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ABSTRACTS OF COMMUNICATIONS

The Ninety-second Meeting of The Nutrition Society (Forty-second of the Scottish Group) was held in the Biochemistry Department Lecture Theatre, University of Edinburgh, on Saturday, 5 February 1955, at 10 a.m., when the following papers were read :

Feeding Standards for Poultry. By W. BOLTON, *Poultry Research Centre, West Mains Road, Edinburgh 9*

The sale of poultry food in the U.K. is only lightly controlled. A vendor must furnish to the purchaser a statement setting out the contents of albuminoids or crude protein, oil and crude fibre. He must also state the name of any ingredient which merely supplies bulk and it is implied that deleterious ingredients are absent.

The reputable provender millers base their mash formulas on the U.S.A. recommended standards, although in the U.S.A. the main cereal used is maize, while in the U.K. maize, wheat, barley and oats are all incorporated.

Digestibility trials carried out at the Poultry Research Centre have shown that the energy values (digestible carbohydrate plus $2.3 \times$ digestible fat) of the cereals is greatest for maize and lowest for oats, and that neither the crude fibre nor the nitrogen-free extractive gives a good indication of the digestible carbohydrate. However, the ratio of the contents of available carbohydrate, i.e. the sum of the sugars, dextrans and starches expressed as starch, was in close accord with that for the digestible carbohydrate (Bolton, 1955*a*). When complete diets were fed to birds of different ages it was found that the available carbohydrate accounted for about 90% of the digestible carbohydrate in all groups (Bolton, 1955*b*). This criterion, therefore, was much superior to either crude fibre or nitrogen-free extractive. The digestible oil comprised about 90% of the total ether extract and Duckworth, Naftalin & Dalgarno (1950) have shown that at least 90% of added oil or fat is digested even when added in amounts as high as 12%.

Fat, suitably stabilized by the addition of antioxidant, has been used in poultry diets at up to 10% in the U.S.A. and in baby pig diets in the U.K. at 5%. The extra energy supplied by the fat needs to be balanced by increased levels of protein, minerals and vitamins, i.e. the assessment of the energy level of the diet can be expected to assume increasing importance. It is suggested that the adoption of the available carbohydrate instead of the present crude fibre would greatly assist in the evaluation of poultry diets.

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The Retention of Vitamin B₁₂ by Growing Cockerels. By D. H. SHRIMPTON,
Rowett Research Institute, Bucksburn, Aberdeenshire

Thirty-six unsexed chicks from a vitamin B₁₂-depleted breeding flock were given grain feeds for 3 days and then divided into two groups, one being given the all-vegetable diet A (Shrimpton, 1954) and the other a stock ration (diet D), containing 12% white fish meal and 7% dried skim milk. Both rations were fed *ad lib.* and the birds were housed on wire screens to prevent access to their droppings.

As was expected, in the first 8 weeks, birds fed on diet D grew more quickly than those fed on diet A. Also only seven of the birds fed on diet D died compared with thirteen deaths in the group fed on diet A. After this period the live weights of the two groups converged.

Four cockerels in each group were killed serially after 23 weeks and the total amount of 'leichmannii' vitamin B₁₂ in each carcass (see table) was estimated (contributions from the gut contents, blood, head, feet, bones and feathers were neglected). Birds which had no vitamin B₁₂ in their diet retained considerable quantities of the vitamin of the same order as those which had animal protein in their diet. However, the tissues did not appear to be saturated since three further birds fed on diet D, which received 200 µg vitamin B₁₂ by intramuscular injection during the last week before killing contained 75, 81 and 129 µg of 'leichmannii' vitamin B₁₂ respectively.

Age	Mean live weight (g)				Estimate of vitamin B ₁₂ ingested (µg)	Total vitamin B ₁₂ in individual carcasses (µg)			
	3 days	4 weeks	8 weeks	23 weeks		0-23 weeks	3 days	23 weeks	38 weeks
Diet A	} 40	130	570	2430	0	} (0.13)†	21	19	11*, 25
Diet D		210	600	2250	110		25	29	23, 36

* Total liver content of 4 µg as compared with approximately 12 µg in other birds of this group.

† Shrimpton (1954).

