywhere throughout the cytoplasmic matrix there were significant concentrations of microtubules and/or filaments. Since these structures were always in the closest contact with the moving parts, they appeared to be the most likely elements involved In producing the movements. Although at the time there were very few reports indicating the occurrence of muscle-like proteins in nonmuscle cells, the concentrations and dispositions of filaments in our fibroblasts suggested the likelihood of a useful analogy with the muscle cell motility system.

"Our work has been cited most often in relation to investigations which have demonstrated the 'muscle' protein content of a wide variety of nonmuscle cells and which, by the use of fluorescent antibodies, have shown the broad distribution of these proteins in a variety of cultured cells. It may seem paradoxical that in such cells the motility proteins are concentrated in the stress fiber filament bundles, structures that appear almost immobile in the living cell, but this may make sense if these fibers are concerned with slowly extending and stabilizing the cells' basal attachments, a process probably requiring considerable force. In the long run, however, solutions to the understanding of this and other questions concerning the motility of nonmuscle cells are likely to come only after a very detailed knowledge of the intracellular distribution of the entire range of motility proteins has evolved."