In 67 instances the results of the tubeless test were compared with the findings after augmented histamine stimulation. Only two false-positive results were detected, and these were explained by errors in technique. Fewer false-negative results occurred with betazole hydrochloride than when caffeine benzoate was used as the stimulant.

The tubeless method of gastric analysis, using the dye azure A and betazole hydrochloride, appears to be a reliable method for the screening of patients for achlorhydria.

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REFERENCES

- Becker, F. P., and Maslon, M. (1953). *New Engl. J. Med.*, **249**, 68.
 Bock, O. A. A. (1961a). *Lancet*, **2**, 102.
 — (1961b). Unpublished observations.
 Bolt, R. J., Ossius, T. G., and Pollard, H. M. (1957). *Gastroenterology*, **32**, 34.
 Bruce, J., Card, W. I., Marks, I. N., and Sircus, W. (1959). *J. roy. Coll. Surg. Engl.*, **4**, 85.
 Callender, S. T., Retief, F. P., and Witts, L. J. (1960). *Gut*, **1**, 326.
 Conway, H., and Meikle, R. W. (1953). *Brit. med. J.*, **2**, 1019.
 Denborough, M. A., Retief, F. P., and Witts, L. J. (1958). *Ibid.*, **1**, 1213.
 Fentress, V., and Sandweiss, D. J. (1955). *Harper Hosp. Bull.*, **13**, 184.
 — (1957). *J. Amer. med. Ass.*, **165**, 21.
 Flood, C. A., Jones, B., Rotton, W. M., and Schwarz, H. (1953). *Gastroenterology*, **23**, 607.
 Galambos, J. T., and Kirsner, J. B. (1955). *Arch. intern. Med.*, **96**, 752.
 Gilbert, S. S., Matzner, M. J., and Schwartz, I. R. (1957). *Amer. J. Gastroent.*, **27**, 277.
 Glass, G. B. J., Speer, F. D., Nieburgs, H. E., Ishimori, A., Jones, E. L., Baker, H., Schwartz, S. A., and Smith, R. (1960). *Gastroenterology*, **39**, 429.
 Goldbloom, A. A., Feinstein, M. A., and Eiber, H. B. (1955). *Amer. J. dig. Dis.*, **22**, 288.
 Grossman, M. I., Woolley, J. R., Dutton, D. F., and Ivy, A. C. (1945). *Gastroenterology*, **4**, 347.
 Harkness, J., and Durant, J. A. (1953). *J. clin. Path.*, **6**, 178.
 Kay, A. W. (1953). *Brit. med. J.*, **2**, 77.
 Kirsner, J. B., and Ford, H. (1955). *J. Lab. clin. Med.*, **46**, 307.
 Malach, M., and Banks, B. M. (1952). *New Engl. J. Med.*, **247**, 880.
 Marks, I. N., and Shay, H. (1960). *Amer. J. dig. Dis.*, **5**, 1.
 Poliner, I. J., Hayes, M. A., and Spiro, H. M. (1957). *New Engl. J. Med.*, **256**, 1051.
 Pollard, H. M., Carballo, A., and Bolt, R. J. (1954). *J. Lab. clin. Med.*, **43**, 340.
 Prout, W. (1824). *Phil. Trans., Lond.*, Part 2, p. 45.
 Rechtshaffen, J. S., Venet, L., and Weingarten, M. (1957). *J. Amer. med. Ass.*, **164**, 1467.
 Rodman, T., Gutman, A., and Myerson, R. M. (1958). *Ibid.*, **167**, 172.
 Rosenthal, H. L., and Buscaglia, S. (1958). *Ibid.*, **168**, 409.
 Segal, H. L., and Miller, L. L. (1955). *Gastroenterology*, **29**, 633.
 — and Morton, J. J. (1950a). *Proc. Soc. exp. Biol. (N.Y.)*, **74**, 218.
 — and Young, H. Y. (1950b). *Gastroenterology*, **16**, 380.
 — and Plumb, E. J. (1955). *Ibid.*, **28**, 402.
 — Rumbold, J. C., Friedman, B. L., and Finigan, M. M. (1959a). *New Engl. J. Med.*, **261**, 544.
 — Shephardson, C. R., and Plain, G. L. (1959b). *Ibid.*, **261**, 542.
 Sharp, G. S., Hazlet, J. W., and Shankman, S. (1954). *Cancer*, **7**, 289.
 Shay, H., Ostrove, R., and Siple, H. (1954). *J. Amer. med. Ass.*, **156**, 224.
 Sievers, M. L., and Fischer, G. L. (1957). *Amer. J. dig. Dis.*, **2**, 363.
 Sievers, M. L., and Gieselman, R. V. (1956). *Ibid.*, **1**, 241.
 Wolf, S. (1959). *Ass. Res. nerv. Dis. Proc.*, **37**, 147.

