

The Editors of the Proceedings of the Nutrition Society accept no responsibility for the abstracts of papers read at the Society's meetings for original communications. These are published as received from the authors.

ABSTRACTS OF COMMUNICATIONS

The Two Hundred and Fourteenth Meeting of the Nutrition Society was held at the Sir John Atkins Laboratories, Queen Elizabeth College, Campden Hill, London, W8, on Friday, 26 September 1969, at 15.45 hours, when the following papers were read:

The absorption of micellar lipid by the small intestine of the sheep. By C. P. FREEMAN and D. E. NOAKES, *Unilever Research Laboratory, Colworth House, Sharnbrook, Bedford*

The absorption of micellar lipid from the small intestine of the sheep was studied using a method similar to that described previously for the pig (Freeman, Noakes, Annison & Hill, 1968). Two sheep were prepared with double re-entrant cannulas in the jejunal region of the small intestine. During experiments an isolated segment of small intestine was perfused at controlled flow-rates with mixed micellar solutions of radioactively-labelled lipids in sodium glycodeoxycholate (NaGDC) solution, and uptake calculated as described earlier (Freeman *et al.* 1968).

The uptake of micellar lipid by the small intestine was demonstrated, and the capacity of the loop to absorb lipid in this form was high. The efficiency of absorption was influenced by the flow of micellar lipid through the loop, decreasing noticeably at flow-rates greater than about 3 ml/min. Since lysolecithin forms a considerable proportion of the lipid arriving in the small intestine of the sheep (Leat & Harrison, 1967), and has been shown to be a component, together with unesterified fatty acids, of the micellar phase of sheep intestinal digesta (Lennox, Lough & Garton, 1968), its role in the uptake of micellar lipid was of interest. At concentrations below the saturation level, the uptake of [^{14}C]stearic acid from mixed micellar solutions of the type stearic acid/lysolecithin/NaGDC was similar to that when lysolecithin was replaced by 1-mono-olein, or from stearic acid/NaGDC micelles formed in the absence of lysolecithin or mono-olein. In experiments with mixed micelles of [^3H]stearic acid and [^{14}C]lysolecithin, the uptake of lysolecithin was identical to that of stearic acid. No differences in uptake from equimolar mixed micellar solutions were observed between oleic acid and stearic acid, or between oleic acid and its *trans*-isomer, elaidic acid.

It is concluded that the capacity of the small intestine to absorb micellar lipid is not a limiting factor in fat absorption in the sheep, and that this phase of the absorptive process (i.e. uptake of micellar lipid from the intestinal lumen) does not exercise fatty acid specificity. Lysolecithin appears to have no metabolic role in the uptake of fatty acid micelles by the intestine, but functions to enhance the micellar solubilization of long-chain saturated fatty acids, a role in which it has been shown to be

particularly effective in vitro (Freeman, 1969), and one which is normally mediated by monoglyceride in the non-ruminant animal.

REFERENCES

- Freeman, C. P. (1969). *Br. J. Nutr.* (1969). **23**, 249.
 Freeman, C. P., Noakes, D. E., Annison, E. F. & Hill, K. J. (1968). *Br. J. Nutr.* **22**, 739.
 Leat, W. M. F. & Harrison, F. A. (1967). *Biochem J.* **105**, 13P.
 Lennox, A. M., Lough, A. K. & Garton, G. A. (1968). *Br. J. Nutr.* **22**, 237.

The relationship between sucrose intake, plasma insulin and platelet adhesiveness in men with and without occlusive atherosclerosis.

By JOHN YUDKIN and STEPHEN SZANTO, *Department of Nutrition, Queen Elizabeth College, London, W8* and V. V. KAKKAR, *Department of Surgery, King's College Hospital Medical School, London, SE5*

We have previously reported an experiment in which six men, out of nineteen given a diet rich in sucrose, were shown to develop increased platelet adhesiveness and hyperinsulinism (Szanto & Yudkin, 1969). From this study, and from studies of other workers, we suggested that hyperinsulinism is an early manifestation of atherosclerosis, that only a portion of the population will show sucrose-induced hyperinsulinism, and that only these will be susceptible to the effect of dietary sucrose in producing occlusive atherosclerotic disease, including both ischaemic heart disease and peripheral arterial disease.

