ordinary damp litter from podocarp-broadleaf forest, subalpine forest, and beech litter. She reported that the animals can be extracted alive by slowly drying out litter in a Berlese funnel, with a water-jacket maintained at a temperature of 40°C and with the end leading into water. They can be kept in the laboratory on moist filter paper and fed on humus. The ostracodes have survived total immersion in water in the laboratory for at least a week and can withstand drying out by closing the valves. The length of the ostracodes is recorded as from 0.56 to 1.04 mm.

There is a possibility that terrestrial ostracodes may be present also in the Northern Hemisphere. A record of terrestrial ostracodes in North America would be of interest to both zoologists and geologists. Because the presence of fossil ostracodes has hitherto been taken as evidence of an aquatic environment, data on the frequency, distribution, and ecology of terrestrial forms would have some bearing on paleoecological interpretations.

Researchers who examine extracts from Berlese funnels are asked to watch for possible ostracodes. I will be interested to hear of any terrestrial ostracodes found.

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Oxygen Diffusion

Scholander has recently described an experiment which demonstrated that the presence of hemoglobin in a wet membrane increased the diffusion rate of oxygen as much as eightfold over the rate through the same membrane when it contained only water [*Science* **131**, 585 (1960)]. Actually, Scholander measured only the change in ratio of the diffusion rates of oxygen and nitrogen when hemoglobin was added to water. He interpreted his data as evidence for an increased diffusion rate resulting from the presence of hemoglobin.

Although Scholander's experimental data are not subject to argument, there is some question concerning his interpretation of these data. He interprets his data to mean that there is an increase in oxygen diffusion rate through a liquid containing hemoglobin compared with the same liquid free of hemoglobin. He then proceeds to develop a hypothesis to explain this increase in oxygen transport.

In his experiment Scholander measured the resistance to diffusional flow through three resistances in series. At the upper surface there was an air-liquid interface; in the filter paper there was liquid; at the bottom surface there was a liquid-water vapor interface. The experiment showed that the *sum* of the three resistances decreased for oxygen diffusion (compared with nitrogen) when hemoglobin was added to the liquid in the filter paper. The experiment does not permit one to say that the oxygen-nitrogen diffusion ratio has increased in the liquid. It may well be that the increase is at one of the interfaces. The problem of diffusion through a liquid-gas interface is not easily treated. A detailed description of the difficulties is given by R. W. Schrage in *A Theoretical Study of Interface Mass Transfer* (Columbia University Press, New York, 1953).

A modification of Scholander's procedure would permit measurement of the diffusional resistance in the membrane alone. This could be done by filling the upper chamber with distilled water saturated with oxygen and nitrogen at a given pressure. The lower chamber would be filled with deaerated distilled water. In this system there would be no phase interface. Samples of the water in the lower chamber could be analyzed for oxygen and nitrogen content as a function of time. If the concentrations in the upper and lower chambers did not change much, then it would be evident that the boundary conditions are fairly simple, and the diffusion coefficient of the membrane and its liquid could be calculated without trouble. If the results of this experiment agreed with previous results, then indeed there would be evidence of a change in the diffusional resistance of water to oxygen when hemoglobin is added. It is equally likely, however, that the diffusional resistance at the liquid-air or liquid-vacuum interface would be changed.

If the hemoglobin tended to diffuse away from the filter paper, the filter-paper unit could perhaps be made in the form of a sandwich in which only the center paper was impregnated with hemoglobin.

To examine the changes at the interfaces, two additional experiments could be performed. In the first, the upper chamber would be filled with water containing oxygen and nitrogen in solution. The lower chamber would contain an inert gas, such as helium or argon, at a pressure sufficient to prevent bulk flow of the water from the upper chamber. By this experiment one can find changes in the diffusional flow resistance at the lower interface. In second experiment, the lower chamber would be filled with deaerated distilled water while the upper chamber would contain oxygen and nitrogen in the gas phase.

The experiments outlined above are all of the steady-state type. It may be interesting to compare the steady-state diffusion coefficients with the coefficients obtained from nonsteady-state measurements. Scholander's apparatus could be used to do a "time-lag" measurement described by Barrer [*J. Phys. Chem.* **57**, 35 (1953)], from which the diffusion coëfficient can be calculated. Ideally, the steady-state and nonsteady-state diffusion coefficients are the same. Differences between the coefficients often shed light on the diffusion mechanism.

In the experiments I have outlined above, it may be necessary to analyze for oxygen and nitrogen directly. I believe this could be done by gas chromatography.

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I agree that it would be of great interest to devise an experiment which would avoid the complication of possible interphase effects, and in fact a great deal of thought was given to this problem. Unfortunately, hemoglobin molecules diffuse too fast through a membrane to make promising a system such as that proposed by Fatt, and experiments on intact red cells seemed to be the nearest practicable approach. When smeared as a layer on the under side of the finest grade Millipore membrane, this layer showed the same enhanced oxygen transport as a hemoglobin solution, and it was assumed that the entrance into and exit from the cells took place through a hemoglobin-free interphase—that is, through the cell membrane plus whatever saline solution covered the cells.

Even if we were to assume that hemoglobin molecules in solution constitute part of the interphase, it would seem difficult to account quantitatively for the observed enhancement of oxygen transport. At a low pressure this may exceed diffusion by a factor of 8, and because we are dealing with a steady-state transport, each layer of the membrane transmits the same amount of oxygen. If we were to treat the system as diffusive flow through three resistances in series, as suggested by Fatt, we might, for the sake of argument, consider a surface layer of 1-micron thickness to have zero resistance. This would still leave 148 microns of solution to be traversed by diffusion, and it would seem that a specific interphase effect, if indeed there is such an effect, could hardly give enhancement of more than a few percent.

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