mediated by aldosterone as Doca does not mimic the antidiuretic effect of thiazides nor does spironolactone antagonize it (Earley & Orloff 1962).

The antidiuretic effect of thiazides is thus the result of the induced sodium deficit. The fall in serum osmolality may be contributory by reducing thirst. As depletion of body sodium will be self-limiting the major hazard to the use of thiazides is potassium depletion. Treatment of patients with vasopressin insufficiency type of diabetes insipidus with thiazides is only indicated for those who are intolerant of hormone replacement. In nephrogenic diabetes insipidus thiazides have a more important therapeutic application.

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The Electrolyte Content of Fæces[1]

Stool is the Cinderella of electrolyte studies. It is a fascinating material. Despite its solid appearance it contains 70% or more of water. It is also known to contain many electrolytes, which are usually identified after ashing in a muffle furnace – a procedure which destroys all organic material and tells us nothing about the physical state of the inorganic constituents.

[1]Much of the material used in this paper has previously appeared in *Clinical Science* (Wrong *et al.* 1965) and is reproduced here with kind permission

Table 1
Composition of fæcal dialysate from 8 normal subjects

	Mean	*Range*
Osmolality (mOsm/kg)	376	336–423
pH	7·02	5·62–7·98
Sodium (mEq/l.)	31·6	4·4–112
Potassium (mEq/l.)	75	29–147
Na/K ratio	0·31	0·043–3·78
Ammonium (mEq/l.)	14·2	2·4–34
Calcium (mEq/l.)	38	5·6–72
Magnesium (mEq/l.)	49	13–98
Chloride (mEq/l.)	16·0	5–38
Total carbon dioxide (mM/l.)	40	4–66
Phosphate (mM/l.)	2·72	0·48–11·8
Sulphate (mEq/l.)	2·8	1·78–4·50
Organic anion (mEq/l.)	179	133–238
Total nitrogen (mM/l.)	95	38–206
Total phosphorus (mM/l.)	3·6	0·81–8·9

The electrolytes in stool might exist in an insoluble form or be dissolved in stool water. Stool water itself can be thought of as existing in two compartments – an 'extracellular' or continuous phase in which the stool solids are suspended, and an 'intracellular' phase imprisoned in bacteria, protozoa, cells derived from the intestine, vegetable fibres and seeds. The first of these is the component of greatest physiological interest, for it is influenced by the secretory and absorptive activity of the colon. Theoretically this fluid, and its contained solute, should be dialysable through a semipermeable membrane.

We have dialysed stools in the colon of the living subject, a procedure which takes advantage of the mixing effect of peristalsis. For this purpose we have constructed dialysing bags of Visking cellulose tubing, filled with an inert colloidal solution (either 8% polyvinyl pyrrolidone or 10% dextran) which are swallowed and passed in the stool 24–120 hours after swallowing. Radiological studies have demonstrated bags in the large bowel within three hours of swallowing, and our *in vitro* experiments have shown that their contents reach chemical equilibrium with their environment in about one hour; these two facts indicate that the bags have ample time to reach diffusion equilibrium with the contents of the large intestine.

The fluid contained in these bags is easier and pleasanter to handle than fæces and it can be analysed easily by conventional techniques. Table 1 shows results obtained from 8 normal subjects. Osmolalities were slightly higher than plasma, even after correction for the presence of colloid; this slight hyperosmolality was the result of bacterial action, for the fluid collected after giving intestinal antibiotics was isotonic. The pH of dialysate varied from 5·4 to 8·0, almost as

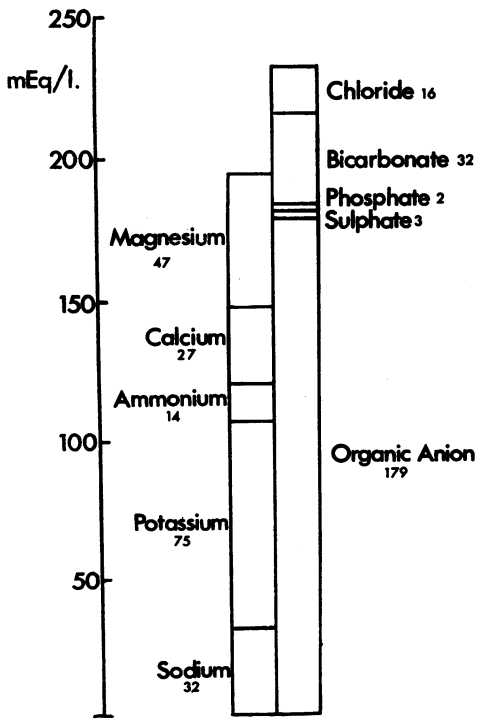

Fig 1 *Ionogram of normal fæcal dialysate derived from mean concentrations*

great a range as urine pH. Total nitrogen was 15% contributed by ammonium, and we never found any urea in specimens from healthy subjects unless they were taking intestinal antibiotics. Potassium was the cation present in largest concentration, followed by magnesium, calcium, sodium and ammonium. Most of the anion was organic; gas chromatography showed that about half of this was acetate, and the remainder consisted of butyrate, formate, proprionate, isobutyrate, valerate, iso-valerate, lactate, and succinate. The large amount of total CO_2 must have consisted mainly of bicarbonate; the concentrations of chloride were appreciably less.

