East African Medical Survey Annual Report 1956

49

RESEARCH

Section I.—Nutrition

A.—A Report of a Diet Survey in the Taveta-Pare Area of Tanganyika.

The survey was undertaken at the request of Dr. Bagster-Wilson, Director of the East African Institute for the Study of Vector-borne Diseases, and in collaboration with his staff.

The area surveyed is in the Taveta-Pare area of Tanga Province and is the site of an experiment on control of malaria by the spraying of insecticides. The object of carrying out the survey in this area was to obtain a base line from which any change in nutrition and health of the population, which might follow the scheme of control, could be measured. The team consisted of Dr. Trant (in charge), Mrs. J. Meek (Health Visitor) and Mr. Vaz. Assistants to act as interpreters and to give general help were engaged locally. The period of survey was May to November, 1955. Since both food supplies and the need for manual labour are subject to seasonal variations in any area devoted to subsistence agriculture, it is a pity the survey could not have covered a whole year. This, for various reasons, was impossible. If, however, in the future a further survey is made for comparison, it will be necessary for it to cover a corresponding part of the year. It so happened that the Mohammedan fast of Ramadhan fell in the survey period; the effects of the fast on the diet were observed, and are very interesting.

The headquarters of the survey were at Gonja. Quantitative observations were carried out at the following places: Kimorico, Kizerui, Usangi, Taveta Forest, Magofu, Makayuni and Kibango. In addition, a number of qualitative data, e.g. questionnaires answered by schoolchildren about the number and nature of meals consumed, were collected.

It need hardly be stressed that an investigation of the diet consumed by primitive peoples presents considerable difficulties. With patients in hospital who are under close control, or with a group of educated and co-operative individuals, an accurate measurement of individual diets is quite feasible. The measurement of individual diets in this investigation, was quite impossible as is invariably the case in surveys on people with similar habits. In many cases, the persons comprising the family eat from a common dish, or, more frequently, the men eat separately from the women and children, each group using a common dish. Sometimes visitors come and share the meal. The presence of strangers, particularly Europeans, at mealtimes is resented. The only feasible method of measurement is, therefore, the one which was adopted and is briefly as follows.

After preliminary discussions with the Headman or Chief, some thirty, or, if possible, rather more than thirty, families were chosen for the survey. The aim was to include thirty families but usually several had to be dropped out because they became un-co-operative; it was therefore desirable to start with rather more than thirty where possible. This procedure, of course, prevented the sample being a truly random one. Ten houses were allocated for observation to each of the three members of the team. For the most part, the people ate two main meals per day. Some families, in addition, ate an early morning meal. In some cases only an evening meal was consumed. Since the location of the headquarters often prevented the three members of the team actually observing the "breakfast", the householder was asked to produce, if possible, an amount of food equal to that eaten at breakfast; if not, the observers had to rely on question and answer as to the nature and amount of food taken at breakfast. In any event, the meal was a light one, and often consisted only of tea. Where a mid-day meal was taken, the food was usually ready for cooking at about 11 a.m. It was then weighed by the observers. If cooking had by any chance started earlier, it was arranged that the woman of the house would put out a dish with an amount of food equal to that which she had already begun to cook. At this visit, questions were asked about any food left over from the day before, and about any food which had been wasted. There is no doubt that the answers were not always accurate, but in the main it is thought that little food was left over, and that the inaccuracy introduced was not very great. When a second meal was cooked and eaten, the constituents were weighed before cooking. Occasionally the second meal consisted of food remaining from the mid-day cooking.

This procedure will furnish information only about the total food consumed by the family, and guests if any. Since the group would comprise of persons of both sexes and of ages ranging from infancy to old age, it is obvious that figures showing either the total consumption or the consumption per head, will be of little value. Children, of course, require much more food in proportion to their age and sizes than adults, and conversely, old people require and consume less. Since the ages and composition of families will necessarily change with time, a survey carried out months or years later, even on the same individuals, would not provide figures which could be compared with previous observations. To endeavour to surmount this difficulty, an attempt was made to calculate the theoretical calorie requirements of the group, taking into account age, sex and body weight. The report of the Committee on Calorie Requirements, sponsored by F.A.O., ("Calorie Requirements", Washington, 950), indicates the methods by which this can be done. This figure then provides a "yard-stick" with which the diet actually consumed can be compared. A similar figure, though not an identical one, owing to changes in the composition of the family groups, can subsequently be prepared in comparison with a later survey, and it can be seen how closely the food consumption approximates to the appropriate "yard-stick" in that case. The method by which the calculation is made is briefly as follows: (the reader should consult the original publication for details and for the various assumptions made and for their justification). The committee assumes the calorie requirements of a "reference" man and woman of standard weight, living in a temperate climate, and twenty-five years of age. It gives formulæ by which these figures can be corrected for body weight, age and environmental temperature when these differ from the "reference" as of course they do in the population investigated. For children, aged from 1 to 15 years, separate values are given for appropriate age groups irrespective of body weight. For persons aged 16 to 20 years inclusive, it is suggested that the calorie requirements should be taken for males as 120 per cent of well-nourished active males of 25 years of age, belonging to the same population, and for females as 105 per cent of female requirements of 25 years of age. For persons aged 21 and onwards, the following formula was used:

$$E=(1{\cdot}1875-0{\cdot}0075A)\,(1{\cdot}050-0{\cdot}005T)\quad aW^{0\cdot73}$$

where:

E = Energy requirement in calories.

A = Age in years.

T = Environmental temperature (in our case assumed to be 25°C.).

a = activity (including B.M.R.) (in our case represented by the factor 152 for either sex).

W = Body weight in kilograms.

The method of calculation here used, differed from that recommended by F.A.O. in one particular, which must be stressed. The members of the team were very impressed by the fact that the African women took a very large part in heavy manual work, not only of an agricultural nature, but also in carrying water, firewood, agricultural produce, etc., and in such activities as walking long distances to market. They have, therefore, used the same formula for both sexes, whereas the F.A.O. Committee recommended different formulæ for men and women. This procedure is not strictly justifiable on theoretical grounds since the constants in the formula for women takes into account not only the assumed lower scale of physical activity, but also allows for the fact that the surface area and also the basal calories per square metre of surface area are lower in women than in men. On the other hand, it is clear that the Committee did not contemplate their "reference woman" undertaking the sort of activity which is the lot of African women, and it is thought that the method adopted will give a better approximation than strict adherence to the formula given for females. A further point in favour of the use of the higher (or male) factor is that account has not been taken for the presence of pregnant and lactating women in the groups studied. Both these physiological conditions increase the calorie requirements considerably.

Unfortunately, in some instances, the team relied for information about the body weights of some of the groups studied upon data from records of a health survey which was simultaneously being carried out by members of Dr. Bagster-Wilson's Institute. A number of these records, for various reasons, could not be obtained and unfortunately if the weights of one or two members of the family group are missing, the calculation cannot be carried out. In the event, it was found that a complete data were available for only 44 families, which were distributed in the various localities studied. This, of course, introduces a further selection and detracts from the statistical value of the results. Table I gives a summary of the food consumption of these 44 families; Table II shows the calculated calorie requirements of the individuals concerned considered as a group; Table III gives the frequency with which each foodstuff was consumed. The "Index" in Table III represents the number of times a particular foodstuff is eaten by a family during one week, expressed as a daily average.

If, for instance, a family eats maize flour 21 times during a week, then the maize flour index is

$$\frac{21 \text{ (times)}}{7 \text{ (days)}} = 3$$

Again, if maize flour index is 0·2, it means that the foodstuff was eaten $0{\cdot}2 \times 7 = 1{\cdot}4$ times during the week. (About once in every five days.)

Comparison of Tables I and II indicate that the observed calorie intake is greater than that calculated from the F.A.O. Report. The amount of animal protein is very low.

At this stage, three other matters deserve consideration. The first is the question of waste of foodstuffs during cooking. The figures given for the food constituents, total calories, etc., are derived from "Tables of Representative Values of Foods Commonly Used in Tropical Countries" by B. S. Platt (M.R.C. Special Report Series No. 253, 1954).* The figures for food constituents and calories given in these tables refer to the edible portions of food, and as the food was already prepared for cooking, when it was weighed, "waste", e.g. skin and stumps of vegetables, husks of cereals, skins of fruit, etc., will already have been removed. Loss of food constituents will, however, occur in cooking. The loss of protein, carbohydrate and fat is probably very small, but that of vitamins may be considerable. There are the added difficulties that the vitamin content in various samples of the same foodstuff may vary and that bacterial synthesis of vitamins in the intestinal canal may occur. An accurate allowance for this can only be made by the analysis of the cooked food; this is practicable under strictly controlled conditions and with extensive laboratory resources, but is quite impracticable under field conditions. Many vitamins will be partly destroyed in cooking, particularly by the method adopted by Africans. It is probably better to look for clinical signs of vitamin deficiency among the population under observation rather than to rely on calculations. The second point is concerned with the amount of foodstuffs actually absorbed. It is generally assumed (e.g. *see* Hutchison's "Food and the Principles of Dietetics" 11th Edition) that persons consuming the type of diet available in western countries excrete in the stools about 5 per cent or less of the calorie value and of the nitrogen consumed. It is not, however, certain that a higher

---

*In compiling these and similar tables, it is, of course, necessary to take a figure for the water content of the various foodstuffs. This is obviously variable, and will depend on methods of preparation, and conditions of storage.

