able for obtaining quantitative results. A glass tube is divided into three compartments by two cellulose membranes. After evacuating the three partitions, the end spaces are filled with water vapour of different but constant pressures. The pressure in the intermediate chamber then adjusts itself so that the pressure differences across the membranes are inversely proportional to the diffusion constants. It was found that this pressure was always much nearer to that of the high vapour pressure side, independent of the direction of the diffusive flow. If one side was completely evacuated, the pressure in the middle chamber rose until it was equal to that of the high-pressure side, thus leading to the paradox, mentioned by King, that the amount diffusing may decrease with increasing concentration gradient.

These results can be explained most simply by taking into account two or more states of adsorption of the diffusing vapour in the adsorbing material, in which states the adsorbed molecules have markedly different mobilities. Then Fick's law applies, not to the adsorbed total, but only to the concentration of the mobile part (for keratin, Speakman's "capillary water"[3], and for cellulose Peirce's loosely bound "β-water"[4]) which reach appreciable values only at the higher concentrations of total water. A fuller account of the quantitative relationship between adsorption and the diffusion constant in the case of hair will be given elsewhere[5].

There is some evidence that similar phenomena can occur in the diffusion of adsorbed substances even where no swelling takes place (for example, in the diffusion of dyestuffs through cellulose[6]), though these conditions are complicated by the presence of ions. Here, too, the diffusion 'constant', as in the case of water diffusion, rises with the total concentration of the adsorbed material.

E. GLÜCKAUF.

University Science Laboratories,
Durham.
Nov. 11.

[1] King, G., *Nature*, **154**, 575 (1944).
[2] Spilhaus, A. F., Massachusetts Inst. of Technology, Meteorol. Course. Prof. Notes No. 8 (1935).
[3] Speakman, J. B., *Trans. Far. Soc.*, **40**, 6 (1944).
[4] Peirce, F. T., *J. Text. Ind.*, T, **20**, 133 (1929).
[5] Glückauf, E., *Q. J. Roy. Met. Soc.*, in the press.
[6] Garvie, W. M., and Neale, S. M., *Trans. Far. Soc.*, **34**, 335 (1938).

Plant Nutrients in the Sea

Two difficulties have been raised by critics of the suggestion that, for the benefit of the fisheries, large-scale addition of plant nutrients to selected parts of the sea may be considered in the future[1]. The first difficulty concerns the quantities of nutrients required; Michael Graham describes these as "mountainous, nay astronomical"[2], and Dr. W. R. G. Atkins, on surer grounds, estimates the annual turnover of phosphorus in the phytoplankton of the English Channel at about one ton for each square kilometre of surface[3]. The quantity is neither astronomical nor even discouraging.

The Agricultural Statistics for 1937, the latest available, show that the quantity of phosphatic nutrients used in the United Kingdom and Eire in that year represented 201,000 tons as P_2O_5, equivalent to 2,718 lb. P_2O_5 or 1,187 lb. of phosphorus on each square kilometre of all crop and pasture land (41 million acres). But most fertilizers are applied to arable land (13½ million acres), so that the quantity of phosphorus distributed annually on an arable square kilometre is probably more than 3,000 lb. This is considerably in excess of the annual turnover in a square kilometre column of the English Channel. Dutch farmers use about six times as much fertilizer per acre as we do, so that compared with their liberal broadcasting on the surface soil, the turnover in the equivalent column of the English Channel seems almost puny.

The truth is that neither quantity nor cost of fertilizers matters very much to the farmer, provided a profitable return is produced. The return, and not the "mountainous" quantities or "vast expenditure", should be the criterion also in the sea. Furthermore, I conceive that if plant nutrient experiments are ever made in the North Sea, they will at first be limited in extent and confined to areas where currents, plankton and bottom fauna suggest possibilities of success. It seems more reasonable to develop a mediocre into a rich feeding ground with a minimum of labour than to transplant fish from one to the other.

The second suggested difficulty is that the soluble fertilizers once added to the surface waters will be "dissipated into the ocean"[3]. But the indications are that, in suitable areas, the fertilizers are almost immediately converted into phytoplankton, which is rapidly converted into zooplankton and bottom fauna, and no one suggests that the plankton or bottom fauna are dissipated into the ocean. The waters of the sea and their contents are more stable than might be supposed. There will be some loss, but there is considerable loss of fertilizers even on arable land, owing to rainfall and chemical action—the test again must be, are sufficient quantities utilized to make a profitable return? That has still to be decided.

JAMES RITCHIE.

Department of Zoology,
University of Edinburgh.

[1] Ritchie, J., *Nature*, **154**, 275 (1944).
[2] Graham, M., *Nature*, **154**, 366 (1944).
[3] Atkins, W. R. G., *Nature*, **154**, 490 (1944).

Professional Service in Universities, Technical Colleges and Industry

READERS of the leading article on "Professional Institutions" in *Nature* of December 9 may be interested to know that my Council had in fact taken the initiative in the way suggested in its opening paragraph. The views of the vice-chancellors of the universities and the principals of technical colleges of Great Britain are being sought as to:

(i) The conditions under which scientific workers of different grades in universities and technical colleges should undertake research or consulting work for industry, Government and Government-subsidized organizations.

(ii) The provisions that could usefully be made for the ready interchange of scientific workers between teaching posts, industry and Government service.

The nature of the replies will determine in what way we shall pursue the matter further.

ROBERT H. PICKARD.
(Chairman.)

Joint Council of Professional Scientists,
c/o The Institute of Physics,
at The University,
Reading, Berks.
Dec. 12.