If this is correct, individuals with these diseases should have relatively high levels of insulin, and these should be related to their usual sucrose intake. On the other hand, individuals with no atherosclerosis should have lower levels of insulin, and these should not be related to their sugar intake. The same considerations should apply to the relationship between platelet adhesiveness and sugar intake.

Table 1. *Correlation between sugar intake, insulin level and platelet adhesiveness in twenty-seven men with PVD and twenty-seven 'healthy' men, before and during glucose tolerance test*

(Tau values, and *P* values for two-tailed test)

Time of insulin assay	Sugar intake and insulin		Sugar intake and platelet adhesiveness	
	Tau	<i>P</i>	Tau	<i>P</i>
(A) Men with PVD				
Fasting	0.30	<0.05	0.28	<0.05
30 min	0.52	<0.001		
120 min	0.34	<0.02		
(B) 'Healthy' men				
Fasting	-0.03	NS	0.18	NS
30 min	-0.19	NS		
120 min	-0.06	NS		

NS, not significant.

We have tested this prediction in two groups of subjects. The first was a group of twenty-seven male patients with peripheral vascular disease (PVD), the second was a group of twenty-seven apparently healthy men attending the medical centre of the Institute of Directors, from whom we excluded men with signs of diabetes mellitus, or of hypertension, or of ischaemic heart disease as revealed by the electrocardiograph. The sucrose intake of the two groups was almost the same, with an average of about 120 g/d. Both the platelet adhesiveness and insulin level were higher in the patients. Also in the patients, sugar intake was significantly correlated with platelet adhesiveness and with insulin levels (measured before and after oral glucose). There was no such correlation in the group of 'healthy' individuals. (See Table 1).

REFERENCE

Szanto, S. & Yudkin, J. (1969). *Proc. Nutr. Soc.* **28**, 11A.

Dietary sucrose and the behaviour of blood platelets. By STEPHEN SZANTO and JOHN YUDKIN, *Department of Nutrition, Queen Elizabeth College, London, W8*

It is generally accepted that atherosclerosis is initiated by an accumulation of platelets on the arterial wall (Medical Research Council, 1967). Platelet adhesiveness is known to be increased in individuals with the disease, and in a number of conditions that predispose to atherosclerosis. We have recently shown that, in some individuals, a similar effect on the platelets occurs with an increase in dietary sucrose (Szanto & Yudkin, 1969).

The standard method for measuring platelet adhesiveness, which we also used in our own study, is somewhat insensitive and imprecise. There is now a more sensitive method of detecting abnormality of the platelets, which involves measuring their electrophoretic mobility in the presence of adenosine diphosphate (ADP) (Hampton & Mitchell, 1966).

A number of young men were given a diet high in sucrose for 10 d, and their level of immuno-reactive insulin was measured before and at the end of this period. Six subjects were then chosen, three of whom showed 'sucrose-induced hyperinsulinism' and three of whom did not. After this preliminary selection, the subjects were given a high-sucrose diet for 14 d, and the electrophoretic platelet mobility was measured before the sucrose diet, at the completion of the diet, and 14 d after its completion. At the end of 14 d of high sucrose intake, the platelets of the three subjects who had shown sucrose-induced hyperinsulinism showed a pattern of electrophoretic behaviour in the presence of ADP that is characteristic of individuals with atherosclerosis; this pattern reverted towards normal 14 d after the end of the high-sucrose diet. The pattern of the platelets of the other three subjects was not affected during the experiment.

REFERENCES

- Hampton, J. R. & Mitchell, J. R. A. (1966). *Lancet* ii, 764.
Medical Research Council (1967). *Rep. med. Res. Coun., Lond.* p. 84.
Szanto, S. & Yudkin, J. (1969). *Proc. Nutr. Soc.* **28**, 11A.