The course which is adopted is to take an average figure for purposes of compiling the tables. If, however, the water content of a particular foodstuff varies appreciably from the mean figure employed, considerable errors may be introduced, particularly in the case of staples such as cereals, or flour. There is evidence that the women of the households surveyed were, in fact, in the habit of damping their grain before pounding. The calorie values given may, therefore, be too high. It is hoped to determine the actual water content of samples of the pounded grains in question.

TABLE I—TAVETA-PARE DIET SURVEY

Showing Nutrient Intake per Head per Day—an Analysis of 44 Families

Foodstuff	Amount Eaten	Calories	Proteins	Fat	Carbo-hydrate	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Nicotinic Acid	Ascorbic Acid
	gm.	Cals.	gm.	gm.	gm.	mg.	mg.	I.U.	mg.	mg.	mg.	mg.
Cereals	397·3	1,360·9	36·1	13·8	268·2	46·7	16·5	*	1·12	0·46	6·2	1
Roots and Tubers	164·9	252·2	2·0	0·6	59·3	45·0	2·1	*	0·08	0·11	0·8	36
Plantains ..	185·0	190·5	1·8	0·5	44·4	12·9	0·9	185	0·09	0·11	0·9	18
Legumes ..	94·4	289·3	22·3	1·6	46·1	96·1	6·9	31	0·42	0·30	2·2	—
Vegetables ..	63·5	20·2	1·3	0·1	2·0	75·2	1·0	4,808	0·05	0·08	0·3	40
Meat and fish ..	44·8	79·5	8·6	4·6	*	102·0	1·4	14	0·03	0·09	1·7	*
Milk	72·4	38·4	2·2	1·8	3·3	86·9	*	72	0·03	0·12	*	*
Vegetable oil and ghee ..	5·9	53·1	—	5·9	—	—	—	—	—	—	—	—
Tea—black and white ..	232·4†	151·4	2·7	1·3	51·3	69·3	*	55	0·02	0·17	0·7	*
Beer (Native) ..	130·7	65·3	1·3	*	3·9	5·2	*	*	0·04	0·04	0·7	1
TOTAL ..	1,391·3	2,500·8	78·3	30·2	478·5	539·3	28·8	5,165	1·88	1·48	13·5	96

FOOTNOTE:—

CEREALS:	ROOTS AND TUBERS:	LEGUMES:	VEGETABLES:
Maize flour	Cassava flour	Beans	Green leaves
Maize cob	Cassava, fresh	Peas	Tomatoes
Maize, stamped	Sweet potatoes		Onions
Rice			Pumpkin
Wheat flour			Cabbage

*Trace. †"White" tea contains milk and sugar. "Black" tea contains sugar. The calorie and protein value is, therefore, appreciable.

TABLE II.—TAVETA-PARE DIET SURVEY

Calorie Requirements of the Consumer Group, Calculated in Accordance with the Recommendations Made by F.A.O.

Age Group (Years)	No. in Group	Cal. Req. Head/Day at 25°C. (F.A.O.)	Cal. Req. Group/Day
1–3	16	1,110	17,760
4–6	16	1,480	23,680
7–9	10	1,850	18,500
10–12	10	2,313	23,130
13–15 (boys)	4	2,690	10,760
13–15 (girls)	6	2,405	14,430
16–20	16	2,936	46,976
21–over	83	2,070	171,810
Totals	161		327,046

Therefore the weighted average calorie requirement per head per day is 2,031 calories.

TABLE III.—TAVETA-PARE DIET SURVEY

Showing Frequency of Use of Foodstuffs/Family/Day (2 Meals)

Foodstuff	No. of Times/ Family/Day
Maize flour	0·84
Maize on cob	0·02
Maize stamped	0·20
Rice	0·23
Wheat flour	0·12
Cassava flour	0·08
Cassava fresh	0·14
Sweet potatoes	0·14
Plantains	0·32
Beans	0·53
Peas	0·07
Green leaves	0·18
Tomatoes	0·09
Pumpkin	0·05
Onions	0·13
Cabbage	*
Paw-paw	*
Brinjals	*
Oranges	*
Meat (including chicken)	0·24
Fish	0·12
Milk	0·34
Vegetable oil and ghee	0·20
Tea	1·11
Beer	0·16
Coconuts	0·05

*Trace.

proportion may not, in some circumstances, be excreted by Africans. Investigations of this matter will be referred to later. The third and most important point refers to energy expenditure. The F.A.O. Committee assumed that their "reference" individuals are engaged in relatively light activities such as "light industry, truck driving, dairy farming, market gardening, or general laboratory work" for eight hours a day. The Committee recognises that in any community some individuals will be engaged in much heavier work involving greater energy expenditure, while others will lead more sedentary lives than the individual considered as "reference", and they suggest that these two extreme categories "cancel out" leaving the activities of the "reference" individual as a fair representation of those of the group as a whole. This view may well be correct. It must, however, be remembered that rural African communities are predominantly agricultural and that agriculture is heavy work though admittedly seasonal in its demands.

The following example shows that energy expenditure, far higher than that contemplated for the "reference" individual, may be carried out. The calculations are based on data provided in a recent review (Passmore and Durnin, Physiological Reviews 35, p. 801, 1955).

It was observed that the women of Usangi were accustomed to go two or three times a week to their *shambas* situated at Butu, returning in the evening with agricultural produce. We have the following data:

(*a*) Usangi is about 1,800 feet above Butu.
(*b*) The horizontal distance is about six miles.
(*c*) Their average body weight was 47 kilos.
(*d*) The women carried loads of approximately 25 kg. during the ascent (observed).
(*e*) The downhill journey took 1½ hours (observed).
(*f*) The ascent took 3 hours (observed).
(*g*) They spent 3½ hours on their *shambas* (observed).
(*h*) They spent 3 hours actually working on the *shambas* (assumed).

We have made a further assumption, that the path from Usangi to Butu was a smooth even slope. This will give us the lowest energy cost for the climb. It is, of course, manifestly a false assumption, since, like all mountain paths, this one is rough with abrupt ups and downs, which will greatly add to the energy expenditure. The energy cost of climbing increases abruptly with the gradient and also with the roughness of the path. We cannot, however, survey the path, and in this instance it is desirable to underestimate the energy expenditure rather than to risk exaggerating it. With these data and assumptions, it is possible to make, using the figures given by Passmore and Durnin, a rough estimate of the energy expenditure of these women on the days when they visited Butu. It is as follows:

Occupation	*Calorie Expenditure*
Journey down to *shambas*	370
Work on *shambas*	900
Ascent to Usangi carrying load ..	900
Six hours at home (cooking, resting, household chores)	830
10 hours in bed..	600
	3,600

If we calculate the calorie requirements by the F.A.O. formulæ, using the formula appropriate to men, we get a requirement of 2,273 calories per day. (The formula appropriate to women, would give us a figure of 1,996.) The mean observed calorie intake of the group approximated to 2,200. The figure 3,600 is, admittedly, only an approximation, but we have tried to err in the direction of understatement. It seems likely, therefore, that on the days that these women went to Butu, their energy expenditure greatly exceeded their calorie intake.

The immediate source of the additional calories must, of course, have been their body substance. It is well known that there may be large temporary expenditure of energy over and above the calorie intake; but, of course, sooner or later the balance must be redressed either by lowered energy expenditure ("rest"), or increased calorie intake, if the body composition is not to be altered.

It may be that these women were able to redress the balance by rest on the days when they remained at Usangi. Alternatively, their food intake may have been increased to offset the extra expenditure. In this case, other members of the community must have had less than the average figure observed.

It is felt that the point may be emphasised here that in judging the adequacy of a diet consumed by a community, account must be taken, not only of the food consumed, but also of energy expended. It should further be remembered that energy expenditure will automatically be cut down if the calorie intake is inadequate to meet the demands made upon it. Numerous instances, of course, exist, both recorded and unrecorded, of great physical exertion being undertaken when the food supply is inadequate or even non-existent. Such exertions, however, can only be short-lived since the only source of additional energy is the body substance. If energy expenditure exceeds intake for more than a short period, exhaustion will follow, and if conditions are not righted, death will supervene. It follows from this that in the long run, energy expenditure must be strictly limited by energy intake, and that the work output of an undernourished community will necessarily be low. A more obscure point is the effect of limited energy intake upon intelligence and, more particularly, upon education. There is no evidence that mental exertion, of itself, demands any appreciable increase in energy expenditure. On the other hand, it is well known that hunger and exhaustion and physical discomfort make mental concentration extremely difficult. The problem is particularly relevant in the case of schoolchildren. Normal well-fed children require weight for weight much more energy than do adults. This is partly due to growth. The laying down of new tissue requires, first, that the foodstuffs to form new tissue must be present in adequate amounts and, second, that the chemical energy required for their synthesis into body tissue may be available. In addition, it is common knowledge that normal, healthy children are extremely active. Their activity is of course, not for the most part a waste of energy, but it is part of their physical education. Their "play" is the process by which they build up their patterns of muscular and nervous co-ordination. Any attempts at educating African children who are not adequately nourished will be very seriously handicapped.

