ABSTRACTS OF COMMUNICATIONS

The Fifty-first Meeting of The Nutrition Society (Twenty-fourth of the Scottish Group) was held at the College of Domestic Science, 1 Park Drive, Glasgow, C. 3, on Saturday, 26 February, at 11 a.m., when the following papers were read:

An Outbreak of Nutritional (Iron Deficiency) Anaemia in Weanling Stock Rats. By A. L. BACHARACH, W. F. J. CUTHBERTSON and DOREEN M. THORNTON, *Research Division, Glaxo Laboratories Ltd., Greenford, Middlesex*

Winter Feeding and Calf Mortality. By W. J. A. PAYNE, *West of Scotland College of Agriculture, Auchincruive, Ayr.*

In three winter-feeding experiments and three herd surveys, the effect of winter-feeding practice on the health and mortality of calves in Scottish herds was ascertained. The experimental work and the surveys show that the inclusion of preserved grass, either dried or as silage, in the winter ration of cows is effective in reducing the calf-mortality rate during the spring months.

In the experiments a comparison was made between cows on a ration containing (1) large amounts of grass silage and/or dried grass or (2) a high proportion of imported concentrates. Ration 1 significantly decreased the incidence of 'nutritional scour' in the offspring and the number of stillbirths and deaths in the 1st month of life as compared with ration 2.

The first survey included 1958 births in forty-two herds during the period 1 October 1947–30 September 1948, the second 3776 births in seven herds during the period 1932–47; and the third 13,285 births in 422 herds during the period 1 October–31 March in the winters of 1945–6 and 1946–7. These surveys confirmed that winter-feeding practices influence the stillbirth rate and the mortality rate during the first 3 months of life. It was also found that there is comparatively little variation in calf-feeding methods in west of Scotland herds, and that the first fortnight is the most critical period in the life of the young calf.

The Protection of the New-born Calf against Fatal Scours by Small Quantities of Fat-free Colostrum, and their Effect on the Composition of the Blood Serum. By R. ASCHAFFENBURG, S. BARTLETT, S. K. KON and D. M. WALKER, *National Institute for Research in Dairying, University of Reading*, and C. BRIGGS, E. COTCHIN and R. LOVELL, *Research Institute in Animal Pathology, Royal Veterinary College, Camden Town, N.W.* 1

The results of earlier work (Aschaffenburg, Bartlett, Kon, Terry, Thompson, Walker, Briggs & Cotchin, 1948) led to experiments in which new-born Shorthorn bull calves

were given in their first feed as little as 80, 200 or 400 ml. of fat-free colostrum, and were then kept for 3 weeks on our 'synthetic milk' (Aschaffenburg *et al.* 1948). A further calf received no colostrum. The results for six blocks of four calves are summarized in the table.

	Fat-free colostrum (ml.)			
No. of calves	0	80	200	400
Used	6	6	6	6
Died	5	0	0	0
Mean performance score* (%)	11	66 ± 5†	72 ± 4†	67 ± 4†
Mean live-weight gain during first 21 days (lb.)	—	3 ± 2·3†	4 ± 1·9†	2 ± 0·7†

* See Aschaffenburg *et al.* 1948.
† Standard deviation.

Thus even 80 ml. protected the calves against fatal scours from which all but one of the control calves died. However, the mean performance scores and weight gains were inferior to those obtained earlier for eight Shorthorn calves given about 7 l. of fat-free colostrum (81 ± 4 % and 14 ± 2·2 lb. respectively), probably because scouring was more frequent and severe. Experiments with small quantities of fat-free colostrum and the corresponding whey and dialysed whey showed that the removal of casein and of dialysable components did not impair the protective power.

No consistent increase in the euglobulin nitrogen of the blood serum was observed with the quantities of colostrum quoted in the table. A simple turbidity test for serum with about 0·7 mM-zinc sulphate was developed by one of us (R.A.) from the γ-globulin test of Kunkel (1947), and proved capable of detecting the transfer of 'immune lactoglobulins' from 200 or 400 ml. of fat-free colostrum. It has since been of value in excluding from experiments calves that had suckled before collection from the farm.