FAECAL P.V.P. EXCRETION IN HYPOALBUMINAEMIA AND GASTRO- INTESTINAL DISEASE

BY

A. M. DAWSON, M.D., M.R.C.P.

Lecturer, Department of Medicine

ROGER WILLIAMS, M.D., M.R.C.P.

Lecturer, Department of Medicine

AND

H. S. WILLIAMS, M.Sc.

Chief Hospital Physicist, Physics Department
The Royal Free Hospital, London

Until recently hypoproteinaemia in disease has been ascribed to poor intake, impaired absorption, or faulty metabolism of such protein precursors as amino-acids or peptides. Apart from the nephrotic syndrome, excessive catabolism or loss from the body has only rarely been invoked. Nevertheless recent reports indicate that excessive catabolism due to loss of protein into the intestinal tract is predominant in a variety of disorders associated with low serum proteins (Citrin *et al.*, 1957; Gordon, 1959a; Schwartz and Jarnum; 1959; Steinfeld *et al.*, 1960; Jarnum and Schwartz, 1960). Hypoproteinaemia results because the liver has only a limited capacity to synthesize albumin, and breakdown soon outstrips synthesis (Schwartz and Jarnum, 1959; Steinfeld *et al.*, 1960).

Intestinal loss is difficult to demonstrate because the gut lumen is relatively inaccessible and any exuded protein is broken down by digestive enzymes and the products are reabsorbed so that the faecal nitrogen is not necessarily raised. Similarly, if plasma albumin labelled with ^{131}I is used as a tracer, it enters the gut lumen, is broken down and the radioactive products are reabsorbed, and the faecal radioactivity may be normal. The ingenious technique of Gordon (1959a) of using polyvinylpyrrolidone (P.V.P.) has partially overcome the problem. P.V.P. labelled with ^{131}I is of similar molecular size to albumin, and so, when injected intravenously, can leak through sites that are permeable to the albumin molecule. In contrast to albumin it is relatively unchanged by the action of digestive enzymes and colon bacteria, and therefore much of it can reach the faeces, where it can be assayed by counting the radioactivity of the iodine label. This paper reports the results of this test obtained in a group of patients with a variety of disorders associated with hypoproteinaemia.

Methods

The P.V.P., which was obtained from May and Baker Limited, had an average molecular weight of about 40,000. It was labelled with ^{131}I as described by Gordon (1958) and dialysed in a Visking tube against running water to constant activity. This usually took three days. The starting polymer was slightly different from that used by Gordon and the product probably resembled that produced by Ravin *et al.* (1952). When fed by mouth approximately 40% was recovered in the faeces, less being recovered if the patient was constipated or the preparation was old. Even so, this preparation has proved to be satisfactory for the intravenous test when used within one week of preparation. The material was

A new £75,000 training centre for rural medical aids in Tanganyika was formally opened at Ifakara on July 22. The centre is staffed by three doctors, two biologists, and three technicians, and is sponsored and financed by a Swiss organization, the Basle Foundation for Aid to Developing Countries.

autoclaved before intravenous use, and this was shown not to cause any liberation of free iodine. After blocking the patient's thyroid with potassium iodide, 10–20 μ c of ^{131}I P.V.P. was given intravenously and the urine and faeces were collected separately for four 24-hour periods, care being taken to prevent urine contamination of the faecal specimen. The radioactivity of the specimens was measured in a circular ring counter containing eight Geiger tubes. The results are expressed as the percentage excretion in the faeces of an intravenous dose in a four-day period. The serum albumin was measured during this period by electrophoresis and scanning.

Twenty-one patients with a variety of gastro-intestinal disorders were studied (Tables I and II). These included giant rugal hypertrophy of the stomach, idiopathic steatorrhoea (proved by small-intestinal biopsy), ulcerative lesions of the gut, and idiopathic hypoproteinaemia. One of the cases (No. 16) of idiopathic hypoproteinaemia has previously been reported by Bound and Hackett (1953). The two patients labelled cryptogenic steatorrhoea failed to show any of the known causes for the steatorrhoea either in life or finally at necropsy. Eleven of the patients had a low serum albumin level (<3.5 g./100 ml.). The test was also performed on five patients with cirrhosis of the liver and two with the nephrotic syndrome (Table III). Eighteen patients without disorders of protein metabolism or disease of the gastro-intestinal tract were also studied.

