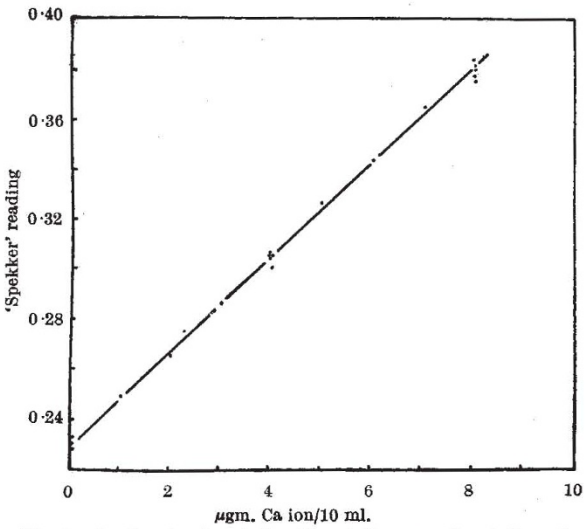

Fig. 1. 1 ml. potassium hydroxide solution; x ml. solution of calcium; distilled water to 5 ml. plus 5 ml. murexide solution (20 mgm./l.). Final pH, 11·2

strontium and magnesium ions give a result which is 10 per cent too high, while ferrous and ferric ions give a result 4–5 per cent too low.

The use of potassium cyanide ($\sim$ 1 gm./l.) in the potassium hydroxide completely eliminated interference from copper, mercuric, silver, cobalt and cadmium ions. The effects due to zinc, ferrous, ferric, strontium and magnesium ions are largely unaffected.

We wish to thank the Directors of the County Laboratories, Ltd., for permission to publish this communication.

T. T. Gorsuch
A. M. Posner

County Laboratories, Ltd.,
Stanmore, Middx.

[1] Schwarzenbach, E., and Gysling, H., *Helv. Chim. Acta*, **32**, 1314 (1949).
[2] Ostertag, H., and Rinck, M. E., *Chim. Anal.*, **34**, 108 (1952).

Cellular Electrolytes and Adrenal Steroids

It has long been established that deficiency in adrenal cortical hormones can give rise to loss of intracellular sodium, and that excess of these hormones leads to a retention of sodium and water by tissue cells, with a loss of intracellular potassium.

The distribution of electrolytes between red cells and plasma in Addison's disease and Cushing's syndrome has been investigated in this laboratory. In three cases of Addison's disease the plasma sodium was lowered and the potassium raised; but in the red cell these electrolytes remained unchanged. The results of the red-cell analyses were not unexpected, since the cellular electrolytes of adrenalectomized animals remain normal unless the animals are maintained on water only. In two cases of Cushing's syndrome the plasma sodium was found to be normal and the potassium-level depressed; again, the red-cell content of both sodium and potassium was normal. It is highly probable that the rates of movement of sodium and potassium across the red-cell membrane are significantly influenced by adrenal steroids, and Streeten and Solomon[1] have demonstrated that corticotrophin (ACTH) or cortisone administered to patients caused a slowing of the rate of influx and efflux of potassium across the red-cell membrane, without leading to the anticipated net loss of cellular potassium. Furthermore, hydrocortisone *in vitro* produced a similar response.

To test whether the human erythrocyte was suitable for the investigation of hormone effects on electrolytes, the following *in vitro* experiment was carried out. Human blood was heparinized and cold-stored at 4°–6° C. for six days. During this period the red-cell sodium concentration doubled, the potassium fell and water increased. The cold-stored cells were next incubated for 3–5 hr. at 38° C. in a Krebs–Ringer bicarbonate buffer. Glucose was added to all samples, and deoxycorticosterone was used to test the influence of adrenal steroids on the active transport of sodium. In samples incubated with glucose alone, there was a considerable extrusion of sodium and water by the red cells. The effect of added deoxycorticosterone was significantly to inhibit this active transport. During the incubation period the red cells gained potassium, a gain which was not found in the presence of deoxycorticosterone. The results of a typical experiment are given in Table 1.

Table 1. Effects of Deoxycorticosterone on Active Sodium Transport in Human Red Cells

Incubation carried out at 38° C. in Krebs–Ringer bicarbonate, pH 7·4; gas phase 5 per cent carbon dioxide in oxygen. Glucose concentration 0·01 M. Time 3·0 hr.

	Sodium (m.equiv./l. cells)	Net sodium change	Potassium (m.equiv./l. cells)	Water (gm./l. cells)
Cold-stored red cells	46·0		70·0	740
Red cells incubated with glucose	34·0	12·0	76·0	728
Red cells with glucose and deoxycorticosterone	41·0	5·0	70·0	734

The effect of deoxycorticosterone on cellular electrolytes was therefore to inhibit the active transport of sodium from the cells; it might, therefore, be expected to give rise *in vivo* to pathological retention of sodium and water. It has previously been found to have a similar action on yeasts[2] and on rat tissues by Schatzmann[3]. Cortisone has been found to be without influence on the sodium transport of human red cells (Maizels, personal communication).

It is generally believed that the active transport of ions in tissue is dependent on the energy metabolism of the cell, and there is some evidence to show that adrenal steroids influence the electrolyte distribution by means of their effect on energy metabolism. The observations reported above may facilitate the study of hormone activity, electrolyte distribution and energy metabolism in human cells.

The investigations recorded above are part of a research programme suggested by Sir Henry Cohen. The use of deoxycorticosterone was suggested by Dr. I. Chester Jones (Liverpool) and the drug kindly given by Ciba Laboratories. I wish to acknowledge discussions with Prof. H. A. Krebs and his colleagues, Prof. M. Maizels and Prof. C. H. Gray. Skilled technical assistance was given by Mrs. Anne Chambers.

E. Sherwood Jones

Department of Medicine,
University, Liverpool.
April 1.

[1] Streeten, D. H. P., and Solomon, A. K., *J. Gen. Physiol.*, **37**, 643 (1954).
[2] Conway, E. J., and Hingerty, D., *Biochem. J.*, **55**, 455 (1953).
[3] Schatzmann, H. J., *Experientia*, **10**, 189 (1954).