swing the protective tariff back from the researchers to the teacher as teacher. . . ."

These quotations come from a speech by Paul Kirkpatrick of Stanford University, delivered at a meeting of the American Physical Society in New York last January. They state in better words than many of us can muster the opinion prevailing among many teachers of undergraduate college physics and are worthy of more publicity than they have been given.

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Liesegang Phenomenon

In a recent report [*Science* **129**, 1365 (1959)], Van Oss and Hirsch-Ayalon claim that the Hirsch effect constitutes the proper explanation of the Liesegang phenomenon. This claim is based on the assumption that the Liesegang rings act as membranes which prevent further diffusion of the reacting substances. These authors also cite experimental evidence (see their references 9 and 21) in support of their conclusion that the rings remain impermeable to the diffusing outer (presumably more concentrated) reactant until the other (inner) reactant is exhausted in the vicinity of the ring.

Although it is generally agreed that the medium is exhausted of this reactant in the vicinity of the ring, the evidence for the impermeability of the ring is by no means conclusive. The Liesegang phenomenon is equally well explained [see, for example, Wagner, *J. Colloid Sci.* **5**, 85 (1950)] if a critical ion-product concentration, such as a supersaturation product, is required as a necessary condition for ring formation. In that case the clear spaces between the rings merely result from the lowering of the inner electrolyte concentration by adsorption on the last ring or by counterdiffusion. As a result, the outer electrolyte must then diffuse for some distance until the critical concentration is again reached.

Another argument against accepting the Hirsch effect as the *only* explanation of Liesegang rings under all conditions is found in the experiments by Morse [*J. Phys. Chem.* **34**, 1554 (1930)] in which rings of rather widely spaced crystals were formed in water without any colloidal material present. It seems a little farfetched to suppose that these rings act as membranes.

Van Oss and Hirsch also state that Ostwald's supersaturation theory is refuted by Hatchek's experiments. The arguments against this view have already been presented in some detail [K. H. Stern, *Chem. Revs.* **54**, 79 (1953)]. Basically they amount to this: that supersaturation can exist in the presence of crystals, particularly if these are well dispersed; and that under these conditions rings still form because the rate of crystal growth is less than the diffusion velocity of the reactants. When the rings consist of very small crystals, closely spaced, the Hirsch effect may very well operate.

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As the title of our report, "*An* explanation of the Liesegang phenomenon," implies, we did not claim to advance an explanation that excludes all other explanations. It is indeed quite probable that in certain cases diffusion, supersaturation, or even gel-protection effects play their role. Still, as we pointed out, Liesegang bands have been known to occur under circumstances where these effects were lacking. Now, although it remains difficult to ascertain which effect predominates in the formation of any particular set of Liesegang bands, the Hirsch effect can in a general way satisfactorily account for all the circumstances under which Liesegang bands are formed, needing no assumptions on diffusion, supersaturation, or gel protection. The Hirsch effect, an experimentally established and general phenomenon, must give rise to Liesegang bands exactly under those circumstances where these bands actually occur.

The role of the gel or membrane in the Hirsch effect must not be overestimated, the effect itself being independent of the presence of colloid material. Only for the quantitative measurement of the Hirsch effect are carrier membranes, or other porous walls, used to advantage, principally to avoid convection.

The Hirsch precipitates are best considered as barriers to the forming ions rather than as membranes. Actually, by the time Liesegang layers appear and can be inspected, they have already lost their property as barriers (except for the last layer, if one is quick enough). Thus, the occurrence of bands of widely spaced crystals in water does not exclude a Hirsch effect.

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Radioactive Fallout

Your issue of 22 May [*Science* **129**, 1412 (22 May 1959)] contained an assessment, issued by the General Advisory Committee of the Atomic Energy Commission, of the dangers to the human race of radioactive fallout. Without discussing the obvious impertinence of a collection of physicists, chemists, engineers, and what-have-you who presume to issue a pronouncement on a crucial biological question, I should like to offer comment on certain of the points which they raised.

1) The fact that "the amount of total body external radiation resulting from fallout to date, together with future fallout . . . from previous weapons tests, is: (i) less than 5 percent as much as the average exposure to cosmic rays and other background radiation" is repeated ad nauseam to reassure the public. However, this argument is a red herring designed to deceive. The principal dangers (both physiological and genetic) to the human race from fallout stem from the decay of the radioactive fallout material after it has been taken into the body and incorporated within certain cells and tissues. That the total quantity of radiation reaching the whole body from outside is far greater is largely irrelevant to the question of the potential dangers of fallout from nuclear tests. Throwing rubber balls at a person is not an intelligent way of finding out what would happen were he to swallow one.

2) With respect to the internal effects of strontium-90, they comfort us with the statement that "the amount of strontium-90 which has been found in food and water is less of a hazard than the