Chicks hatched from this breeding flock and with no dietary source of vitamin B₁₂, grew poorly and only retained an extra 0.35 µg of the vitamin during the first 4 weeks (Shrimpton, 1954). However, the cockerels reported here have retained in the succeeding 20 weeks the order of 20 µg of vitamin B₁₂. Further, in contrast to the young chicks, this amount was evidently sufficient for normal growth and was similar to that found in birds of 40 weeks of age, even when a dietary source of vitamin B₁₂ was available.

These findings are in line with those of Jackson, Machlin, Brandenburger, Kellogg & Denton (1953) using ⁶⁰Co-labelled vitamin B₁₂ who suggested that chicks could absorb significant amounts of vitamin B₁₂ from endogenous sources, presumably the alimentary flora, after the age of 6 weeks.

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Triorthocresyl Phosphate and Vitamin E Metabolism in Calves. By
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An apparent 'antivitamin E activity' of triorthocresyl phosphate (TOCP) was demonstrated using rabbits by Bloch & Hottinger (1943). Later, Draper, James & Johnson (1952) claimed that TOCP when given to lambs receiving rations low in tocopherol content, caused the rapid appearance of signs of muscular dystrophy, and concluded TOCP was an antivitamin E substance in this species also. Experiments were made by us with eight calves given rations of milk and dried skim milk, supplemented with vitamins A and D and containing very little vitamin E. Two were given no other supplement and six TOCP. Of these two received in addition 100 mg and two 500 mg DL- α -tocopheryl acetate daily. The initial dose of TOCP was 1 g/day which resulted in mild clinical signs of hyperexcitability and slight diarrhoea by the 5th day. The signs progressed in all animals irrespective of tocopherol supplement until the 3rd week and subsequently diminished. After 7 weeks the dose of TOCP was increased to 4 g/day. The calves developed severe signs of neurological disease within 7 days, became paralysed and either died or were slaughtered *in extremis*. Paralysis first involved the extremities, was associated with abolition of motor reflexes, and no abnormality of the muscle itself was detected. The calves given no vitamin E were not affected more than those given supplements. The muscles were normal macroscopically and microscopically, and chemically did not show the diminution in creatine content or increase in the Na:K ratio characteristic of dystrophy.

There was, however, a progressive increase in the faecal excretion of tocopherol and its quinone when TOCP was given together with a decrease in the serum concentration of tocopherol. Despite the large dose of 500 mg tocopherol which after 20 days had resulted in a concentration in the serum of more than 800 $\mu\text{g}/100\text{ ml.}$, the concentration had fallen by 80 days to 100 $\mu\text{g}/100\text{ ml.}$, faecal excretion having increased tenfold in the interim. This supports the conclusion of Myers, Mulder & Simons (1953) that TOCP interferes with absorption from the gut.

It was concluded that despite this effect of TOCP on tocopherol absorption, when it is added to rations containing minimal amounts of tocopherol it does not lead to muscular dystrophy, but to a neurological disturbance most probably associated with demyelination of motor nerves. Even massive doses of α -tocopheryl acetate do not reverse this effect.

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Draper, H. H., James, M. F. & Johnson, B. C. (1952). *J. Nutr.* **47**, 583.
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***Drosophila melanogaster* as a Test Organism for Aseptic Nutritional Research.** By J. H. SANG (introduced by W. BOLTON), A.R.C. SCIENTIFIC STAFF, *Poultry Research Centre, West Mains Road, Edinburgh 9*

The difficulties of rearing the common laboratory animals under aseptic conditions are well known, and these difficulties, and excessive costs, have limited the amount of nutritional research which could be done in this field. Consequently, there is a place for another multi-cellular test organism which can be more easily handled. The fruit-fly, *Drosophila*, has been so used and was, indeed, the first multi-cellular organism to be cultured on a diet of known composition (Trager, 1947). But early techniques did not allow large numbers to be handled and a quantitatively defined diet could not be elaborated. Improved sterilization and handling procedures now make this possible, and experiments involving as many as 5000 individuals can be set up and reliable dose-response curves determined for all essential dietary requirements. Further, the quantity of food medium (and space) necessary for such work is about the same as that involved in ordinary bacteriological work. The life cycle of the fly is about 10 days at 25°.