A further point cannot be allowed to pass without comment, though it will excite little surprise in the minds of those familiar with African medicine. The average weights observed during this survey were:

Adult men	49·8 kilos.
Adult women	46·5 kilos.

These are very low compared with the mean weights of adults in western countries. Passmore and Durnin, in the review referred to above, give the energy expenditure for many different types of activity. Energy expenditure is, of course, related to body weight and except in a few instances, the data all refer to persons weighing 60 kg. or more. This is rather unfortunate, since it means that most of these figures are inapplicable to Africans for whom values will have to be determined afresh.

It is obvious that in any activity involving locomotion, the energy expenditure will increase with body weight, so that a light individual, provided he is not handicapped by ill health, will be at some advantage over a heavy one. Conversely, in activities not involving locomotion, the heavy individual (provided the additional weight is not due only to fat) will have the advantage of larger muscles, coupled with longer bones, and, therefore, greater power and leverage. The light weight and small stature observed among many (though not all) African tribes, may depend on genetic factors; but it may also reflect deficient nutrition during the period of growth.

It has been mentioned that the food consumption of two communities, who professed the Mohammedan faith, were studied during and after the Mohammedan fast of Ramadhan. As is well known, during Ramadhan the devout Mohammedan takes

TABLE IV—KIBANGO (11th May—17th May, 1955)

Nutrient Intake per Head per Day During Ramadhan—Number of Families Examined: 16

Foodstuff	Amount Eaten	Calories	Proteins	Fat	Carbo-hydrate	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Nicotinic Acid	Ascorbic Acid
	gm.	Cals.	gm.	gm.	gm.	mg.	mg.	I.U.	mg.	mg.	mg.	mg.
Cereals	273	938	23·3	7·6	193·7	29·5	8·6	*	0·72	0·30	4·8	1
Plantains ..	151	155	1·5	0·4	36·2	10·6	0·7	151	0·07	0·09	0·7	15
Roots and tubers	148	312	2·2	*	74·9	57·0	4·1	10	0·04	0·06	1·2	12
Vegetables ..	60	23	1·6	0·2	3·5	91·4	1·2	5,536	0·06	0·10	0·3	43
Meat, milk and fish ..	104	67	5·9	2·9	3·9	221·6	0·6	87	0·04	0·16	0·6	*
Tea	72	43	*	*	13·2	12·6	*	10	*	0·07	*	*
Oil	1·6	14	—	1·6	—		—		—	—	—	—
TOTAL ..	809·6	1,552	34·5	12·7	325·4	422·7	15·2	5,794	0·93	0·78	7·6	71

FOOTNOTE:—

CEREALS:
- Maize flour
- Maize, whole
- Maize, cob
- Rice

ROOTS AND TUBERS
- Cassava flour
- Cassava root
- Sweet potatoes
- Taro

VEGETABLES
- Green leaves
- Okra
- Pumpkin

*Trace.

TABLE V—KIBANGO (13TH JUNE–15TH JUNE, 1955)

Nutrient Intake per Head per Day after Ramadhan—Number of Families Examined:16

Foodstuff	Amount Eaten	Calories	Proteins	Fat	Carbo-hydrate	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Nicotinic Acid	Ascorbic Acid
	gm.	Cals.	gm.	gm.	gm.	mg.	mg.	I.U.	mg.	mg.	mg.	mg.
Cereals	419	1,393	37·0	13·9	283·6	47·1	15·9	*	1·17	0·48	6·8	2
Plantains ..	7	7	*	*	1·7	0·5	*	7	*	*	*	1
Roots and tubers	147	462	2·1	*	113·2	80·8	5·8	—	*	—	1·6	—
Beans	8	24	1·9	0·2	3·8	8·8	0·6	—	0·04	0·03	0·2	—
Vegetables ..	74	24	1·1	0·1	3·8	85·9	1·0	5,065	0·06	0·10	0·5	40
Meat, milk and fish ..	127	88	6·4	4·5	5·2	165·2	0·6	118	0·05	0·20	0·7	1
Tea	71	38	0·1	—	9·6	0·3	—	—	0·01	0·07	—	—
Oil	1·5	13	—	1·5	—	—	—	—	—	—	—	—
TOTAL ..	854·5	2,049	48·6	20·2	420·9	388·6	23·9	5,190	1·33	0·88	9·8	44

FOOTNOTE:

CEREALS:
- Maize flour
- Maize, whole
- Maize, cob
- Rice

VEGETABLES:
- Green leaves
- Okra
- Tomatoes
- Pumpkin

*Trace.

neither food not drink between sunrise and sunset. It so happened that the fast, which is a movable one, occurred in the year in question during the rice harvest. The observed food intake of the two communities during and after Ramadhan is, with the calculated calorie requirements, recorded in Tables IV to IX respectively. The difference in the food consumption between the two periods is obvious, and since the people were engaged in heavy work, the effect of the poor diet must have been severe. It is no doubt easier for people engaged in other occupations than agriculture to adjust their activities to their diet, and in wealthier communities to which a wider choice of diet is open and which may employ servants to prepare meals, Ramadhan may be less of an ordeal.

TABLE VI.—KIBANGO

Calorie Requirements
No. of Families: 12
No. of People: 42

Age Group (Years)	No. in Group	Cal Req. Head/Day at 25° C. (F.A.O.)	Cal. Req. Group/Day
1–3	2	1,110	2,220
4–6	1	1,480	1,480
7–9	5	1,850	9,250
10–12	1	2,313	2,313
13–15	5	2,547	12,735
16–20 .. .. (Average weight = 43 kg.)	7	2,511	17,577
21 and over.. .. .. .. (Average age = 41·6 years Average weight = 43·6 kg.)	21	1,935	40,635
Totals	42		86,210

Therefore the weighted average Cal. req./head/day = 2,052 calories.

In addition to their observations on diet, Dr. Trant and her team carried out a series of interesting observations on the social habits and customs of the people with whom they were concerned. It is, unfortunately, impossible to include them in a report of this nature. Nevertheless, they should form a valuable contribution to sociological studies. They include descriptions of markets, of the pottery trade at Usangi, of the activities of a fishing community, of the salt industry, of cane pressing, and beer-making.

TABLE VII—KIZERUI—TAVETA-PARE DIET SURVEY

Showing Nutrient Intake per Head per Day During Ramadhan (2nd May—8th May, 1955)—Families Examined: 29

Foodstuff	Amount Eaten	Calories	Proteins	Fat	Carbo-hydrate	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Nicotinic Acid	Ascorbic Acid
	gm.	Cals.	gm.	gm.	gm.	mg.	mg.	I.U.	mg.	mg.	mg.	mg.
Cereals	314	1,070	26·9	9·2	219·8	34·4	10·7	*	0·83	0·35	5·4	1
Roots and tubers	37	72	0·4	*	17·2	13·5	0·7	4	*	0·01	*	*
Plantains ..	17	17	0·2	*	4·1	1·2	*	17	*	0·01	*	2
Legumes ..	3	9	0·7	*	1·4	3·3	*	*	*	*	*	*
Vegetables ..	42	16	1·5	0·1	2·2	81·2	1·1	4,860	0·05	0·09	0·3	38
Meat and milk ..	74	58	4·3	3·3	2·8	73·7	0·4	66	0·03	0·12	0·8	1
Coconuts ..	14	56	0·6	5·6	1·0	1·4	0·3	—	0·01	—	*	*
Tea	79	52	1·1	0·5	18·6	27·7	*	22	0·01	0·07	0·3	—
Oil	3	27	—	3·0	—	—	—	—	—	—	—	—
TOTAL ..	583	1,377	35·7	21·7	267·1	236·4	13·2	4,969	0·93	0·65	6·8	42

*Trace

Table VIII—Kizerui—Taveta-Pare Diet Survey

Nutrient Intake per Head per Day after Ramadhan, 9th June–11th June, 1955—Families Examined: 29

Foodstuff	Amount Eaten	Calories	Proteins	Fat	Carbo-hydrate	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Nicotinic Acid	Ascorbic Acid
	gm.	Cals.	gm.	gm.	gm.	mg.	mg.	I.U.	mg.	mg.	mg.	mg.
Cereals	454·0	1,562	38·1	11·9	305	48·3	13·4	*	1·16	0·48	8·3	1
Roots and tubers	84·7	210	1·0	0·1	51	37·2	2·4	1	0·01	0·01	0·7	6
Plantains, fresh..	4·7	4	*	*	1	*	*	4	*	*	*	*
Legumes ..	10·0	30	2·3	0·2	5	11·2	0·8		0·04	0·03	0·2	—
Vegetables ..	30·9	13	1·2	0·1	2	62·9	0·9	3,874	0·04	0·07	0·2	30
Animal products	137·6	139	12·2	8·0	4	192·4	2·1	108	0·08	0·25	2·4	1
Oils and fats ..	4·0	35	*	3·8		—		—				—
Tea	160·0	198	2·9	1·9	42	96·0	*	80	0·08	0·27	*	*
Miscellaneous ..	10·3	20	0·3	1·2	2	5·2	*	25	*	*	0·1	2
Total ..	896·2	2,211	58·0	27·2	412	453·2	19·6	4,092	1·41	1·11	11·9	40

Footnote:

Cereals: Maize flour, Maize, whole, Maize, cob, Rice

Roots and Tubers: Cassava flour, Cassava root, Sweet potatoes, Taro

Legumes: Beans, Mung

Vegetables: Green leaves, Okra, Tomatoes, Plantains, fresh

Animal Products: Milk, Fish, fresh, Fish, dried, Meat

Oils and Fats: Vegetable oil, Butter

Miscellaneous: Wheat flour, Groundnuts, Coconut milk, Sugar, Pumpkin flowers.