Ulceration of the colon in guinea-pigs fed carrageenin. By J. WATT, *Department of Pathology, University of Liverpool* and R. MARCUS, *Clatterbridge Hospital, Bebington* (introduced by G. A. J. PITT)

During investigations of gastric function in guinea-pigs fed carrageenin over a prolonged period we observed as an incidental finding multiple ulcerative lesions in the caecum in 100% of animals. The lesions occurred in spite of the fact that the guinea-pigs appeared to be healthy and had all gained weight satisfactorily.

Fifteen male albino guinea-pigs were fed a standard cube diet (SG1) supplemented with fresh cabbage and hay. A 1% aqueous solution of carrageenin derived from the red seaweed *Eucheuma spinosum* was freshly prepared each day and supplied *ad lib.* as drinking fluid over a period of 5 months. The carrageenin had been obtained by simple extraction and then drum-dried (supplies of drum-dried carrageenin were purchased from a commercial source). Allowing for spillage from drinking bottles the daily consumption of carrageenin per animal was less than 0.15 g/100 g body-weight. The average monthly gain in body-weight among the carrageenin-fed animals was 125 ± 7 g (SE) compared with 135 ± 15 g (SE) among controls which had received no carrageenin over the same period.

No gastric secretory experiments had been performed on any of these animals; they were killed, using ether anaesthesia, primarily for histological investigation of the gastric mucosa. The large bowel was emptied of faeces and carefully examined using transmitted light.

In all animals fed carrageenin multiple focal ulcers were present in the caecum and in four the lesions had extended distally beyond the caecum for about 3 cm. Microscopically the ulcers involved mainly the mucosa and showed subacute or chronic inflammatory reaction. Control animals showed no pathology in the gastrointestinal tract. The significance of this hitherto undescribed effect of carrageenin in the guinea-pig requires further investigation.

The effect of undernutrition and subsequent rehabilitation on the growth and chemical composition of the cerebellum, brainstem and fore-brain of the rat. By J. W. T. DICKERSON and JENNIFER JARVIS, *Department of Biochemistry, University of Surrey, 14 Falcon Road, Battersea, SW11*, and *Department of Growth and Development, Institute of Child Health, 30 Guildford Street, London, WC1*

In a previous study, the cerebellums of severely undernourished pigs were found to contain concentrations of cholesterol and amounts of DNA similar to those of their age controls, whereas these measurements were lower than control values in the more slowly developing forebrains (Dickerson, Dobbing & McCance, 1967). The concentration of cholesterol and the total amount of DNA in the fore-brain were below control values after maximum rehabilitation.

A similar study has been made of the brains of the offspring of rats undernourished from the 5th day of gestation and through lactation. Undernourished (eighteen)

and control (eighteen) rats were killed at 21 d of age and litter-mates (six ♂, six ♀ undernourished and seven ♂ and six ♀ controls) after 56 d subsequent rehabilitation. Brains were dissected into cerebellum, brainstem and forebrain. Parts were weighed and at 21 d those from three animals were pooled for analysis. At 77 d of age parts from individual animals were analysed separately. Cholesterol, gangliosides, as *N*-acetylneuraminic acid (NANA), acetylcholinesterase (AChE) and DNA were determined.

The weights of the body, forebrain, brain stem and cerebellum of the undernourished rats were 34%, 76%, 77% and 65% respectively of those of the controls. Corresponding values for the animals being rehabilitated were: body-weight 70% (♂) and 83% (♀), forebrain 87% (♂) and 86% (♀), brain stem 89% (♂) and 74% (♀), and cerebellum 84% (♂) and 81% (♀).

In the undernourished rats, the concentration of cholesterol and the total amount of DNA were most deficient in the cerebellum, whereas the concentrations of NANA and AChE were most deficient in the brain stem. After 56 d rehabilitation, the brain stem was the only part studied in which the cholesterol and NANA concentrations were below control values. The absolute amount of DNA was lower than control values in all parts.

The results will be compared and contrasted with those obtained previously on pigs, and discussed in relation to the hypothesis of the time of maximum vulnerability (Davison & Dobbing, 1966).