TABLE I.— ^{131}I -P.V.P. Excretion in Patients with Gastro-intestinal Disease and Idiopathic Hypoproteinaemia

Case No.	Age and Sex	Diagnosis	Serum Albumin (g./100 ml.)	Faecal ^{131}I P.V.P. (% I.V. Dose)	Faecal Fat g./24 hr.	Remarks
1	43 M	Giant rugal hypertrophy of stomach	{ 3.7 4.3	2.6 0.4		Albumin half-life 17 days (normal 20–25 days) After subtotal gastrectomy
2	53 F	Idiopathic steatorrhoea	{ 3.3 4.8	9.7 0.5	9 1	Gluten-free diet
3	73 F	" "	4.0	1.0	2.4	
4	62 M	" "	4.2	1.4		
5	42 F	" "	3.8	0.5	8.8	
6	53 F	Cryptogenic steatorrhoea	2.1	7.1	18	? Post-irradiation
7	42 M	" "	4.6	2.5	10.7	Carcinoma of bronchus associated with hyponatraemia
8	69 M	Jejunal diverticulosis	4.0	2.7	25	
9	60 F	" "	4.2	0.8	2.5	
10	53 F	Biliary-enteric fistulae	2.3	4.9		
11	56 M	Amyloidosis	3.7	3.7		Secondary to rheumatoid arthritis
12	51 M	Pancreatic steatorrhoea	3.7	1.1	21.5	
13	55 M	Total gastrectomy	2.3	0.9		Gross diarrhoea and malnutrition
14	65 F	Systemic sclerosis	3.7	0.9	2.6	Involvement of oesophagus and gut
15	56 F	Idiopathic hypoproteinaemia	{ 2.6 3.3	10.3 2.7		
16	8 M	" "	1.8	5.4		

TABLE II.— ^{131}I -P.V.P. Excretion in Patients with Ulcerative Disease of the Bowel

Case No.	Age and Sex	Diagnosis	Serum Albumin (g./100 ml.)	Faecal ^{131}I P.V.P. (% I.V. Dose)	Remarks
17	67 M	Ulcerative jejunitis	1.4	20.7	Gross diarrhoea
18	49 M	Ileitis	2.4	13.4	
19	38 F	Regional ileitis	{ 2.2 3.4	3.6 0.1	Active Quiescent
20	16 M	Cirrhosis and ulcerative colitis	{ 3.5 2.4 4.2	0.05 3.4 0.4	Pre-colitis Active colitis Quiescent
21	26 M	Ulcerative colitis	{ 2.8 4.2	3.4 0.5	Active Quiescent

TABLE III.—Faecal ^{131}I -P.V.P. Excretion in Patients with Hepatic Cirrhosis and the Nephrotic Syndrome

Case No.	Age and Sex	Diagnosis	Serum Albumin (g./100 ml.)	Faecal ^{131}I P.V.P. (% I.V. Dose)	Remarks
22	41 F	Cirrhosis	1.9	0.7	Diarrhoea. Faecal fat 19 g./24 hr.
23	60 M	" "	2.0	0.1	No diarrhoea
24	63 F	" "	2.4	0.1	
25	73 M	Intrahepatic bile-duct carcinoma	4.3	0.1	Diarrhoea
26	60 M	Primary biliary cirrhosis	2.6	0.1	
27	36 F	Nephrotic syndrome	4.0	0.1	
28	38 F	" "	2.2	1.0	
		" "	3.1	0.1	

Results

Patients who had neither disorders of protein metabolism nor disease of the gastro-intestinal tract had a mean four-day faecal excretion of intravenous ^{131}I P.V.P. of 0.52%, with a range of <0.05 –1.6%. This has been taken as our normal range. We have confirmed Gordon's (1959a) observation that hypoproteinaemia *per se* does not give a false-positive result, for three patients with hepatic cirrhosis and two with a nephrotic syndrome, all with hypoalbuminaemia, had a normal excretion of ^{131}I P.V.P. (Table III). Similarly diarrhoea or steatorrhoea alone does not cause a false-positive result, as one patient with diarrhoea (Case 24) and four with gross steatorrhoea and diarrhoea (Cases 5, 12, 13, and 22) had a normal P.V.P. excretion.