A light precipitate was sometimes present in the dialysing bags, and the fluid inside was therefore ultrafiltered through a second cellulose membrane to discover its nature. This procedure caused reduction in the concentrations of calcium, magnesium, and phosphate by 25%, 4% and 45% respectively. It is likely, therefore, that the precipitate consisted of salts of calcium and magnesium, partly phosphates, but perhaps carbonate and soaps as well. The other solutes tested were completely ultrafiltrable. The explanation for this phenomenon may be that calcium and magnesium ions enter the dialysing bags high in the alimentary tract, but are precipitated lower down as the result of increasing pH and the reduced volume of intestinal contents. Whatever the explanation, it is clear that the method gives figures which are too high for the dialysable component of these three ions.

The 'ionogram' in Fig 1 is derived from the mean values for the concentrations of electrolytes in fæcal dialysate, after correcting the concentrations of calcium, magnesium, and phosphate on the basis of the ultrafiltrability of these ions. The measured anions are 37 mEq/1. higher than the measured cations, a gap which may be partly due to analytical errors, and partly the result of taking small numbers for the average of some of the electrolytes. Of course average values have little meaning when applied to concentrations which vary as much as those of fæcal dialysate.

From experiments in which subjects took an electrolyte-free diet, or a combination of antibiotics to sterilize the alimentary tract, we have been able to determine the origin of most of the electrolytes shown in Fig 1. The calcium and magnesium are largely derived from food residues, as the concentrations fall almost to plasma levels during the electrolyte-free diet. The sodium, potassium and chloride, and some of the bicarbonate, are derived from intestinal secretions, and are little influenced by diet. Much of the ammonium and at least a portion of the bicarbonate and total organic anion are the product of bacterial action, the ammonium and bicarbonate probably coming from urea, which appears at a concentration similar to that in plasma during administration of antibiotics.

Table 2
The effect of mineralocorticoids on fæcal dialysate

	Sodium (mEq/l.)		*Potassium (mEq/l.)*		*Na/K ratio*	
	Mean	*Range*	*Mean*	*Range*	*Mean*	*Range*
Normal, 8 subjects	31·6	4·4–112	75	29–147	0·31	0·043–3·78
Normal, 2 subjects receiving 9α-fluorohydrocortisone 3 mg/day	2·0	1·1–2·6	106	101–111	0·017	0·010–0·025
Normal, 3 subjects receiving aldosterone 0·5 mg I.M. every eight hours	2·2	1·0–5·6	102	73–110	0·024	0·009–0·064
Primary aldosteronism, 4 patients	1·8	1·2–2·6	129	112–163	0·015	0·010–0·019

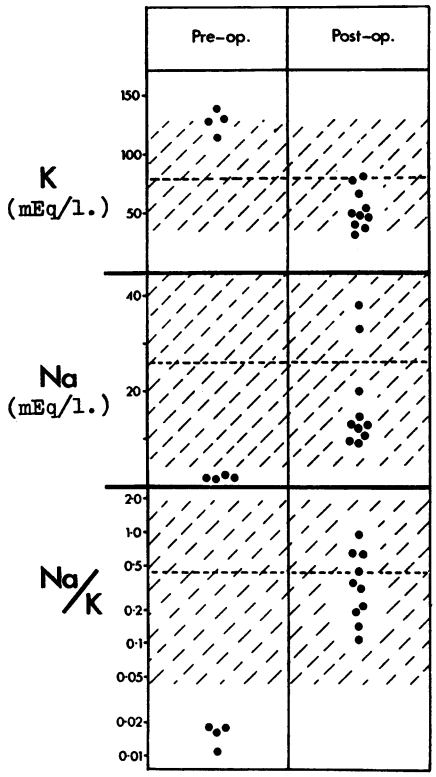

Fig 2 *Primary aldosteronism: composition of fæcal dialysate before and after removal of adrenal adenoma*

The sodium and potassium concentrations in fæcal dialysate are markedly influenced by mineralocorticoids, and show changes which are more impressive than those of urine or saliva (Wrong 1964). Table 2 shows some of the data from normal subjects given aldosterone or 9α-fluorohydrocortisone, and 4 patients with primary aldosteronism associated with an adrenal tumour. The most marked changes were in the sodium concentration and the Na/K ratio of dialysate, the latter falling to 0·024 or under in circumstances of mineralocorticoid excess, a figure which is well below the lowest limit of the normal range. Fig 2 shows data from one of the cases of primary aldosteronism, a patient of Dr C L Cope's, in whom this investigation was of particular value in leading to the correct diagnosis, for this was not obvious on clinical grounds and the aldosterone secretion rate was normal on the day it was measured. After removal of an adrenal adenoma the composition of fæcal dialysate returned to the normal range.

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The following papers were also read:

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Dr K Lederis

Micropuncture Studies of the Urine-concentrating Mechanism in Potassium Depletion
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Professor I Chester Jones and Dr I W Henderson

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Professor H E de Wardener and Dr S J McDonald

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Dr M A Floyer

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Dr E F de Bono

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Dr M A Barraclough and Dr J Lee

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