We are grateful to the Nuffield Foundation for supporting the work of the Department of Growth and Development.

REFERENCES

- Davison, A. N. & Dobbing, J. (1966). *Br. med. Bull.* **22**, 40.
Dickerson, J. W. T., Dobbing, J. & McCance, R. A. (1967). *Proc. R. Soc. B* **166**, 396.

A study lasting 42 days on 'overfeeding' of six young men. By J. V. G. A. DURNIN and N. NORGAN, *Institute of Physiology, University of Glasgow*

Availability for rats of the lysine in field beans (*Vicia Faba* L.). By K. ANANTHARAMAN, *National Institute for Research in Dairying, Shinfield, Reading*

Field beans are rich in lysine; samples of winter and spring varieties contained about 8.0 g/16 g N. However, their content of available lysine as measured by the FDNB-method of Carpenter (1960) was about 6.2 g/16 g N, which suggests that a proportion of the lysine is biologically unavailable.

This communication presents for comparison both biological and chemical assays of available lysine in the two varieties of beans. The biological tests were done with hooded rats; the basal diet and experimental design were as described by Carpenter

(1957) and Bjarnason & Carpenter (1969). Weaned rats were maintained on the basal diet for 5 d before allocation of four male and four female rats to each of the different treatments. All the rats were caged singly. For determining the standard response curve the basal diet was given alone, and with supplements of 0.15, 0.30, 0.45 and 0.60 g lysine/100 g. The corresponding values for daily weight gain/rat were, respectively, 1.79, 3.15, 4.38, 5.00 and 5.60 g, measured over a 10 d experimental period.

The test samples, for both chemical and biological assays, were milled and heated in a steam autoclave for 0.5 h at 107° to inactivate trypsin inhibitor. The heated materials were included in the basal diet at three different test levels, at the expense of maize starch. The results are given in the table.

Level in diet (%)	Winter beans (N% × 6.25 = 25.65)			Spring beans (N% × 6.25 = 28.65)		
	6.7	13.4	20.1	6.7	13.4	20.1
Weight gain (g/rat d)	2.98	4.09	4.79	3.12	4.18	5.03
Lysine equivalent from standard curve (g)	0.126	0.263	0.383	0.141	0.277	0.439
Available lysine (g/16 g N)	7.34	7.66	7.45	7.39	7.25	7.66

At the highest test level the beans contributed an additional 5.4% crude protein to the diet. However, there was no evidence of non-parallelism in the tests and it is concluded that the biological availability of lysine in the beans is greater than 90%, as against only 75% by the FDNB-method.

Blair & Bolton (1968) have suggested that field beans could profitably be more extensively used in animal rations, and the present findings show clearly their value as a rich source of biologically available lysine.

I thank Dr J. W. G. Porter for affording me the facilities for the trials and for helpful criticisms.

REFERENCES

- Bjarnason, J. & Carpenter, K. J. (1969). *Br. J. Nutr.* **23**, 859.
 Blair, R. & Bolton, W. (1968). *J. agric. Sci., Camb.* **71**, 355.
 Carpenter, K. J. (1957). *Proc. int. Congr. Nutr.* IV. *Paris. Abstr.* p. 154.
 Carpenter, K. J. (1960). *Biochem. J.* **77**, 604.

The effect of diets containing soya products on the passage of digesta through the alimentary tract of the pre-ruminant calf. By R. H. SMITH, W. B. HILL and J. W. SISSONS, *National Institute for Research in Dairying, Shinfield, Reading*

Suitably fistulated, milk-fed calves were given single experimental feeds at intervals of 2 or 3 d. Digesta leaving the abomasum or distal ileum were collected, measured and sampled but most of the abomasal effluent was then immediately returned to the duodenum; that removed was replaced by a suitable solution.

Experimental feeds, all with added polyethylene glycol (PEG), were cow's milk or synthetic milks containing emulsified margarine, glucose, minerals and, as a protein

source, calcium caseinate, isolated soya protein or different fat-extracted soya flours characterized as (a) 55% protein heat-treated, (b) 55% protein unheated and (c) 69% protein heat-treated.