In patients with gastro-intestinal disease and idiopathic hypoproteinaemia (Tables I and II) there is a roughly hyperbolic relationship between the serum albumin level and the faecal ^{131}I P.V.P. excretion (Fig. 1), similar to that described by Gordon (1959b). All but one of the patients with hypoproteinaemia had a high faecal excretion of ^{131}I P.V.P. As this patient

(Case 13) had had a total gastrectomy for recurrent peptic ulceration, it is probable that this man's hypoproteinaemia could be accounted for by a poor appetite coupled with gross malabsorption. Four of the 15 tests on patients with a normal serum albumin level were abnormal, but three of these patients had a serum albumin level at the lower limit of normal—that is, 3.5–4 g./100 ml. These four patients suffered from amyloidosis associated with rheumatoid arthritis (Case 11), giant rugal hypertrophy of the stomach (Case 1), jejunal diverticulosis (Case 8), and cryptogenic steatorrhoea (Case 7). Such an overlap is not surprising, for

FIG. 1.—Relationship between serum albumin and ^{131}I -P.V.P. excretion in patients with gastro-intestinal disease or "idiopathic" hypoproteinaemia. The stippled area represents normal range of excretion of ^{131}I P.V.P. (Reproduced by courtesy of the Honorary Editors of the *Proceedings of the Royal Society of Medicine*.)

a diminished total body albumin may not initially be reflected by a low serum albumin level; also, the loss from the gut may fluctuate.

Serial Studies

Six of the patients with an abnormal ^{131}I -P.V.P. excretion were studied more than once (Tables I and II) and cases histories of three of these are described.

Case 1. Giant Rugal Hypertrophy of the Stomach (effect of subtotal gastrectomy).—A 43-year-old man had complained of epigastric pain for four years. A barium meal initially showed rather coarse rugae but within normal limits. During the last six months pain had increased and had caused loss of time from work. A further barium meal in July, 1960 (Fig. 2), showed grossly hypertrophic rugae in the stomach and this finding was confirmed by gastroscopy. There was no history of oedema, and the serum albumin was 3.7 g./100 ml. The ^{131}I P.V.P. test showed a raised faecal excretion (2.6%), while an albumin turnover showed a slightly shortened half-life of 17 days (normal 20–25 days). A subtotal gastrectomy was performed in August, 1960, and the diagnosis of giant rugal hypertrophy of the stomach was confirmed (Fig. 3). The operation brought relief of the abdominal pain, the serum albumin rose to 4.3 g./100 ml., and the faecal excretion of ^{131}I P.V.P. became normal (0.4%).

Case 2. Idiopathic Steatorrhoea (effect of a gluten-free diet).—This patient, a 53-year-old woman, had had diarrhoea for the 18 months preceding admission in November, 1959.

FIG. 2.—Case 1. Barium-meal radiograph of patient with giant rugal hypertrophy of the stomach.

FIG. 3.—Case 1. Resected specimen of stomach of patient with giant rugal hypertrophy.

Her bowels were open five or six times a day and the stools were loose, pale, and offensive. She was underweight (42 kg., later dropping to 37 kg.), with marked pitting oedema of the ankles. Investigation showed the typical picture of a malabsorption syndrome with an iron-deficiency anaemia, hypoproteinaemia (serum albumin 3.3 g./100 ml.) and steatorrhoea (faecal fat 9 g./24 hours). The absorption of folic acid, vitamin B₁₂ and xylose was impaired. A jejunal biopsy showed complete "atrophy" of the villi, and the P.V.P. excretion over a three-day period totalled 9.7% of the administered dose. She was treated with a gluten-free diet, and over the next few months improved dramatically. By October, 1960, she had gained 12 kg. and passed only one normal motion daily. The serum albumin had risen to 4.8 g./100 ml. and the faecal fat excretion was less than 1 g. a day. The total ^{131}I -P.V.P. excretion over a four-day period was normal (0.5%).

Case 15. Idiopathic Hypoproteinaemia.—A 56-year-old woman had complained of ankle oedema for three years, with tiredness, fluctuant diarrhoea, and, on some occasions, rectal bleeding. In June, 1959, she was investigated by Dr. Wade Volwiler, in Seattle, when radiographs of her gut and sigmoidoscopy were normal. At that time her serum albumin level was 2.6 g./100 ml. and the ^{131}I -P.V.P. excretion 10.3% (occult blood being absent at this time). While in London during May, 1960, her symptoms had diminished, her oedema was mild, her serum albumin level had risen to 3.3 g./100 ml., and the ^{131}I -P.V.P. excretion in her faeces was 2.7%. Her symptoms still fluctuated, and whether she will remain a patient with "idiopathic hypoproteinaemia" or whether frank gastro-intestinal disease will declare itself is unknown.