*Trace.

TABLE IX.—KIZERUI CALORIE REQUIREMENTS

Total No. of People in the 10 Families Under Observation: 39

Age Group (Years)	No. in Group	Cal. Req. Head/Day at 25°C. (F.A.O.)	Cal. Req. Group/Day
1–3	4	1,110	4,440
4–6	3	1,480	4,440
7–9	1	1,850	1,850
10–12	2	2,313	4,626
13–15	4	2,547	10,188
16–20 (Average weight = 42·6 kg.)	5	2,712	13,560
21 and over (Average weight = 46·5 kg.) (Average Age = 36 years)	20	2,122	42,440
Totals	39		81,544

Therefore the weighted average calorie req./head/day = 2,091 calories.

B.—ABSORPTION OF FOODSTUFFS BY AFRICANS
(Miss M. D. Lyle, Dr. Sylvia Darke, Mrs. J. Meek)

Reference has already been made to the possibility that in some circumstances Africans may excrete a larger proportion of their dietary calories and nitrogen in the stool than do Europeans. Should this be the case it is, of course, of considerable importance. Clearly, the value of measurements of food consumption will be greatly impaired if an unexpectedly large proportion of nutritient materials is excreted unused by the bowel.

The question of nitrogen and calorie absorption has previously been investigated by Dr. Laddell and his collaborators in West Africa. (Hot Climate Physiological Research Unit, Oshodi, Annual Report, 1954.)

These workers were largely concerned with nitrogen and calorie absorption on a diet consisting chiefly of cassava. They found that, while the calorie absorption was 94 per cent, the nitrogen absorption on a low protein intake might be as low as 53·5 per cent.

We are at present carrying out a series of observations on the proportion of dietary calories and nitrogen lost in the stool. The first of these was made on a group of patients in the metabolic ward at the Mulago Hospital. Although the patients had been admitted suffering from malnutrition, they had been for many months in the ward, where they had received a diet rich in calories and protein and, in general, of a European pattern, i.e. not of excessive bulk, nor containing large amounts of indigestible fibre. These balance experiments extended over periods of 2–7 days. The beginning and end of the stool collections were marked by the ingestion of carmine capsules, and it was possible to measure and analyse the food intake with considerable accuracy. The dietary and stool calories were directly determined by means of a bomb calorimeter, the nitrogen by chemical estimation. Since, in the bomb, the nitrogen of nitrogenous substances is converted to nitric oxide, with the evolution of 5·4 calories per gram, while in the body protein nitrogen is converted into urea with the evolution of approximately 4·0 calories per gram, a correction was applied, based on the food and stool nitrogen, to allow for this.

The extent of the absorption of the dietary nitrogen and calories may conveniently be expressed as a percentage of the intake. An otherwise healthy individual wil continue to pass fæces if supplied with water and salts only. In this case the solid matter of the stool consists of secretions and cells shed from the alimentary canal, and of living and dead bacteria. This being so, figures obtained by comparing the calories and nitrogen of the diet with the calories and nitrogen lost in the stool, will never show an absorption as great as 100 per cent. It is generally accepted, however, that normal persons on a diet which does not contain an unusually high proportion of indigestible material will show an absorption of 95 per cent or more.

A further series of observations of shorter duration and carried out under less favourable circumstances, have been made on schoolboys at Mwanza, by the courtesy of the Headmaster of Bwiru School. Here again, the figures show that the calorie absorption was about 90 per cent of consumption. Through the courtesy of the Tanganyika Medical Department, and of the Superintendent of H.M. Prison at Butimba, there are at present in progress a series of observations on prisoners. In the absence of a metabolic ward, the technique cannot be considered as wholly satisfactory. The observations must, therefore, be considered as of a preliminary nature only. So far as they go, they do suggest that these subjects on the diet consumed are absorbing in some cases appreciably less than 90 per cent of the calories eaten.

These three sets of results are included in Tables X and XI, though the observations on calorie absorption by the prisoners remain to be repeated and verified.

With regard to the Kampala subjects it should be noted that:

(1) The "Controls" were European members of the staff, or ("N" and "B"), Makerere College students (Africans).

(2) The "Subjects" were patients in the Metabolic ward, with the exception of one, who was a Ward Orderly (all Africans).

(3) The calorie and protein content of the diet was in most cases very high (a nitrogen intake of 10 grams would be "adequate" for an individual weighing 62·5 kilos. All but one weighed less than 60 kilos). The protein intake consisted chiefly of dried, separated milk and meat.

(4) The patients had all been admitted to the ward as malnourished subjects, but had, in most cases, been under treatment for a long time.

(5) The patients had all been wormed. It is our experience that even after several treatments, sufficiently careful searches will still reveal hookworm ova. On the other hand, actual worm counts have shown that the bulk of the animals are removed at the first worming; only a very few are removed on the second and subsequent occasions, i.e. after a single treatment, the subjects are left with a very light, and probably negligible infection.

(6) The argument that some of these subjects were given more protein than they could, in any case, absorb, is not valid. If it were, the highest absorption rates would correspond with the lowest nitrogen intake, and vice versa. This is not so.

Table X gives figures for the absorption of calories. The difference between the percentage calorie absorption of the Kampala patients and the Mwanza schoolboys is not significant. These have therefore been pooled, giving a mean absorption of 93·73 per cent, with a standard deviation of 2·87. The mean percentage absorption of calories by the prisoners, however, is only 81·4 per cent, with a standard deviation of 4·54. The difference between this group and the remainder is highly significant. In the case of the Kampala patients, and the schoolboys, an absorption deficiency of the order found, would have no practical significance. Their dietary calories were ample in any case. The picture, however, in the case of the prisoners is very different. Their calorie requirements, worked out on the basis of the F.A.O. Report quoted earlier, are shown and it will be noted that, although the actual calorie value of the ingested food was in every case but one slightly above the calculated figure, as a result of the absorption defect, the calories available to the body were, in all but one case, well below the "requirement" value. If these results are confirmed, they will be of considerable importance.

TABLE X—PERCENTAGE ABSORPTION OF CALORIES BY KAMPALA PATIENTS, MWANZA SCHOOLBOYS AND PRISONERS

Subject	Period of Observation	Food Calories	Food Nirtogen	Nitrogen Correction	Corrected Food Calories	Stool Calories	Stool Nitrogen	Nitrogen Correction	Corrected Stool Calories	Calories Absorbed	Percentage absorption
			gm.				gm.				
KAMPALA PATIENTS:				Mean Stool Solids 44·3 grams/day							
Simoni	50 hours	8,756	61·12	458	8,298	525	5·19	39	486	7,812	94·0
Ktambera	48 hours	5,900	47·7	358	5,542	51	1·72	13	38	5,504	99·3
Mariko	57 hours	11,870	82·1	616	11,254	592	6·33	47	555	10,699	95·1
Naigesenti	55 hours	10,600	61·25	459	10,141	1,027	10·83	81	946	9,195	94·6
Kibenje (1)	7 days	25,633	181·9	1,365	24,268	1,902	24·18	181	1,721	22,547	92·6
Kibenje (2)	7 days	25,767	170·1	1,275	24,492	1,672	22·70	170	1,502	22,990	93·6
Simoni (1)	7 days	19,579	132·6	995	18,584	788	11·39	81	707	17,877	96·2
Simoni (2)	7 days	19,900	152·2	1,142	18,758	841	12·71	95	746	18,012	96·0
Mariko	7 days	22,990	162·9	1,222	21,768	1,095	12·57	94	1,001	20,767	90·3
										Mean:	94·63
MWANZA SCHOOLBOYS:				Mean Stool Solids 55 grams/day							
Regatus	48 hours	5,341	23·13	202	5,039	451	4·92	43	408	4,361	91·9
Gideon	48 hours	5,653	31·59	272	5,381	324	3·46	30	294	5,087	94·5
Simon	48 hours	5,943	30·66	268	5,675	397	4·11	36	361	5,314	92·8
Morris	48 hours	7,191	36·63	321	6,870	925	8·45	74	851	6,019	87·7
										Mean:	91·72
						Mean of Kampala patients and schoolboys together:					93·73
										S.D.	2·87