Soya-flour diets were readily accepted by the calves for the first two or three feeds but after that were drunk reluctantly or rejected. In later experiments feeding was by abomasal infusion.

After cow's milk was given, water and PEG left the abomasum at a steadily diminishing rate. About 90% of the PEG was recovered in 6 h. Water recovery was 50, 100 and 150% of that fed after about 1.5, 4 and 7 h respectively. Nitrogen left the abomasum at a nearly constant rate throughout the collection period and about 50% of the dietary intake was recovered after 6 h. Transit time through the small intestine and recovery of water and PEG at the ileum were essentially as described previously (Smith, 1966).

Compared with cow's milk the other diets showed only the following major differences.

Soya-protein diet. Dietary nitrogen was almost completely retained in the abomasum during the first 4-5 h after feeding. After this it emerged rapidly and about 70% appeared in the next 2 h.

Soya-flour diets. One of these diets given for the first time behaved rather like the soya-protein diet. Giving further feeds of any soya-flour diet led, however, to inhibition of digesta flow from the abomasum and after two or three such feeds the flow usually nearly stopped during about 0.5-3 h after feeding. Thus little PEG appeared at the ileum up to about 5 h after feeding although transit time through the small intestine decreased and the volume of ileal effluent increased greatly, apparently because of an upset in mineral and water exchange (cf. Smith, 1966).

Thus all the soya diets affected the pattern of nitrogen flow but only the flours affected drastically the general handling of digesta. The possibility that this was due to an allergic reaction within the gut is to be investigated.

REFERENCE

Smith, R. H. (1966). *J. Physiol., Lond.* **183**, 532.

Dietary carbohydrate, exercise and hepatic pyruvate kinase in the rat.

By JANET AITKEN and JOHN YUDKIN, *Department of Nutrition, Queen Elizabeth College, London, W8*

A change in carbohydrate from starch to sucrose in the diet of rats produces a considerable increase in the activity of hepatic pyruvate kinase (Yudkin & Krauss, 1967). Because of the possible role of dietary sucrose in the aetiology of ischaemic heart disease in man, and since physical activity is believed to protect against the disease, we have studied the effects of exercise in rats on the increase in the enzyme activity produced by sucrose.

Rats of the Lister strain, about 13 weeks old, were fed purified diets with 62%

carbohydrate as maize starch or sucrose. Pyruvate kinase was assayed by a modification of the method of Bücher & Pfeleiderer (1955). The rats, housed individually, were divided into five groups each of six animals. For 2 weeks, the rats from two groups were trained to run on a moving belt, with gradually increasing speed and for gradually increasing periods. Then, for 11 d, one of these groups and one non-exercised group were transferred from the laboratory stock diet to a purified diet with starch; a second exercised group and a second non-exercised group were transferred to a diet with sucrose. The fifth group was not exercised and continued on the stock diet.

Exercise was carried out for 1 h in the morning and 1 h in the afternoon, each of three periods of running for 20 min with 5 min rest after the first and second period. The belt was travelling at 45 feet/min, so that each rat ran 1 mile/d.

Estimation of pyruvate kinase in the liver (Table 1) revealed that exercise did not affect the increase in enzyme activity induced by sucrose.

Table 1. *Effect of exercise on hepatic pyruvate kinase in the rat*

Diet	Activity	Final weight (g)	Enzyme activity of liver (units*)
Sucrose	+	293	24.4
Sucrose	—	339	23.8
Starch	+	288	15.4
Starch	—	305	14.4
Stock	—	311	10.5

*See Bücher & Pfeleiderer (1955).

REFERENCES

- Bücher, T. & Pfeleiderer, G. (1955). *Meth. Enzym.* **1**, 435.
 Yudkin, J. & Krauss, R. (1967). *Nature, Lond.* **215**, 75.