For optimal growth, *Drosophila* requires casein or equivalent amino-acids, fructose, cholesterol, lecithin, RNA, the B-vitamins (except, perhaps, vitamin B₁₂) and salts. Excessive amounts of all but the vitamins slow growth and, as with vertebrates, excess choline has toxic effects. Lecithin, on the other hand, can serve as a choline source, and, within limits, will protect the organism against excess choline. Examination of highly inbred pure lines shows that there are considerable variations in the minimal requirements of different lines and their crosses. No single optimal diet can therefore be defined. So far no differences in synthetic abilities have been found between lines, but there is little doubt that such qualitatively different variants will be found among the many strains of the fly kept for genetic purposes. Unlike vertebrates, *Drosophila* is unable to synthesize nicotinic acid from tryptophan, and it will be shown, as an illustration of the use of the techniques described, that it is also unable to utilize quinolinic acid to effect this synthesis.

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Trager, W. (1947). *Biol. Rev.* **22**, 148.

Interrelations between Passage of Food through the Digestive Tract and its Digestibility. By K. L. BLAXTER, N. MCC. GRAHAM and F. W. WAINMAN, *Hannah Dairy Research Institute, Kirkhill, Ayr*

Eighteen experiments were made with six sheep in which the same sample of dried grass was fed, either as long material, or as cubes made after the grass had been ground to medium fineness or as cubes made from very finely ground material. Three levels of feeding were adopted, 600, 1200 and 1500 g/day. In each experiment the passage of food through the gut was measured employing the technique of

Balch (1950), and the apparent digestibility of the dietary dry matter determined. Experiments lasted for 21–27 days, faeces being collected on the 11th and subsequent days at 6 h and later 12 h intervals.

Increasing the amount of food given resulted in its more rapid passage through the gut for each of the three foods. At each feeding level the passage of fine cubes was more rapid than that of medium cubes, which was in turn more rapid than that of long material. With increasing time taken to pass through the gut, the shape of the curves relating cumulative quantity excreted to time, changed. They became less steep. This suggests that long material passed through the fore-stomachs more slowly than did cubes.

The apparent digestibility of the dry matter fell with increasing intake, this being most marked with fine cubes and negligible with long material. The mean results (two sheep per determination) are given in Table 1 together with the mean length of time a single meal stayed in the gut, computed from summations of abscissae in the passage curves.

Table 1. *Apparent digestibility of the dry matter of dried grass by sheep when given it in different physical forms*

Physical form of the dried grass	Amount given (g/day)	Apparent digestibility (%)	Mean length of time the food stayed in the gut (h)
Long	600	80.3	103
	1200	79.1	72
	1500	79.4	68
Cubes made from medium particles	600	76.9	74
	1200	71.5	53
	1500	69.9	42
Cubes made from fine particles	600	75.9	53
	1200	68.8	39
	1500	65.4	34

The results suggest that the physical form of food and the quantity given influence the length of time it stays in the gut, and when the time is short a decrease in the digestibility of the food is apparent.

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Pre-eclamptic Toxaemia, Weight Gain during Pregnancy, and the Energy Value of the Diet in Late Pregnancy. By A. M. THOMSON and W. Z. BILLEWICZ, *Midwifery Department, University of Aberdeen, and External Staff, Medical Research Council*

Restriction of weight gains during pregnancy has not hitherto been practised in Aberdeen, and it is thus possible to study the 'natural' relationships between weight

gain, the energy value of diet, and the incidence of pre-eclampsia. During the 7th month of pregnancy 545 married primigravidae co-operated satisfactorily in a 1-week individual diet survey (weighing method). Thirty developed 'albuminuric pre-eclampsia' (P.E.T.) of moderate or severe degree, and 130 had milder hypertensive states. The diagnostic criteria of pre-eclampsia and hypertension were those of Nelson (1955); our sample showed the same incidence and trends as he found in a more extensive series. Adequate body-weight records were available in nearly 500 surveyed patients. The first part of the table shows that high weight gains were more common in P.E.T. and other hypertensive conditions than in non-hypertensives. The second part shows that the average rate of gain in weight was greater in women with higher calorie intakes, at least in the non-hypertensive and 'other hypertensive' groups.