REFERENCES

Aschaffenburg, R., Bartlett, S., Kon, S. K., Terry, P., Thompson, S. Y., Walker, D. M., Briggs, C. & Cotchin, E. (1948). *Biochem. J.* **42**, xxx.
Kunkel, H. G. (1947). *Proc. Soc. exp. Biol., N.Y.*, **66**, 217.

The Endogenous Nitrogen Metabolism and Basal Energy Metabolism of the Young Ayrshire Calf.

By K. L. BLAXTER and W. A. WOOD, *The Hannah Dairy Research Institute, Kirkhill, Ayr*

The relation between basal metabolism and endogenous nitrogen metabolism in three young Ayrshire calves was investigated. Semi-synthetic diets made to resemble whole milk in composition were used during all preliminary and post-experimental periods, and the endogenous nitrogen excretion was determined when the calf was subsisting on a diet containing no protein other than that contained in a small quantity of yeast extract (Macrae, El-Sadr & Sellers, 1942). Basal metabolism was determined by respiratory exchange methods 24 hr. after withdrawal of food.

The basal metabolism of the calves was found to be very high, 41·9, 42·0 and 45·5 Cal./kg./day. Their endogenous nitrogen metabolism was 83·8, 80·8 and

81·9 mg./kg./day. Both these are at least double the values found at maturity in cattle (Brody, 1945; Swanson & Herman, 1943). The mean ratio of endogenous nitrogen loss to basal heat loss was 1·90 ± 0·068 mg./Cal. This value is in close agreement with Smuts's (1935) value obtained on mature animals of different species of 2·0 mg./basal Cal. and indicates that the metabolism of the very young animal obeys the 'Terroine-Sorg-Matter' law (Terroine & Sorg-Matter, 1927), which states that the ratio of endogenous nitrogen metabolism to basal heat loss is a constant.

The distribution of urinary nitrogen changed markedly when the nitrogen-free diet was given. The daily excretion of creatinine and of uric acid and allantoin remained constant; urea and ammonia excretion fell to 24 % of the initial values. Creatine excretion was greatly reduced and in two cases creatine disappeared from the urine altogether. The distribution of urinary nitrogen during the period of low nitrogen feeding indicated that 12 % of the total endogenous nitrogen was present as creatinine nitrogen, 49 % as urea and ammonia nitrogen, and over 30 % as purine nitrogen.

REFERENCES

Brody, S. (1945). *Bioenergetics and Growth*, p. 1023. New York: Reinhold Publishing Corporation.
Macrae, T. F., El-Sadr, M. M. & Sellers, K. C. (1942). *Biochem. J.* **36**, 460.
Smuts, D. B. (1935). *J. Nutrit.* **9**, 403.
Swanson, E. W. & Herman, H. A. (1943). *Res. Bull. Mo. agric. Exp. Sta.* no. 372.
Terroine, E. F. & Sorg-Matter, H. (1927). *Arch. int. Physiol.* **29**, 121.

The Passage of Food through the Abomasum of the Sheep. By A. T. PHILLIPSON, R. GREEN, R. S. REID and L. E. VOWLES, *The Rowett Research Institute, Bucksburn, Aberdeenshire*

The volume of food passing from the abomasum of sheep was measured in one animal by exteriorizing the whole flow from the pyloric antrum to the duodenum and in six sheep according to the methods previously described (Phillipson, 1948). In the first animal measurements over 7 and 8 hr. periods were made 14 days after the operations; the material collected was reintroduced into the duodenum with as little delay as possible, for the quantity of food in the duodenum influences the output of the stomach. The average flow/hr. for the two series was 389 and 444 ml. respectively. With the second method the average output for six individual sheep on different diets ranged from 589 to 988/hr. These collections were made for 1·5 hr. periods only and the material was not returned to the duodenum during the observations; consequently they represent an exaggeration of the true flow. Three collections lasting 10·5–12 hr. in which food was regularly reintroduced into the lower part of the duodenum gave an average output of 318–371 ml./hr.

Estimates of the flow through the duodenum based on the concentration of undigested food residues in the duodenal contents and on the quantity of food residues passed per 24 hr. in the faeces suggest that for the two sheep investigated (41 and 68 kg.), eating hay alone or hay plus 50 g. linseed meal, the quantity of material leaving the abomasum was from 400 to 450 ml./hr. When the food of the larger animal was

hay and concentrates in equal parts, the total dry matter consumed being the same as that of the hay diet, the output was estimated to be 272 ml./hr. With hay it is reasonable to suppose that further digestion in the intestine is unimportant, but this may not be so with concentrates, and error due to this may account for the low figure for output.