Absence of response of some tongue conditions in children to administration of vitamins. By JOHN YUDKIN, *Queen Elizabeth College, London, W8*, and D. H. NORMAN and MEGAN E. WILKINSON, *Dental and Health Department, Hounslow, Middx*, and W. T. C. BERRY, *Department of Health and Social Security*

Taylor (1966) reported that tongue conditions due to malnutrition were prevalent at all ages, and demonstrated to some of us these conditions in secondary school-children of both sexes in Hounslow. We tested whether these appearances could be altered by the administration of vitamins of the B complex and ascorbic acid, which Taylor believes are those most likely to be implicated.

We examined 150 boys and girls aged 11–14 years in secondary schools, and selected fifty-three showing the signs described by Taylor. We paid particular attention to (a) numerous red large fungiform papillae, often most obvious near the tip of the tongue (b) fissuring, other than a shallow irregular longitudinal fissure, (c) filiform papillae, either uniformly shorter or more swollen than those we arbitrarily took as being normal.

Before the vitamins were given, two of us made two examinations of the children's tongues, at an interval of 2 months. The tongues were examined visually, and coloured photographs taken. No significant change was observed between the first and second examinations.

The double-blind study began by the allocation of the children into two groups, by choosing alternate names alphabetically. One group was given placebo tablets, the other was given tablets containing: thiamine 2.5 mg, riboflavine 5 mg, pyridoxine 2.5 mg, nicotinamide 15 mg and ascorbic acid 100 mg.

The tablets were given on each school day, 5 days a week, during two school terms, under the direct supervision of four teachers from the four schools. They were not given during the Easter holidays, so that out of a period of 166 d, tablets were given on 103 d. The tongues were again examined and photographed after 49 d, and at the end of the trial. The results as recorded by each of the two observers are shown in Table 1.

Observer	No. of children					
	Vitamin tablet			Placebo tablet		
	No change	Better	Worse	No change	Better	Worse
B	12	2	0	12	4	3
Y	11	2	1	14	3	2

Clearly, no significant change was produced by the vitamin tablets. It is possible that the condition would have improved had we used larger amounts of the vitamins, or more prolonged treatment. However, epithelial lesions due to vitamin deficiencies tend to improve within a few days with quite moderate amounts of vitamin (Yudkin, 1946). We therefore incline to the alternative view, that the tongue signs were not due to deficiency of any of the vitamins that we administered.

We are indebted to the teachers who so conscientiously administered the tablets; to Roche Products Ltd, who supplied the vitamin and placebo tablets; to Dr Geoffrey Taylor who kindly visited the schools with some of us to demonstrate the sorts of lesion that he had in mind; and above all to the volunteers themselves.

REFERENCES

- Taylor, G. (1966). *Lancet* i, 926.
 Yudkin, J. (1946). *J. trop. Med. Hyg.* 49, 83.

The value of BP-Protein Concentrate for growing pigs. By R. S. BARBER, R. BRAUDE, K. G. MITCHELL and A. W. MYRES, *National Institute for Research in Dairying, Shinfield, Reading RG2 9AT*

BP-Protein Concentrate (hydrocarbon-grown yeast) was used as the sole protein supplement in rations of growing pigs, and its value was compared with that of high-quality white fish meal. Standard and marginal levels of supplementation were used (7 or 3% of fish meal reduced by half after the pigs reached 54 kg live weight, and

corresponding amounts, on crude protein basis, from the BP-Protein Concentrate to which appropriate amounts of methionine were added). Ten pigs per treatment were involved in a feeding trial covering the period from 20 to 90 kg live weight, and six pigs per treatment in a metabolic test from 20 to 60 kg. Individual feeding, wet and restricted according to a scale based on live weight was employed. Results presented for growth rate, efficiency of feed conversion, carcass quality, nitrogen retention and digestibility of rations led to the general conclusion: BP-Protein Concentrate (with added methionine) is a good protein supplement for growing pigs.