Subject		Stool Calories	Stool Nitrogen	Nitrogen Correction	Corrected Stool Calories	Calories Absorbed	Percentage absorption	Calculated Caloric requirements
			gm.					
PRISONERS (MALE):		Solids 136·3 grams day						
Mandaro	Period of observation–3 days.	1,989	17·52	131	1,858	7,280	79·5	9,048
Mandaro	Food nitrogen 43·32 gm.	1,678	15·57	117	1,561	7,577	82·9	9,048
Masikili	Nitrogen correction 327 Cal.	2,400	24·25	182	2,218	6,920	75·7	8,400
Idi	Uncorrected Food Cal. 9465.	1,650	19·35	145	1,505	7,633	83·5	9,309
Busia	Corrected Food Cal. 9138.	1,095	13·31	100	995	8,143	89·1	8,070
Masaga	(From mean of 4 daily food samples taken at	2,129	15·93	119	2,010	7,128	78·0	8,268
Mwandu	random.)	1,928	24·21	182	1,746	7,392	80·9	8,655
						Mean:	81·4	
						S.D.	4·54	

Student's "t" test applied to the comparison between mean percentage absorption of "patients" and "schoolboys" together and "prisoners" gives: $t=6{\cdot}52$; $p<0{\cdot}01$

TABLE XI—ABSORPTION OF NITROGEN BY CONTROLS, PATIENTS, MWANZA SCHOOLBOYS AND PRISONERS

Subject and Sex	Description of Subject	Days of Observation	Mean Daily Food Nitrogen	Mean Daily Stool Nitrogen	Nitrogen absorbed	Percentage Absorption
			gm.	gm.	gm.	
N. (m) ..	Makerere Student (Control)	14	19·0	1·38	17·62	92·7
B. (m)	,, ,, ,,	7	14·6	1·84	12·76	87·5
MWS. (f) ..	European ,,	29	14·5	1·56	12·94	88·6
JG. (f)	,, ,,	11	17·8	1·54	16·26	91·4
TRM. (m) ..	,, ,,	20	30·5	1·90	28·60	93·8
					Mean of all Controls:	90·8
					S.D.:	2·64
Gabriel ..	African Patient	144	21·4	2·69	18·71	87·5
Kidza	,, ,,	12	24·9	3·39	21·51	86·3
Mutambazi ..	,, ,,	23	2·7	3·37	19·33	85·1
Azikali ..	,, ,,	25	14·5	2·78	12·72	87·7
Matovu ..	,, ,,	95	27·2	2·69	24·51	90·1
Kyeyune ..	,,	150	16·9	2·71	14·19	83·9
Male	,, ,,	184	21·6	3·09	18·51	85·7
Kataro ..	,, ,,	19	20·4	4·17	16·23	79·5
Kabwa ..	,, ,,	62	25·9	4·01	21·89	84·5
Simoni	,, ,,	15	11·2	2·70	8·50	76·0
Naigesenti ..	,, ,,	62	24·9	3·93	20·97	84·2
Lwangazu ..	,, ,,	21	24·4	2·26	22·14	90·7
Kayongo ..	Ward Orderly	21	21·0	3·26	17·74	84·5
					Mean of all "patients":	85·0
					S.D.:	3·85

TABLE XI—(*Contd.*)

Subject and Sex	Description of Subject	Days of Observation	Mean Daily Food Nitrogen	Mean Daily Stool Nitrogen	Nitrogen absorbed	Percentage Absorption	Calculated Nitrogen requirements*
			gm.	gm.	gm.		
Regatus ..	Schoolboy	2	23·1	4·92	18·21	78·8	
Gideon ..	,,	2	31·6	3·46	28·13	89·1	
Simon	,,	2	30·7	4·11	26·55	86·7	
Morris	,,	2	36·6	8·45	28·18	77·0	
				Mean of Schoolboys:		82·9	
				S.D.:		6·38	
Mandaro (m)	Prisoner	3	14·44	5·84	8·60	59·8	10·3
Mandaro (m) ..	,,	3	14·44	5·19	9·25	64·1	10·3
Masikili (m) ..	,,	3	14·44	8·08	6·36	44·1	9·3
Idi	,,	3	14·44	6·45	7·99	55·4	11·7
Busia	,,	3	14·44	4·44	10·00	69·3	9·2
Masaga ..	,,	3	14·44	5·31	9·13	63·2	9·1
Mwandu ..	,,	3	14·44	8·07	6·37	44·1	9·3
				Mean of all Prisoners:		57·1	
				S.D.:		11·58	

***Calculated on the basis of one gram of protein per kilo of body weight.**

Student's "t" test applied to the above means gives the following values:

	"t"	"p"		"t"	"p"
Controls v patients	3·65	$<0{\cdot}01$	Schoolboys v patients	difference not significant	
Controls v Schoolboys	2·33	$<0{\cdot}1$ $>0{\cdot}05$	Prisoners v patients	6·21	$<0{\cdot}01$
Controls v prisoners	9·65	0·01	Prisoners v Schoolboys	4·76	$<0{\cdot}01$

Table XI gives the figures for nitrogen absorption by four groups of subjects. The first two groups were studied in Kampala. The primary purpose of the work was to examine the nitrogen balance, and the results of this have already been published (Holmes, Jones and Stanier. *British Journal of Nutrition, 8*, 173--1954). The figures have not, however, previously been analysed from the point of view of nitrogen absorption. As will be seen, the observations cover considerable periods of time and the mean values may be taken as being quite accurate. The figures for nitrogen intake were calculated from tables, but direct analysis on various occasions gave good agreement between the values found and those calculated. (Holmes, Jones and Stanier, l.c.). It will be observed that the patients showed a significantly lower figure for nitrogen absorption than did the controls. This is interesting, because they had all been wormed, and had all been in hospital on a high calorie-high protein diet for weeks, and in some cases for months.

The other two sets of values given in Table XI relate to observations made in Mwanza on schoolboys and prisoners. In the case of the schoolboys, the nitrogen intake was directly measured on aliquots of the food consumed, but stool markers could not be used. In the case of the prisoners, a daily ration of food, taken at random, was reserved and analysed on four separate occasions. The agreement between the four sets of values, both for nitrogen and calories, was remarkably good; nevertheless, this technique cannot be considered as wholly satisfactory, so that the whole investigation is being repeated, taking food aliquots and using stool markers. Table XI shows that the "controls" absorbed a significantly higher percentage of ingested nitrogen than the "Patients" and that there was no significant difference between the absorption of the patients and the schoolboys, but that the prisoners absorbed very significantly less than any of the other three groups.

As in the case of the calorie absorption, the defect in the absorption of nitrogen is probably of little practical importance in the case of the patients and the schoolboys, but in the case of the prisoners, it has the effect, in five of the seven cases, of reducing the nitrogen absorption to a figure well below the calculated nitrogen requirements, though the nitrogen actually consumed is in all cases quite adequate. It is likely that the diet consumed by many Africans is similar, or even inferior to that consumed by the prisoners, which consisted of maize meal, rice, beans, meat, and some milk, with sugar, fresh vegetables and condiments. If they have a similar defect in absorption, the matter may be of considerable practical importance.

The cause of the defective absorption, both of calories and nitrogen, will of course be the subject of investigation, and in the meantime, it is felt that speculation is rather profitless.

STUDIES ON BODY COMPOSITION

Brief mention may be made of a further line of work. It had earlier been observed at Kampala (Holmes, Jones and Stanier, 1954) that previously malnourished Africans were capable, when placed on a high-protein, high-calorie diet, of retaining very large amounts of nitrogen for very long periods. This retained nitrogen can hardly have suffered any other fate than conversion into tissue protein; but when the expected gain in tissue was calculated, it was found to bear no relationship to the observed change in body weight. It is well known that prolonged under-nutrition is accompanied by an increase in extra-cellular fluid, which returns to normal on refeeding. Measurements of extra-cellular fluid, however, showed that the changes in its amount were not sufficiently large to account for the observed discrepancy in body weight. The possibility of changes in intra-cellular fluid remained, i.e. the possibility that the subjects at first suffered from cell hydration, and that on refeeding water was lost from the cells, and replaced by protein.

A series of studies of body composition by the method of McCance and Widdowson (1951) seemed to offer *indirect* support to this hypothesis—indirect because the calculation used in the method which involves the assumption of a certain degree of tissue hydration on subjects before refeeding, gave values which were obviously fallacious, while those obtained after refeeding were within the expected limits, and the fallacious results were such as would necessarily follow, if the assumed degree of tissue hydration had been, in the case of the malnourished subjects, too low.

Further support for the hypothesis of tissue hydration was furnished by determinations of potassium balance, and of direct analysis of tissues. These results are the subject of a paper which has been accepted for publication in the *British Journal of Nutrition.*

If malnutrition can result in tissue hydration, the matter is of great importance. If, for instance, a person's muscles contain a greater proportion of water than normal, it is hardly possible that they can function as efficiently as those of a normal individual. We hope, therefore, to reinvestigate the matter, using the newer and better techniques, which are becoming available, and which entail the use of radio-active isotopes. Steps are being taken to this end. If the "set-up" can be established, it will certainly have application to many other problems beside that just mentioned.

