progress away from the capillary tip depending on the speed with which the amoeba flows into the capillary.

This interpretation of the pressure events is certainly not the only plausible one, but because it does satisfy the observations and is consistent with the positive pressure gradient theory of pseudopod extension and retraction, it points out that the cited suction experiments do not constitute a direct test of the hydraulic flow theory but are inconclusive in that regard. Even though the observation that the applied suction "rarely showed any detectable effect on the streaming pattern except in the immediate vicinity of the capillary orifice" can be interpreted as evidence that the negative pressure gradient is established only in the vicinity of the orifice, since no effect is noticed elsewhere; it would seem that directly testing the theory on this basis awaits the deveopment of a method to measure the internal pressure distribution.

G. S. KIRBY
Department of Mechanical Engineering, Texas Tech University, Lubbock 79409

R. A. RINALDI
Department of Biophysics, New York University, 4 Washington Place, New York 10003

I. L. CAMERON
Department of Anatomy, University of Texas Medical School, San Antonio 78229

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22 March 1972

In their critique of our capillary suction test of the pressure gradient theory of amoeboid movement, Jahn and Votta (*1*) have attempted to substitute a diagrammatic, hypothetical interpretation from a "thought experiment" for well-documented, detailed observations of living amoebae under actual experimental conditions. We stated that our major conclusion was based on many experiments in which the endoplasm was observed (not assumed) to flow into the capillary.

In our report we did point out that a result somewhat similar to Jahn and Votta's hypothetical result [figure 1 in (*1*)] can be achieved by sucking a pseudopod into a tube of slightly smaller diameter so that it is squeezed; this forces the endoplasm to flow forward. As we stated in our report, however, this situation results in the formation of spherical rather than cylindrical pseudopod tips. The outflow of cytoplasm from a tear in the tail of an amoeba, a result less reproducible in our hands than in those of Goldacre (*2*), does not tell us anything about the possible existence of a pressure gradient inside the cell.

The critique of Kirby *et al.* (*3*) is gratifying in that our experiment was repeated and the observations verified. On the other hand they suggest [figure 1 in (*3*)] that virtually the entire pressure drop in our experiments may have taken place along the capillary into which the endoplasm of the amoebae was sucked. This suggestion is demonstrably incorrect.

The pressure drop, Δp, along a capillary of radius r and length L containing a fluid of viscosity μ flowing at the volume rate of flow Q can be estimated quite precisely from the Hagen-Poiseuille equation (*4*), shown below with the appropriate values inserted:

$$\Delta p = \frac{8\mu LQ}{\pi r^4} = \frac{(8)(0.015)(2)(25 \times 10^{-8})}{(3.14)(6.25 \times 10^{-10})} = 30.6 \text{ dyne/cm}^2$$

Taking the pressure difference applied as 30 cm of water (2.94×10^4 dyne/cm^2), the pressure drop along the capillary tubing applied to the amoeba amounted to 0.1 percent of the reading of our pressure transducer, well within the accuracy claimed in our report.

The important fact to know is how the pressure drop occurs in the amoeba between the capillary orifice and the bath. The apparent rigidity of the amoeba's ectoplasmic tube and the freedom of the endoplasm to move out of it into the capillary suggest that the pressure drop should occur along the length of the amoeba unless our current views about amoeba structure are incorrect.

It is difficult to see how turgor pressure could be present in an amoeba unrestrained by a cell wall and containing a contractile vacuole to maintain water equilibrium. Even if turgor pressure were present, it is difficult to understand how it might be controlled so as to generate the complicated pattern of pressure gradients required to explain the complexities of amoeboid movement.

The authors of both critiques have failed to recognize the significance of the fact that a "pressure sink" (regardless of its absolute magnitude) down which cytoplasm flows at a rate several times the largest volume rate of flow ever measured in the intact cell does not prevent pseudopods from extending away from the direction of suction. The evidence bearing on theories of amoeboid movement has been reviewed recently (*5*).

ROBERT D. ALLEN
ROBERT ZEH, JOHN CONDEELIS
Department of Biological Sciences, State University of New York, Albany 12203

DAVID W. FRANCIS
Department of Biological Sciences, University of Delaware, Newark 19711

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26 June 1972

Memory Transfer: Correction

In our report "Interanimal memory transfer: results from brain and liver homogenates" (*1*) we noted a statistical and typographical error. The chi-square analyses as presented were calculated incorrectly and therefore should be ignored. Reanalysis of all statistical tests used in this experiment indicated no other error. Although these changes do not require reinterpretation of the results, we deeply regret any inconvenience to the readers.

BONNIE FRANK, DONALD G. STEIN
JEFFREY ROSEN
Clark University, Worcester, Massachusetts

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20 September 1970

Because of clerical error this correction was not published when received.—Ed.