excreted as sulphate. This would at the same time indicate a mechanism of sulphate formation via a thiosulphate stage.

Bolesław Skarzynski
Tadeusz W. Szczepkowski
Mirosława Weber
Department of Physiological Chemistry,
Medical Academy,
Cracow.
June 19.

[1] Schmiedeberg, O., *Arch. Heilk.*, **8**, 422 (1867).
[2] Nyiri, W., *Biochem. Z.*, **141**, 160 (1923).
[3] Pirie, N. W., *Biochem. J.*, **28**, 1063 (1924).
[4] Sörbo, B., *Biochim. Biophys. Acta*, **24**, 324 (1957).
[5] Skarzynski B., Ostrowski, W., Krawczyk, A., *Bull. de l'Acad. Polonaise Sci.*, Cl. II, **5**, 159 (1957). Ostrowski, W., Krawczyk, A., *Acta Biochim. Polonica*, **4**, 249 (1957). Skarzynski, B., Ostrowski, W., *Nature*, **182**, 933 (1958). Ostrowski, W., Skarzynski, B., Szczepkowski, T. W., *Nukleonika*, **3**, 85 (1958). Skarzynski, B., Szczepkowski, T. W., *Nature*, **183**, 1413 (1959).

PLANT PHYSIOLOGY

Role of the Anion in Magnesium Uptake from Foliar Applications of its Salts on Apple

During recent work on uptake of magnesium from foliar applications of its salts, the findings of Fisher and Walker[1], that apple leaves take up magnesium more rapidly from the nitrate and chloride than from the sulphate, were confirmed, and an explanation of this differential behaviour is proposed as follows.

Table 1 shows the results of an experiment in which leaves were *momentarily dipped* in $M/10$ solutions of the three salts and the amount of magnesium applied to the leaves, as well as their subsequent magnesium content, determined. It shows that the whole increase in leaf magnesium content brought about by the chloride or nitrate solutions occurred within 2 hr., but that, in the case of the sulphate, a significant increase within two hours ($P < 0{\cdot}05$) was followed by a further significant increase overnight ($P < 0{\cdot}05$). In each case the total increase in magnesium content up to 22 hr. represents about 50–60 per cent of the magnesium deposited on the leaf, the latter being substantially the same for each of the three salts. These observations conform with our general experience that although magnesium is usually taken up from chloride or nitrate applications on the day they are made, with the sulphate this usually occurs during the following night, although it can also be taken up on the day that it is applied, as in the present instance (Table 1); and in one experiment, magnesium was not taken up from this salt over a period of 48 hr.

Fig. 1 shows the magnesium content of detached apple leaves which, in contrast, were *left immersed* in $M/10$ solutions of one of the three salts for various times, and it will be seen that here the rate at which magnesium was taken up was independent of the anion. It is therefore reasonable to suppose that when leaves were momentarily dipped in a $M/10$ solution the initial rate at which magnesium was taken up was the same for all three salts; and since we have already shown that the same amount of magnesium was deposited on the leaves as a result of such treatments it would appear that the observed differences in rate of uptake which occurred when leaves were momentarily dipped must be due to differences in the physical nature of the deposits left behind on them.

A possibly relevant difference is that the chloride and nitrate are normally deliquescent, whilst the sulphate is not. A consideration of the relative humidities quoted in Table 1 shows that, in this

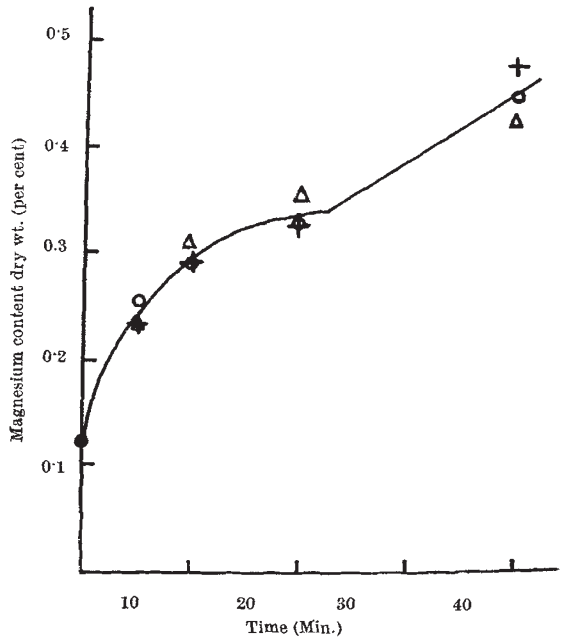

Fig. 1.—The magnesium content of leaves immersed for various times in $M/10$ solutions of three salts. +, nitrate; o, chloride; △, sulphate.

Table 1. Deposition and Uptake of Magnesium in Leaves after Dipping in $M/10$ Solutions of Three Salts

Magnesium salt used	Magnesium content per leaf (per cent dry wt.) Magnesium within the leaf at: 11.20 hr. just prior to dipping	13.20 hr. on the day of dipping	9.20 hr. on the next morning	Initial superficial deposit
Sulphate	0·08	0·15	0·20	0·27
Nitrate	0·08	0·24	0·23	0·24
Chloride	0·09	0·24	0·25	0·23
None	0·07	0·08	0·09	—
Relative humidity(%)	72	56	96	—

experiment, deposits of the chloride or nitrate, which are deliquescent over this humidity-range, were likely to have remained in solution on the leaf surface over the period, but that deposits of the sulphate, which crystallize out at relative humidities below 82 per cent, would have dried out, and only been brought into solution again overnight. Assuming therefore that magnesium is only taken up by the leaf from solution, entry from the sulphate would in this instance have been halted in the morning, and resumed when the relative humidity exceeded 82 per cent, during the night. The nature of the deposit as determined by the humidity of the atmosphere would therefore appear to be decisive in the uptake of magnesium by apple leaves.

It is suggested that these findings have an immediate importance in relation to the practice of applying foliar sprays of magnesium salts in attempts to remedy the widespread and economically serious deficiences of magnesium occurring in apple orchards.

A detailed account of this work will be published elsewhere.

M. Allen
Plant Protective Chemistry Section,
East Malling Research Station,
Nr. Maidstone, Kent.

[1] Fisher, E. G., and Walker, D. R., *Proc. Amer. Soc. Hort. Sci.*, **65**, 17 (1955).