Ulcerative Lesions of the Gut

The remaining three patients had ulcerative lesions of the gut (Table II).

Case 19.—A woman aged 38 had regional ileitis. During the active phase of her disease her serum albumin was 2.2 g./100 ml. and the faecal excretion of P.V.P. was 3.6%. During remission the serum albumin rose to 3.4 g./100 ml. and her P.V.P. fell to 0.1%.

Case 20.—A boy of 16 had cirrhosis of the liver of the juvenile "active" type (Bearn *et al.*, 1956). The serum albumin level was 3.5 g./100 ml. and the ^{131}I -P.V.P. excretion less than 0.05%. Some three months later typical ulcerative colitis developed explosively, and a further month later his serum albumin level had fallen to 2.4 g./100 ml. and his ^{131}I -P.V.P. excretion had increased to 3.4%. Three months later still, during a quiescent phase of his colitis, his serum albumin level had risen to 4.2 g./100 ml. and the ^{131}I -P.V.P. excretion had fallen to the normal level of 0.4%.

Case 21.—A man aged 26 had ulcerative colitis, and during the active stage of his disease had a serum albumin level of 2.8 g./100 ml. and a high excretion of ^{131}I P.V.P. in the faeces (3.4%). After steroid treatment his serum albumin level rose to 4.2 g./100 ml. and the ^{131}I -P.V.P. excretion fell to 0.5%.

Discussion

Only 35–45 g. of dietary protein a day is needed to maintain good health and vigor and to produce nitrogen balance. This was dramatically demonstrated many years ago by Dr. Chittenden, who, after a vigorous professional life on 45 g. of protein daily, climbed the Matterhorn in late middle age. In addition, hypoalbuminaemia is a late manifestation of simple starvation (Keys *et al.*, 1946), and so impaired absorption of protein would have to be far greater than that usually observed to explain the hypoproteinaemia associated with gastro-intestinal disease.

P.V.P. is an inert large-molecular substance which presumably follows similar pathways to albumin, but it is not metabolized in the same way. It is not perfect

as an albumin marker, because each batch contains a large variety of molecular sizes, of which only the majority have a molecular weight of about 40,000 (compared with the molecular weight of albumin, which is 69,000). The shape and the charges on the P.V.P. and albumin molecules are also different. P.V.P. injected intravenously is partially phagocytosed by the reticulo-endothelial system and is de-iodinated (Ravin *et al.*, 1952). The free iodine is excreted in the urine, and this explains the much higher recovery of free iodine in the urine of patients in the first 24 hours after intravenous P.V.P. compared with intravenous ^{131}I albumin. This also causes the blood level to fall more rapidly. A small amount of faecal ^{131}I P.V.P. therefore may represent an appreciable loss of albumin into the gut.

There are also other reasons why one should not expect an exact quantitative relationship between serum albumin and faecal ^{131}I -P.V.P. excretion even if loss of protein into the gut is the only cause of the hypoproteinaemia. These are (a) the serum albumin level does not necessarily reflect the total body albumin; (b) loss of protein from the gut may fluctuate; and (c) ^{131}I P.V.P. exuded into the gut is not completely recovered in the faeces. In fact, only a rough correlation was found in these patients and by previous workers (Gordon, 1959b; Jarnum and Schwartz, 1960; Steinfeld *et al.*, 1960). Nevertheless, these considerations do not detract from the test's empirical value when performed under standardized conditions, and the results of serial observations underline the relationship between hypoproteinaemia and ^{131}I -P.V.P. loss into the gastro-intestinal tract.

The patient with giant rugal hypertrophy of the stomach is of interest, for it was in such a patient that gastro-intestinal loss of protein was first demonstrated to be of importance in the aetiology of hypoalbuminaemia (Citrin *et al.*, 1957). The loss may be due to an exaggeration of the normal exudation of albumin into the stomach (Wetterfors *et al.*, 1960) due to the increased gastric surface area or there may be increased permeability of the gastric mucosa to albumin. The response to surgery has been reported by Schwartz and Jarnum (1959).