Chloride concentrations in different parts of the stomach of sheep

	Whole contents (mg./100 g.)	Liquor (mg./100 ml.)	Dry matter (g./100 ml.)
Rumen	26–87	23–54	10·5–15·9
Omasum	123–190	129–204	17·6–24·4
Abomasum	396–455	404–458	5·3–9·8

Quantity of omasal and rumen contents which will produce the concentrations present in the abomasum, assuming that chloride in gastric juice is 553 *mg., and dry matter* 1·24 *g.*

	Whole contents (ml.)	Filtrate (ml.)	Dry matter (g.)
Rumen	23–44	22–43	—
Omasum	32–58	42–58	26–96

The total chloride found in gastric juice obtained from two sheep with a Pavlov pouch varied from 502 to 569 and from 536 to 595 mg./100 ml., respectively. The dry matter of the juice gave an average figure of 1·24 g./100 ml. The chloride and dry matter concentrations in the rumen, omasal and abomasal contents of six sheep slaughtered at varying times after feeding are given in the table. Using the average figure for the chloride of gastric juice, 553 mg./100 ml., it can be calculated that, for every 100 ml. gastric juice, from 32 to 48 g. of omasal contents, or 22–43 ml. of rumen liquor, must be added to produce the dilution present in the abomasum. The same calculation based on dry-matter figures for the omasal and abomasal contents shows a wider range, 26–96 g. The discrepancy may be the result of differential passage of liquor and omasal contents to the abomasum. These calculations suggest that gastric juice forms 50–80 % of the total abomasal contents. The volume secreted per 24 hr. from one Pavlov pouch varied from 955 to 1185 ml., and as the pouch represents approximately 16 % of the whole organ the total gastric secretion is likely to be considerable. Even so, a consideration of the dilutions does not suggest that the average output from the intact abomasum exceeds the range of 300–450 ml./hr. found by long-term collections or the use of plant residues.

The concentration of volatile acids in the duodenal material collected from animals on different diets (expressed as acetic acid) ranged from 10 to 123 mg./100 ml., or, on the above estimate, from 30 to 553 mg./hr. This figure is considerably less than the quantity estimated to be absorbed directly from the rumen (Barcroft, McAnally & Phillipson, 1944).

REFERENCES

Barcroft, J., McAnally, R. A. & Phillipson, A. T. (1944). *J. exp. Biol.* **20**, 120.
Phillipson, A. T. (1948). *J. Physiol.* **107**, 21*P*.

Estimating Food Intake by Questioning and Weighing: a One-day Survey of Eight Subjects. By S. D. MORRISON, FLORA C. RUSSELL and JEAN STEVENSON, *Strathcona Club, Bucksburn, Aberdeenshire*

The amounts of cooked foods consumed by eight club residents at four consecutive meals, the total amount of each cooked dish and corresponding amounts of raw ingredients were weighed and recorded. The energy value of each meal was calculated in two ways by application of appropriate data in tables of food composition to (1) weights of cooked foods and (2) equivalent weights of raw foods.

At the end of the weighed survey each subject was invited to reconstruct the meals eaten in terms of volumes of liquid foods and linear measurements or mass of solid foods, suitable equipment and sample foods being provided. From the quantities of foods so estimated the energy values of the meals were computed by application of published values for apparently comparable cooked foods.

The average 1-day intake of calories (the sum of four meals) estimated by the questionnaire method was 94 % of the average energy value obtained by the evaluation of weighed foods (raw ingredients). But the results for individual subjects obtained by the questionnaire method ranged from 63 to 125 % of the corresponding results obtained by the weighing method (raw ingredients) and in only one was the discrepancy within the limits of ± 5 %. The discrepancies in individual meals of individual subjects were even greater, only three being within the limits of ± 10 %. In the weighed survey the energy values of the meals calculated from published analyses of cooked foods ranged from 77 to 122 % of the values calculated from published analyses of raw ingredients.