	20-30 weeks			30-36 weeks		
	P.E.T.	Other hypertensive	Non-hypertensive	P.E.T.	Other hypertensive	Non-hypertensive
Average weight gain per week (lb.)	Percentages			Percentages		
— 0.8	24.1	20.2	34.0	17.2	32.8	44.1
0.8 — 1.2	24.1	41.2	38.1	13.8	25.4	36.3
1.2 +	51.7	38.6	27.9	69.0	41.8	19.6
Average daily calorie intakes (Cal.)	Mean weight gains per week (lb.)			Mean weight gains per week (lb.)		
— 2200	1.34	1.06	0.83	1.33	0.99	0.78
2200 — 2700	1.00	1.15	1.01	1.42	1.11	0.81
2700 +	1.34	1.23	1.20	1.30	1.30	1.10
No. of cases	29	119	326	29	122	331

In P.E.T., the rate of gain is just as high in the 30-36 as in the 20-30 week period, whereas in non-hypertensive pregnancies the rate of gain decreases in the later period. The differences may be due to excessive fluid retention in cases of P.E.T. However, in each of the three clinical groups higher 30-36 week gains were associated with higher net gains (weight at discharge from hospital about 10 days after delivery, minus weight at the 20th week of pregnancy), suggesting that the higher weight gains were not wholly due to fluid retention. High rates of weight gain or the occurrence of P.E.T. were not obviously related to low protein or high carbohydrate consumption, *per se*.

In the low, medium and high calorie intake groups, the incidences of P.E.T. were 3.3, 6.5 and 6.7%, respectively and in the low, medium and high weight-gain groups, 20-30 weeks, 4.9, 3.9 and 9.9%. The figures suggest that high calorie intakes predispose to pre-eclampsia, but they do not confirm Hamlin's (1952) suggestion that a weight gain exceeding 8 lb. between the 20th and 30th weeks can be used effectively to predict the onset of P.E.T.

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Consumption of Milk and Vitamin Concentrates by Pregnant Women in Aberdeen. By JEAN W. MARR, ELIZABETH B. HOPE, JEAN D. STEVENSON and A. M. THOMSON, *Midwifery Department, University of Aberdeen*

Practically all pregnant women purchase the subsidized pint of milk to which they are entitled daily, but little is known about the amount of milk they themselves drink. It is well known that the total uptake of official vitamin concentrates is far lower than the potential allocation, but their actual consumption by pregnant women has not been studied previously. The table below shows the consumption of milk and of vitamin concentrates by groups of Aberdeen married primigravidae studied during the 7th month of pregnancy between 1948 and 1953. Data for milk are derived from 545 patients who kept reliable records in 1-week weighed individual diet surveys; data for concentrates include a further 179 patients, some of whom did not provide adequate quantitative records in respect of foodstuffs.

In social classes I and II (professional etc. classes), only 58% took 1 pt. of milk or more, from all sources, daily, and in classes IV and V (wives of semi- and unskilled workers) only 18%. 'Working class' mothers seldom kept the subsidized pint of milk separate from the household supply; indeed it was often the only milk purchased for the household. Vitamin A and D tablets (or, rarely, cod-liver oil) were taken regularly (at least 5 days in the survey week) by 60-40% of the women, depending on social class, and in classes IV and V half the women took none. Orange-juice concentrate was used even less extensively. Within social classes consumption of milk and vitamin concentrates rose steadily as maternal age increased. There was little or no evidence of seasonal variations in consumption.

Reasons for not taking vitamin supplements varied greatly. Ignorance and apathy seemed to play a great part. Many women believed that the vitamin A and D tablets were laxatives. The orange-juice concentrate was often disliked, or thought to cause heartburn.

Husband's social class	I & II	III	IV & V
Average daily intake of milk (all sources)		Percentages	
1 pt. or more	58	43	18
$\frac{1}{2}$ -1 pt.	36	45	59
Less than $\frac{1}{2}$ pt.	6	12	23
Number of cases	69	153	323
Consumption of vitamin A & D concentrates			
Regular (5 days or more in week)	60	52	41
Irregular	12	12	10
None	28	35	49
Consumption of orange juice concentrate			
Regular (5 days or more in week)	53	42	31
Irregular	12	18	20
None	36	40	49
Number of cases	76	187	461

We wish to thank the Advisory Committee on Medical Research (Scotland) for sponsoring the grants under which the diet survey work was carried out. Assistance was also afforded by the Social Medicine Research Unit of the Medical Research Council.