The increased loss of ^{131}I P.V.P. in idiopathic steatorrhoea has been reported by Schwartz and Jarnum in one patient and has also been observed by Parkins (1960) in four of a series of 10 patients, although he found no correlation with serum albumin levels. Of our four patients only one had a high faecal P.V.P. excretion, and she also was the only one with a low serum albumin. The mechanism is unknown, and certainly the usual biopsy findings give no structural basis for the increased permeability to protein, nor does the structural abnormality recover during a clinical remission while the patient is on a gluten-free diet. This is in contrast to some patients with idiopathic hypoproteinaemia; for Fraser (1960) has observed mucosal lacteal dilatation in the intestinal biopsy of one patient and suggests that lymphatics weep into the gut and cause the loss of protein. Gordon (1959b) has suggested a similar mechanism. On the other hand, some patients who have been diagnosed as having idiopathic hypoproteinaemia subsequently prove to have overt gastro-intestinal disease (Holman *et al.*, 1959). Any patient who has hypoproteinaemia of unknown cause needs a very careful investigation of the gastro-intestinal tract. This should include the ^{131}I -P.V.P. test, small-bowel biopsy, and, in some cases, even laparotomy.

Summary

The ^{131}I -polyvinylpyrrolidone test has been performed on 21 patients with a variety of gastro-intestinal disorders, of whom 12 had a low serum albumin. Eleven of these 12 had a high faecal excretion of ^{131}I P.V.P.

Serial studies on six patients showed fairly good correlation between the ^{131}I -P.V.P. faecal excretion and the activity of the underlying disease.

Hypoalbuminaemia in three patients with cirrhosis and two with the nephrotic syndrome did not cause a high P.V.P. excretion in the faeces.

These results lend support to the suggestion that increased loss of protein into the gut, rather than impaired synthesis, is the important factor in causing hypoalbuminaemia in most patients with gastro-intestinal disorders.

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REFERENCES

- Bearn, A. G., Kunkel, H. G., and Slater, R. J. (1956). *Amer. J. Med.*, **21**, 3.
 Bound, J. P., and Hackett, W. R. (1953). *Arch. Dis. Childh.*, **28**, 104.
 Citrin, Y., Sterling, K., and Halsted, J. A. (1957). *New Engl. J. Med.*, **257**, 906.
 Frazer, A. C. (1960). International Congress of Gastroenterology, Leyden.
 Gordon, R. S., jun. (1958). *J. Polym. Sci.*, **31**, 191.
 — (1959a). *Lancet*, **1**, 325.
 — (1959b). *Ann. intern. med.*, **51**, 553.
 Holman, H., Nickel, W. Y., jun., and Slesinger, M. S. (1959). *Amer. J. Med.*, **27**, 963.
 Jarnum, S., and Schwartz, M. (1960). *Gastroenterology*, **38**, 769.
 Keys, A., Taylor, H. L., Mickelson, O., and Henschel, A. (1946). *Science*, **103**, 669.
 Parkins, R. A. (1960). *Lancet*, **2**, 1366.
 Ravin, H. A., Seligman, A. M., and Fine, J. (1952). *New Engl. J. Med.*, **247**, 921.
 Schwartz, M., and Jarnum, S. (1959). *Lancet*, **1**, 327.
 Steinfeld, J. L., Davidson, J. D., Gordon, R. S., jun., and Greene, F. E. (1960). *Amer. J. Med.*, **29**, 405.
 Wetterfors, J., Gullberg, R., Liljedahl, S. O., Plantin, L. O., Birke, G., and Olhagen, B. (1960). *Acta med. scand.*, **168**, 347.

Addressing a conference of the British Student Health Officers' Association, Mr. J. B. Burnett (Edinburgh) said that during a survey of the teeth of students at the University of Edinburgh comparisons were made between 549 Scottish and 510 English students. The figure for teeth decayed, missing, or filled (DMF) in the Scottish group was 17.9—considerably higher than that of 16.5 for the English group. Scotland and England were then divided into various geographical areas. The highest DMF figure, 18.35, was that of students from the Highlands, and was explained, Mr. Burnett thought, by the scarcity of dentists in that area. The lowest figure, 14.85, was that of the Southern and Eastern counties, probably because there are more dentists there than anywhere in the country. "One nearly always," he said, "finds nice clean mouths showing regular dental attention in people from the South of England." The high figure, 18.0, in the Central Lowlands, was no surprise: "I think there must be more pies, pastries, bread and jam and French cakes eaten in this area than anywhere else in the world."