The Comparative Nutritive Value of Butter and Hydrogenated Fat (Vanaspati). By R. CHANDA, *Animal Nutrition Section, Indian Veterinary Research Institute, Izatnagar, India**

The effects of various sources of dietary fat on the metabolism of calcium and phosphorus of the growing and of the adult rat were investigated by adding the fats to a basal fat-free diet. The basal diet contained dextrinized starch 59, casein (extracted with alcohol and petroleum ether) 24, yeast (extracted with petroleum ether) 8, and salt mixture (McCollum and Davis) 4 parts. Ninety-five parts of this diet were mixed with five parts of the fat to be tested. The resulting mixture was given to each of six rats kept in individual metabolism cages of the type used by Ackroyd & Hopkins (1916). The fats tested are listed in the table.

Six rats given cow ghee (clarified butterfat) were used as a standard for comparison, and six rats were maintained on the fat-free diet as negative controls. In addition to 15–18 g. of diet, each animal received 5 μg. carotene and 1 μg. calciferol daily. All intakes were corrected for food refusals. Of the fats used, only ghee contained vitamin A or D. The amounts of these vitamins in the ghee were estimated by the spectro-

* At present at the Hannah Dairy Research Institute, Kirkhill, Ayr.

graphic method, and the supplements of the ghee group were reduced so as to make their vitamin intakes equal to those of the test groups.

Collections of the excreta were made 4 days after the preliminary feeding period of 7 days on the experimental diet.

Calcium and phosphorus metabolism with different fats

Fat	Mean adjusted Ca balance (mg./day) (Mean intake 71·4 mg./day)	Mean adjusted P balance (mg./day) (Mean intake 108·4 mg./day)
Cow ghee (clarified butterfat)	31·2	61·8
Ground-nut oil (crude)	26·4	54·8
Ground-nut oil (refined)	29·3	50·7*
Hydrogenated ground-nut oil:		
Dalda, m.p. 36°	25·3	51·9
Dalda, m.p. 40–42°	25·3	47·5*
First Quality, m.p. 40–42°	16·1*	41·7*
Sesame oil (crude)	25·8	50·5
Sesame oil (refined)	27·1	39·8*
Hydrogenated sesame oil:		
Temple, m.p. 41–43°	25·8	26·1*
Rajhans, m.p. 42°	18·0*	26·2*
Cotton-seed oil (crude)	24·1*	46·3*
Cotton-seed oil (refined)	26·7	51·5*
Hydrogenated cotton-seed oil:		
Benaula, m.p. 37–40°	24·9	41·2*
Kotogem, m.p. 41°	21·5*	33·8*
Fat-free diet	−4·6	+9·8

* The differences between these groups and that on cow ghee are significant at the 5% level.

In a second experiment involving growth, female rats in the early stages of pregnancy were removed to a dark room. The young were weaned at 28 days and divided into seven groups of six each. During the whole period of experiment the animals were kept in the dark, on the same diet as that used for the adult rat. In this investigation observations were made with cow ghee and two preparations of hydrogenated ground-nut oil, of sesame oil and of cotton-seed oil. After 4 weeks on the experimental rations the rats were sacrificed and the fat-free femurs were analysed for ash, calcium and phosphorus.

It was observed that calcium balances were negative when the diet was free from fat. Positive calcium balances resulted when the diet was supplemented with fat, but varied markedly with the kind of fat used. The intake of the minerals also varied from group to group. These experimental intakes and balances were treated statistically by analysis of covariance, the means being adjusted to a constant intake. This procedure was justified because the regression of balance on intake was significant. The adjusted means for the balances of calcium and phosphorus are given in the table. It will be noted that as compared with butterfat, calcium balances were not significantly different in oil or vanaspati (hydrogenated oils) groups, except for 'First Quality', 'Rajhans', 'Kotogem' and crude cotton-seed oil. The melting-points of those vanaspatis which gave lowest calcium balances were highest. The lower calcium balance in the crude

cotton-seed oil group may be due to the presence of gossypol, the toxic principle present in cotton-seed. Refining of cotton-seed oil improved its effect in facilitating retention of calcium and phosphorus; this may be due to the removal of gossypol. The refining of ground-nut or sesame oil had little effect. The phosphorus balances in all the groups (except for crude ground-nut oil, crude sesame oil and Dalda, m.p. 36°) were significantly lower than that with cow ghee. The refining of ground-nut and sesame oil reduced the phosphorus balances.