Response to different levels of supplementation with copper sulphate of diets for growing pigs. By R. BRAUDE, K. G. MITCHELL, M. J. NEWPORT and R. J. PITTMAN, *National Institute for Research in Dairying, Shinfield, Reading RG2 9AT*

Copper sulphate is now widely used as a feed additive in rations for growing pigs, and is known to improve their performance. The recommended level of supplementation is 250 mg Cu/kg diet. Previous studies have shown that 125 mg Cu/kg diet give a lower response, but little evidence exists on intermediate levels. In the present experiment, levels of 0, 170, 210 and 250 mg Cu/kg diet were compared. Twelve individually fed pigs were used on each treatment; litter origin, initial weight and sex were taken into consideration when allocating pigs to treatments. Pigs were fed twice daily, and had access to the trough for 30 min at each meal. If the pigs completely cleared up their feed on 2 successive d, their daily allowance was increased by 0.1 kg feed up to a daily maximum of 2.95 kg feed/pig. The pigs were on experiment from 20 to 90 kg live weight.

All three levels of Cu supplementation significantly improved growth rate and feed conversion efficiency over that of the control litter-mates. There were no significant differences in performance of pigs receiving Cu at the different levels. There was no significant effect on carcass quality between pigs on this test. Cu contents of liver and kidneys were markedly increased in pigs receiving dietary Cu supplements, but the levels in these organs related to the levels ingested.

Dietary cyclamate and cyclohexylamine excretion in man. By G. L. S. PAWAN, *Department of Medicine, Middlesex Hospital Medical School, London, W1*

(a) The non-caloric sweetener, sodium cyclamate, was administered orally, 45 mg/kg body-weight, in pure lemon juice to 104 normal adult volunteers. A control urine sample was obtained before, and for 8 h immediately after the cyclamate drink, from each subject. In the urine of nine of the subjects cyclohexylamine (TLC method of Kojima & Ichibagase, 1966, as modified by J. S. Leahy, personal communication) was detected in the urine samples after the cyclamate drink, in

amounts ranging between 0.4–2.6 mg cyclohexylamine/8 h urine sample. This substance was undetected in the urine of the remaining subjects.

(b) In fifty-two other normal volunteers (forty men, twelve women), 24 h urine samples were obtained before, and after, each received 50 mg/kg body-weight of sodium cyclamate administered as before in pure lemon juice. Cyclohexylamine was detected in the urine of eight of the subjects in amounts from 0.5 to 4.6 mg/24 h urine, but was absent from the urine of the other forty-four subjects.

(c) Ten adult volunteers, three of whom were 'cyclohexylamine excreters' in experiment (b) above, received 1 g sodium cyclamate/d for 28 d. Daily 24 h urine collections were obtained from each subject, and analysed for cyclohexylamine. The amounts of this substance in the urine of the 'excreters' increased progressively with time to about the 9th day, when peak values of approximately 7–8 mg/24 h urine were found. The cyclohexylamine values then plateaued out, with some fluctuation, between 4–6 mg/24 h urine. In three other subjects cyclohexylamine was detected in the urine on some days in amounts between 0.6–1.7 mg/24 h urine. In the other four subjects, cyclohexylamine was not detected in the urine throughout the 28 d period of study.

The author would like to thank Professor A. Kekwick for encouragement and the subjects for co-operation. Dr E. L. Harris of Abbott Laboratories Ltd, kindly provided supplies of sodium cyclamate.

REFERENCE

Kojima, S. & Ichibagase, H. (1966). *Chem. Pharm. Bull., Tokyo* **14**, 971.

The Two Hundred and Sixteenth meeting of the Nutrition Society was held in the London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1, on Thursday, 4 December 1969, at 16.30 hours, when the following papers were read:

Quantitative aspects of biohydrogenation in the rumen of the lactating goat. By R. BICKERSTAFFE, D. E. NOAKES and E. F. ANNISON, *Unilever Research Laboratory, Colworth House, Sharnbrook, Bedford*

Unsaturated fatty acids liberated during the rapid hydrolysis of complex lipids in the rumen suffer extensive hydrogenation and isomerization (see Garton, 1966). We have used lactating goats prepared with re-entrant cannula placed just inside the duodenum to allow the quantitative collection and analysis of material leaving the abomasum (Harrison & Hill, 1962). The goats, maintained on a high-fat ration containing 5% soya-bean oil, were fed twice daily or continuously, at intervals of 1 h throughout 24 h.