Section 2.—Observations on Schoolchildren

Object of Investigation and Techniques Used

These observations were carried out by Miss V. Rudder, and have been in progress for some time. Their object was to obtain a continuous record of the health, growth and family history of the average school child in Mwanza. The investigation is meeting with only partial success, owing to the fact that many children (in fact, nearly half of those originally investigated) cease to attend school for various reasons, so that they are lost sight of. It is easier to follow the progress of the pupils at the middle and secondary schools, but as children are not admitted to these before the age of twelve years, no information can be obtained from them about progress during the important period between the 7th and 12th year. The co-operation of the heads and teachers of all the schools concerned is gratefully acknowledged.

Mwanza Town School

This is a primary day school, catering for children of from seven years old upwards. At the outset, the children's weights and heights were recorded, but owing to absences from various causes, including movement of families, continuous weights and heights are available in only a few cases. The ages given for the children are the observer's assessment, since neither the school nor the children can provide accurate information. Stool and urine examinations were carried out on all children to assess the incidence of hookworm or bilharzia and a note was made of the numbers showing enlarged spleens and livers. It must be remembered that splenic enlargement occurs as a result of infection both with malaria and bilharzia. No attempt could be made to examine the blood for malaria parasites, since the taking of blood smears was not permitted. It will be recognised also that only repeated examinations will reveal all cases of infection with schistosomes. The infection rate revealed by this investigation is, therefore, a minimal rate, the true rate being certainly higher.

At the outset, 40 children, whose stools were negative for Sch. Mansoni, and 40 whose stools were positive, were chosen for special study, in the hope of learning something of the effect of this parasite. Subsequent examinations showed, however, that many at first negative became positive, and vice versa. This was to be expected, for the reason mentioned above. In addition, there was the possibility of the "controls" (those with initially negative stools) becoming infected, even if they had initially been free from infection. Of the group with negative stools, nine had enlarged spleens, and two enlarged livers. Of the 40 with positive stools, six had enlarged spleens and two enlarged livers.

At the outset, 64 homes from which the children came were visited to gain an insight into their living conditions. Ten of these houses were subsequently visited from month to month.

The houses visited were, for the most part, satisfactory. The usual house is square, with five to six rooms. Many are whitewashed and decorated. Tables, chairs and crockery are usually to be seen. Some houses have cement floors, and iron roofs are replacing thatch. Latrines are general. Some houses have water piped to them, and there are a number of water points at which piped water can be purchased at one cent per four gallons. The relations between parents or guardians and children appeared, on the whole, to be good. There seemed to be an eagerness for learning.

Discussion on Animal Products in Bukoba

Cattle

Before the war meat was very scarce. The local Ankole breed of cattle with long horns and no humps had been decimated by rinderpest; the grass at Bukoba is amongst the poorest in Tanganyika in spite of the high annual rainfall of 80 in., and the nearest place from which cattle could be obtained was Kahama, 266 miles distant, a great part of which was tsetse fly country. Cattle had to be driven on the hoof all the way, so that the journey took nearly three weeks, and meat was therefore expensive. Only 200 or 300 head per month used to come up for all Bukoba district, but since the war, with the rise in the price of coffee, this has risen to 1,000 or 1,200 head per month. The Bahaya can afford to eat meat now, and according to the survey figures, they do eat it three or four times a week.

At Nyakato in July, 1954, the survey was carried out in the coffee-buying season, and there was an increased circulation of money amongst the Bahaya who were spending it lavishly on beer and clothes. Cattle were slaughtered daily in the two areas surveyed, but most people did not eat meat more than three to four times per week, as mentioned above.

Little goat flesh or mutton was sold in the market. Mutton eating is looked on with great disfavour by the Bahaya women, and one teacher's wife would not let her husband into the house after eating a sheep with some friends, until he had purified himself by washing outside. Neither would she let him have a saucepan to cook the meat in, and she openly expressed her disgust at the practice.

It is true that old prejudices and taboos are disappearing, but there still exists a general dislike towards objects of previous taboos such as goat's milk, eggs, fowls and sheep. This is probably an expression of negativism developed in the adult as a result of his abstaining from this food since childhood owing to old custom.

The Bahaya move about a great deal these days. Buses are always full to overflowing, lake steamers have not space for all their would-be passengers. Prostitutes in the practice of their calling have gone to most large towns in East Africa, and have met many different sorts of people. They have brought home exotic habits of a sophisticated and emancipated life. They have done much to upset the categorical observance of food taboos, and to explode the myths about the mamba fish and totem animals.

Fish

The western shore of Lake Victoria does not give such good catches of fish as does the southerly one. Consequently fish are less plentiful and more expensive in and around Bukoba than at Ukerewe or Mwanza. Meat is less expensive and appears to be more an article of diet than fish as it is better value.

However, on some days a good deal of fish is on sale in the market, and dried and smoked fish is brought in from quite faraway islands, such as Ukara and Godziba, a boat from the latter island may take nearly a week to reach Bukoba, and from Ukara it is two days' sail in fine weather. The prices which their fish fetch in Bukoba, however, are so much higher than they can get at their homes that it stimulates the trade in dried fish.

In many of the lake shore villages, men who have small plantations often possess a canoe or have an interest in one, and they may go out fishing in the early mornings or in the evenings. Small boys fish from the jetty at Bukoba Port or from rocks, so that all in all a good deal of fish is consumed.

Types of Fish Eaten

River Fish: Nahoze.—Not identified. Price, $1\frac{1}{2}d.$ each. Dark in colour.

Ningu: *Labeo victorianus Blg.*—About the size of a large herring or mackerel. Price, 3*d.* each. It may be cooked in peanut or simsim oil, or stewed with plantains.

Mbofu: *Bagrus docmac.*—A variety of catfish. Weight, about 5 lb. Price, 5*s.* to 6*s.* each. Good eating. Frequently dried and smoked by fishermen on islands such as Ukara, and brought to Bukoba for sale.

Ngege: *Tilapia esculenta.*—Resembles a carp or perch. Price, 1*s.* each. Very popular.

Mbete: *Mormyrus kannume Forsk.*—This is called the elephant snout fish on account of its long nose. About 14 in. to 20 in. in length. Price, 4*d.* each. It is not generally eaten by women.

Furu: *Haplochromis.*—A kind of perch. The small furu, which is the variety most often seen is about 3 in. in length and weighs about 1 oz. It is essentially the poor man's fish. Price. 4*d.* for 15 small fish.

Ebio: *Haplochromis seranoides.*—Six in. in length and about 2 in. in width.

Mamba: *Protopterus aethiopicus Heck.*—A lung fish. Two to four ft. in length. Reddish flesh. Not eaten by women.

Enfu.—Not identified. Price, 1*s.* each. Large fish. May be eaten fresh if caught locally or dried if from islands.

INSECTS

Grasshoppers.—These are considered a delicacy. The grasshoppers "Ensenene" come with the rains in November and settle on bushes and grass. Women and children run after them, impaling them in a row on sticks. They are cooked over the fire with a little groundnut or simsim oil. Their wings are pulled off, and in appearance they resemble tiny sardines, except that their heads and eyes have not been cut off. The women at Maruku do not eat them, but in Bukoba both sexes use them as food.

Locusts are eaten when a swarm is in the vicinity.

Lake Flies are caught in a basket twirled on a stick. They are pressed into cakes and are cooked and eaten as a relish. They have a nutty flavour.

Crickets.—These are plentiful. Some varieties are very large.

PREPARATION OF FOOD

Unripe Plantains.—These are the main food of the Bahaya race and are in season practically all the year round.

The minor crops are sweet potatoes, Bambara nuts and some fruits.

The most popular meal is plantains, beans and ningu: *Labeo victorianus*, or other fish.

Method of Cooking

Generally, the beans are placed in water and left to cook for about two hours while the natives peel and cut the plantains and collect firewood for the fire.

Small pieces of banana leaves are used to line the sides and bottom of a large black pot. The fish is then put into it and the beans, together with the water in which they have been cooking, placed round the fish. Fifteen to twenty bananas sliced lengthwise are now placed on top and the whole is covered with another pan and left to cook slowly for two hours, after which it is ready for serving.

Clean grass is spread on the floor with one or two banana leaves and the food is turned out on to this. It is appetizing to look at, being rather like a shape with the fish placed on top. Every member of the household, young and old, sits round and partakes of it.

Stewed unripe plantains are known as "Bitoke" locally. They do not taste like bananas, but rather resemble mashed potatoes. Other writers compare them with vegetable marrow, but they are not so watery as that vegetable.

Plantains cooked with beans or Bambara groundnuts: The beans or nuts are put on to cook first as they take longer. Whilst they are stewing the housewife goes to the banana plantation and cuts a bunch of plantains of the required weight. These are then peeled and cut lengthwise, and, when the beans or nuts are ready the plantains are added to the pot, with perhaps a little more water. The contents are covered with banana leaves to make a watertight lid, and the pot is boiled for 30 to 40 minutes. The plantains with the beans or nuts is then ready to serve, and is turned out on to a fresh banana leaf, as described above.