In the second experiment the weights of fat-free femurs of growing rats were not affected, but the percentage of ash in the bone of the vanaspati groups was 10–12 % less than in bones of animals receiving cow ghee, and these differences were found to be statistically significant. The calcium: phosphorus ratio in the bone ash was unaffected by the kind of fat used.

REFERENCE

Ackroyd, H. & Hopkins, F. G. (1916). *Biochem. J.* 10, 551.

Dietary Selection by the Rat. By D. E. Tribe and Mildred M. Wilson, *The Rowett Research Institute, Bucksburn, Aberdeenshire*

Animals, including the human infant, when given unlimited choice among the components of an adequate diet, will select food in a way that leads to normal growth and reproduction; appetite, however, cannot be taken as an infallible guide to nutritional requirements (Young, 1941).

Rats of approximately equal weight and comparable genetically were individually caged and offered the choice of four diets which were identical except for the kind of starch included. Diet 4 contained in addition a full vitamin B complex supplement, as the diets were deficient in these factors. Diet 1 contained unground raw potato starch, diet 2 unground maize starch, diet 3 unground rice starch, and diet 4 unground maize starch. The rats were offered the following choices: diets 1 and 2, diets 2 and 3, diets 3 and 4, and diets 1 and 4. Rats offered 1 and 2 invariably ate almost entirely from diet 2 and died. The length of survival was longer than in those animals which received 2 alone, owing, presumably, to the small intake of diet 1. Rats offered 2 and 3 ate approximately equal amounts of both rations and died. Rats offered 3 and 4, or 1 and 4, showed an overwhelming preference for the supplemented diet and gained in weight.

The most interesting group was that offered diets 1 and 2, for here, if the rats had eaten sufficient of diet 1, they would have refected (Kon, 1931) and so overcome the deficiency of B vitamins and survived, but they did not. The reason for this may be that potato starch produces indigestion. The effect of the size of the starch granule on selection of diet is under further investigation.

Acknowledgement must be made of the assistance the authors have received from Mr F. Baker.

REFERENCES

Kon, S. K. (1931). *J. Hyg., Camb.*, 31, 543.
Young, P. T. (1941). *Psychol. Bull.* 38, 129.

Hypocupraemia in Dairy Cows. By RUTH ALLCROFT and W. H. PARKER, *Veterinary Laboratory, Ministry of Agriculture, Weybridge, Surrey.*

Copper Pine in Calves. By S. JAMIESON, *North of Scotland College of Agriculture, Craibstone, Aberdeenshire* and RUTH ALLCROFT, *Veterinary Laboratory, Ministry of Agriculture, Weybridge, Surrey*

Some Copper-Molybdenum Relationships in Sheep and Cattle. By RUTH ALLCROFT, *Veterinary Laboratory, Ministry of Agriculture, Weybridge, Surrey.*

The Biological Activity and Metabolism of Vitamin A Acid. By I. M. SHARMAN, *Dunn Nutritional Laboratory, University of Cambridge, and Medical Research Council*

Growth tests on rats confirmed the claim of Arens & van Dorp (1946) that vitamin A acid has biological activity when given in the form of its sodium salt either orally or by injection. The growth responses observed, however, were always less than with equal doses of carotene.

When a rat was dosed orally with 10 mg. of vitamin A acid, and killed 5 hr. later, spectroscopic examination indicated the recovery from the stomach contents of 6·1% of the dose given, as judged by the intensity of a sharp absorption maximum at 343 mμ. No vitamin A acid could be detected in the tissues by this criterion, and no evidence of conversion to vitamin A could be found either by spectroscopic examination or by the application of the antimony-trichloride test. An extract of the intestinal walls, however, showed absorption, with increasing intensity towards the shorter wave-lengths, much more intense than that of an extract made from an undosed animal. This observation suggests that vitamin A acid undergoes changes in the intestinal walls which result in the shortening of its system of conjugated unsaturated linkages.

REFERENCE

Arens, J. F. & Dorp, D. A. van (1946). *Nature, Lond.*, **157**, 190.