Preparation of Drinks

Banana Wine

A bunch of sweet bananas is hung up for seven days till it is overripe. The bananas are then peeled and after peeling they are placed into a sort of small dug-out canoe with blunt ends. Grass is added and the whole mass is trodden upon till it is reduced to a semi-solid pulp. The grass plays a mechanical part and helps to effect a good mashing of the bananas. The pulp is brought to the required consistency with water, the grass is removed, and the juice is kept covered for two to three days to ferment. A handful of previously fermented and finely ground millet may be added to the mixture to speed up fermentation.

The fermented juice makes a very potent drink, and is rich in vitamins A, C. In colour it resembles weak tea with milk added to it. The smell is rather rancid. It is sucked up from a small calabash by means of a hollow reed.

Sweet banana juice is the liquid before fermentation has taken place.

Elderly people drink tea, water or coffee at midday as a rule, and occasionally tea in the early morning. Breakfast is rarely taken but well-to-do families take a piece of bread occasionally with the morning cup of tea.

Younger persons drink beer or sweet banana juice. Lime juice was taken on several occasions during the survey, and milk by one individual.

Sorghum Beer

The proper amount of seed of *Sorghum vulgare*, the red variety, not the white, is dried in the sun and then put into enough water to allow the seed to swell. It is left thus for three days and then placed in the sun for another three days. Using two stones, the seeds are ground and left spread on a sheet of iron over a fire until dry.

Later, the sorghum and maize (in the proportion of one tin sorghum to two tins maize) are put together into a drum and mixed with water. The mixture is left till the following morning when the juice is squeezed through an americani bag. The resultant liquor is the colour of weak milk tea and has a scum on top.

This liquid is extremely potent as results show after it.

Analysis of Diets

The standards used in this report are those laid down by B. S. Platt in his report on Nutrition in the British West Indies, 1946. Platt recommends the following values for nutrients recommended as an immediate objective:—

Calories	2,500
Protein	60 gm.
Calcium	800 mg.
Iron	20 mg.
Vitamin A (as Carotene)	5,000 I.U.
Aneurin, Thiamine	1.5 mg.
Riboflavin	1.8 mg.
Nicotinic acid	12 mg.
Ascorbic acid	30 mg.

In certain items the values seem rather high, and it seems well to quote Platt's reasons for the estimated requirements:—

Calories.—It has been assumed that in the West Indies the body weight of the "average person" is about 60 kg. The "average person" is a device used to allow recommendations to be made per head basis and takes into account the age and sex distribution of men, women, and children in the population.

Protein.—The protein figure of 60 gm. per head per day represents an allowance of 1 gm. per kg. of body weight. Requirements for maintenance may be as low as 35 gm., but on account of the greater needs of children to meet their growth requirements, it is considered that 1 gm. per kg. body weight is the best average figure to adopt.

Calcium.—The calcium allowance of 800 mg. may be higher than necessary for territories where the amount of sunshine contributes to good utilization. In this connexion, however, it is important to stress that, unless supplies of vitamin A are plentiful, the skin will not be kept in sufficiently good condition to exercise its function in the formation of vitamin D on exposure to sunlight.

Iron.—The iron allowance has deliberately been placed higher than usual. The Type Dietary works out at 16 mg. and would normally be considered adequate, but under conditions of a high incidence of infestation with parasites, especially hookworm and malaria, with consequent anæmia, it is necessary to raise the allowance.

Vitamin A.—The vitamin A allowance has been placed at 5,000 I.U. on the assumption that it will be supplied almost entirely in the form of precursors. The conclusion reached in a recent experiment undertaken by the Vitamin A Sub-Committee of the Accessory Food Factors Committee (Medical Research Council and Lister Institute) is that "inclusion in the diet of a daily dose of 2,500 I.U. vitamin A, or of 5,000 I.U. carotene, may be regarded as adequate for maintenance of normal human adults and as leaving a fair margin of safety".

Aneurin, Thiamine.—The important factor is the ratio of vitamin B_1 to energy (calories) derived from carbohydrates and protein (sometimes called non-fat calories). Various values have been given to the vitamin/non-fat calorie ratio, ranging from 0.19 mg. to 0.6 mg. per 1,000 non-fat calories. It will be seen that the value taken here is based on the highest ratio.

Riboflavin.—The value adopted by the Accessory Food Factors Committee (Medical Research Council and Lister Institute) has been taken.

Nicotinic Acid.—From the same authority as riboflavin.

Ascorbic Acid.—In this case the League of Nations' recommendation has been followed.

In Bukoba district the "average person" weighs 58 kg. and the total calories average 2,063 per head per day. The deficiency is mainly in carbohydrates and fats as is shown below. Platt does not give values for fats or carbohydrates, but Nicholls "Tropical Nutrition and Dietetics" suggests that 472 gm. of carbohydrates and 50 gm. of fats are normally required in the tropics. It is not unknown in Africa for tribes to consume a diet moderately satisfactory as regards calories but deficient in protein. In Bukoba district, however, this is not the case with the average family. It is true that several of the diets recorded were poor in this respect, but the average of the 30 families examined showed that the total protein intake per head per day was 63.7 gm., of which 25.32 was of animal, and 38.38 of vegetable origin. This compares very favourably with Thomson's figures for the Lala people in Northern Rhodesia, 1947–1948, in which the average protein intake was 43.2 gm. per head, of which 7.6 was animal and 36.6 vegetable.

Carbohydrates.—The position here is not entirely satisfactory. The average intake is 396.5 gm. out of a recommended 472 gm. The figure is based on plantain values for the most part, as this fruit forms the staples diet of the Bahaya; but there is a difference of opinion between experts as to the correct value of unripe plantains as compared with sweet bananas. Nicholls, 1951, gives an estimate of 62 calories per 100 gm. for unripe plaintains as compared with that of 100 calories for the same weight of sweet bananas, whereas Platt, 1945, uses the same value, namely 103 calories per 100 gm. for both. The difference would appear to be one of moisture content. Nicholls works on a content of 80 per cent, and Platt on one of 70 per cent.

When A.T. and G.M. Culwick (1939), carried out a population survey in Bukoba they found the local plaintain to average about 73 per cent of moisture.

As this report is based on the values in Platt's "Representative Tables", it is possible that the calorie values for carbohydrates is slightly on the high side.

Fats are low, being only on the average 18.9 gm. per day per person out of a desirable 50 gm. Cooking oils are not much used except in the towns, and such fat as there is comes from a variety of different foodstuffs, such as 2 gm. from plantains, 1 gm. from fish, 2.3 gm. from meat, 9 gm. from Bambara groundnuts, and traces in other foods. The peanut (*Arachis Hypogœa*) is not much cultivated round Nyakato, although further inland, and also at Maruku, they are grown. Butter is made where there is milk to spare, and when it is too far from town to be sold. During the two surveys, however, butter did not figure in any of the diets, and milk only once. Calcium values (511 mg. instead of 800) shows a gross deficiency, which may be partly attributed to the scarcity of milk or milk products in the diet. Failing milk, the chief sources of calcium are fish (especially dried fish eaten with the bones), beans, meat, Bambara groundnuts and sweet potatoes.

Iron is in sufficient supply to meet the demand for 20 mg. per person per day. This allowance has been placed by Platt higher than normal to compensate for a probable anæmia due to malaria and hookworm infestation.

Beans and Bambara groundnuts contribute the main part of the supply of this mineral.

Vitamins

The vitamin A content is adequate (5,000 International Units per head per day) for the general average, but the value is unevenly distributed between the 30 families, and many show a reading below 3,000 I.U. It is chiefly met with as carotene in plantains or in sweet potatoes. Green leaves, such as spinach made from sweet potato leaves, cassava or pumpkin leaves or from the Amaranthus plant, are a valuable source of vitamin A but are almost entirely neglected by the Bahaya. Chillies, which are extremely rich in carotene, have not been noted in this survey, and eggs which are similarly rich are hardly eaten at all.

Thiamine (vitamin B), Riboflavin and Niacin (vitamin B complex), are all somewhat under the amount necessary to keep the body in good health, although not grossly deficient. Sweet potatoes, plantains, beans, and dried fish are the main foodstuffs which produce the minute supplies of these essential accessory food factors in the Haya diet.

Ascorbic acid is shown on paper as highly satisfactory (191 mg. out of a desirable 70) because no deduction has been made for loss of vitamin C, during the cooking of the unripe plantains, which takes normally about 40 minutes. In the Dietary Survey carried out in 1947 for African Labour Efficiency Survey by J. H. Henry and M. W. Grant, they write:—

"The nutrient content of food is modified by such factors as duration and conditions of storage, processing (e.g. milling), and the different methods of domestic preparation and cooking to which it is subjected. It is therefore necessary, when assessing the nutritive value of any dietary, to take these factors into account as fully as possible, otherwise the calculated nutrient value may differ considerably from the actual value obtained by the consumers.

The methods of preparation and cooking employed in this community (Railway locations) are, on the whole conservative and unlikely to result in any significant loss of nutrients. There is, however, one marked exception to this and that is the method of cooking green leaves. By placing them in cold water and then bringing them to the boil and continuing to cook them for about three-quarters of an hour, their Ascorbic acid (Vitamin C) value is almost totally destroyed.

The extent of this destruction was kindly determined for us by Dr. Harvey (Bio-chemist at the Medical Research Laboratory, Nairobi) and is shown in the following table."

Ascorbic Acid Content of Fresh and Cooked Leaves

Leaf	Ascorbic Acid, Uncooked mg. per 100 gm.	Cooked
Cowpea (*Vigna unguiculata*) ..	75·8	1·7
Osuga (*Solanum nigrum*) ..	72·6	2·6

Supplies of Ascorbic acid normally come chiefly from fruits and green vegetables, but the Bahaya eat very few green vegetables as we have already seen, and the amount of fruits also which are eaten are almost negligible. Raw cassava, sweet bananas, a little fruit and beer must constitute the chief sources of Ascorbic acid in the Bukoba district. Uncooked plantains would, of course, contribute the largest part, but the cooking destroys so much of the value that it is probable that the true reading of the Vitamin C factor would be somewhere about 56 mg. per 100 edible grams, instead of 191. However, even 56 mg., though not up to the desirable point of 70 mg. daily, is not unsatisfactory for a tropical country where many people exist on much less.

Plaintains, although they contain most qualities of a protective food, have only a comparatively low energy value, and need to be supplemented by other crops with a higher calorie value, such as maize, millet, rice, or cassava which give a value of 300 calories or more for each 100 gm. of the edible grain or root.

FAMILIES UNDER OBSERVATION

The thirty households examined at Nyakato were examined in more detail than those at Maruku. They consisted of 31 men, 55 women and 45 children of varying ages. Nyakato is only five miles from Bukoba town, so that many of the men went to work in town daily and earned reasonable wages. In addition, most householders had a banana and coffee plantation. The bananas, chiefly plantains, were for food and beer. The coffee was a cash crop, so that an income was derived from this source.

The occupations followed by the householders were as follows:—Fourteen persons said that they were cultivators or peasant farmers only. One of these stated that he had been making £100 per annum from his coffee crop. Another put his profit at £25 per year. (At the date of the survey coffee was about £350 per ton.) Three householders were women probably widows living on their own. Three men were shopkeepers. One said that he made about £15 per month (£180 per annum) and probably the other two made about the same profit. Two others were masons' assistants. One made African drums. There was one teacher (£7 10s.), a mason (£12 10*s*.), the headman of the village (£3), a clerk (£8 15*s*.), a houseboy (£3 2*s*.), a nursing orderly in the hospital (£2 5*s*.) and a tailor (£5 10*s*.). The salaries are per month.

Table 6 depicts a family of three persons, husband, wife and one child, with a good food intake. The householder is a tailor, who makes about £5 10*s*. per month at his trade. The chief inadequacy in the diet is a low fat consumption. The total calories are 2862, well over the recommended standard. Meat was eaten at six meals out of the fourteen observed and fish once. This table shows how quite a small amount of liver (36 gm.) can raise vitamin A value to a suprising degree. In this family tea was taken in the early morning on six days out of seven. One kg. (two loaves) of bread was consumed on two days in the week with the tea, and on a third day 600 gm. of chapatties was eaten. Beer was drunk twice with the mid-day meal, and twice on other days with the evening meal. There were no visitors to meals.

Table 7 shows the family of the village headman. He was an old man of 70 years of age with a wife about ten years younger, and a grandchild of 12. His pay as headman would amount to £3 per month. All the food values are down considerably, as also the mineral and vitamin intakes. The total calories are 1,694 per day. very small amounts of fish were eaten at four meals, and about 1½ lb. of meat were eaten during the week. Lime juice was drunk at two midday meals. Beer was drunk with the midday meal on Sunday, and with the evening meal on two occasions. Tea was taken on four mornings of the week, but no bread was eaten with it. No visitors came to meals.

Table 8 is from a household of 12 persons, which is evidently rather too many to be supported from the householder's salary as a mason. He had three wives, six children, and a male lodger. Although he earned £12 10*s*. a month, the total number of calories per head per day in that family was only 1,480. The main defect, as will be seen in the table (Table 8) is in the carbohydrate value. Although they eat 640 gm. each of plantains per day, the CHO value is only 153.6 gm. or roughly one-quarter of the weight of the edible portion. If their staple diet was made from a grain cereal or from cassava, the CHO value would be much greater, in the neighbourhood of 400 gm., 428 cereals, 490 cassava. The young children in this family would not be eating as much as the older persons, so that the latter would probably be able to obtain more calories from the diet than would appear from the table. Comparing Tables 6 and 8, it can readily be seen that the man with a small family can live more comfortably than the man with many responsibilities.

Many wives may allow a man to cultivate a larger plantation but they do not make for peace and quiet in the home. It is also difficult for a man with a large family to eat as well as one with fewer children.

Table 9 illustrates a family living on a starvation diet with a total calorie value of 816 per day. The household consists of the man, two wives, an old mother, and two small children. The diet is deficient in every respect except for Niacin and Ascorbic acid, which are adequate. The staple diet for nine meals out of the fourteen was plantains cooked with either beans or Bambara groundnuts. On one day they had sweet potatoes with 1 lb. (450 gm.) of meat, at midday, but this was the only animal product eaten during the week. At another meal they had yams, 8 lb. (4 kg.), with nearly 1 lb. (400 gm.) of groundnuts, and for the remaining three meals they had sweet potatoes with beans or Bambara groundnuts.

The plantains, potatoes and yams are all bulky foods, and it is possible that with beans or groundnuts, which swell with cooking, that the family might have a feeling of repletion after a meal, and that even an observer might be misled by the apparent volume of the food, unless an analysis was made.

No visitors came to any meals, and no tea or other drinks are mentioned. The householder was suspected of spending his money on drink, as he was seen almost daily at a beershop in the town.

Of the three householders who were women one, who was about 55 years of age, lived by herself. Another widow lived with her old mother aged 70, and a third couple consisted of an old grandmother who lived with a young relative. These three households were evidently very poor. Their diet, though adequate in calorie intake was extremely monotonous. A meal usually consists of a dish of sweet potatoes or stewed plantains without any relish. On the few occasions they had a side dish it was never meat or fish but merely groundnuts or beans. No beer or tea or banana juice was noted during the survey.

The total number of households on a meagre diet with low calorie intake, under 1,000 per head per day were three. Families with an average of 1,500 calories numbered seven. Fifteen were within the region of 2,500 calories, and there were five on bulky diets of 3,000 calories.

Breakfast

This meal is not commonly eaten, but out of the 30 families:—

Seventeen took a cup of tea on two or more mornings of the week.

One family drank tea every morning.

Six families drank tea on six mornings of the week.

Three families drank tea on five mornings of the week.

Four families drank tea on four mornings of the week.

Two families drank tea on three mornings of the week.

One family drank tea on two mornings of the week.

Seven families took bread or chapatties with their tea, but not regularly.

Two families ate bread on four mornings of the week.

Three families ate bread on three mornings of the week.

One family ate bread on two mornings of the week.

One family ate bread on one morning of the week.

Sometimes the tea and the bread were noted "for children only", sometimes "for men only".

The mason's family had three bowls of gruel for the children as well as tea for the older members of the family on three mornings during the week.

It would appear from these notes that the idea of an early morning meal is gaining ground, and the African would find it to his advantage to make it a custom. To work till two or three o'clock in the afternoon without food is exhausting, and the work suffers in consequence.

Visitors to Meals

There were 72 extra persons to meals amongst the 30 households under observation for one week. The three shopkeepers had the greatest number, 39 in all. One had 14, another 15, and the third had 10. Of the other families, one had a mother and child staying with them for a great part of the week, a second had a friend for a few days, so that the total number of outsiders to meals appears high. But casual visitors were usually not more than two to four spread out during the week over nine families.

References

	Volume	*Page*
C		
A. T. and G. M. Culwick. (1939) Population Survey of Bukoba. Secretariat, Dar-es-Salaam	—	—
G		
M. W. Grant. Personal Communication on the Calorie Value of Unripe Plantains	—	—
H		
J. H. Henry and M. W. Grant. Dietary Survey in connection with "African Labour Efficiency Survey," (1947)	—	102
N		
L. Nicholls, C.M.G., M.D., B.C., B.A. (Cantab.). "Tropical Nutrition and Dietetics" 3rd. Edition (1951). Balliere, Tindall and Cox. London	—	—
P		
B. S. Platt, C.M.G., M.B., M.Sc., Ph.D. "Tables of Representative Values of Foods Commonly used in Tropical Countries" Special Report Ser. No. 253	—	—
B. S. Platt. "Nutrition in the British West Indies." Colonial No. 195 (1946)	—	—
T		
E. Thomson. (1949) Dietary Survey of the Serenje Plateau, N. Rhodesia. N. Rhodesia Government Printer, Lusaka ..	—	—