

ALTERNATE SYSTEMS OF HUSBANDRY OR ALTERNATE HUSBANDRY

By Dr. JOHN FISHER.

There is a law in agriculture, as well as in other spheres of production called the Law of Diminishing Return. This law states that under certain conditions there is a less return for each application of labour and capital to land.

Given land of the same quality it seems fairly evident that for, say, each dose of fertilizer applied to a given area there must come a time when that dose of fertilizer will give a less return. The same result will follow from each cultivation, etc. If it did not and each dose of fertilizer continued to give the same increase as the first dose then the good land would give all the yields that were necessary. But all land is not of the same quality. All land is strictly limited, but the good land is more restricted still. All the land on any cane farm is not the best land. There are degrees of quality below the best, and they run right down to very poor land indeed. As practical farmers, cane growers, stockowners, etc., we all realize that the restrictions of this law apply. The poorer qualities of land yield less than the better qualities for the same dosage of labour and capital.

It should be remembered that at the beginning of production and for a short period the Law of Diminishing Return operates in the reverse way. It is a Law of Increasing Return. If we were to plant cane in holes made in virgin veld without ploughing and other cultural operations, without fertilizer and with no cultivations, hoeings, etc., there would be practically a nil return. From this stage on, by giving cultural operations, fertilizer, etc., i.e. by applying labour and capital to the same area, the yield would increase; but not for very long. Very soon this law stops functioning and its reverse comes into play. The law applies to cultivations, to fertilizer, to food for dairy cows, pigs, poultry, etc.

LAW OF DIMINISHING RETURN.

Wheat.—Yield of Grain.

Plot.	Manurial Treatment.	1922.	1923.	1924.	1925.	Total.	Mean.	Increase over no manure.
16	No manure ...	28.68	23.32	36.65	19.68	108.33	27.08	—
18	6 tons F.Y.M.	38.00	26.00	35.32	28.71	128.03	32.01	4.93
17	8 tons F.Y.M.	38.35	29.65	36.00	28.39	132.39	33.10	6.02
19	10 tons F.Y.M.	33.65	27.32	41.32	29.36	131.65	32.91	5.83
20	12 tons F.Y.M.	31.97	27.00	43.32	27.74	130.03	32.51	5.43

Cultivations.—Yield of Potatoes in Bushels.

Plot.	Treatment.	1922.	1923.	1924.	Total Yield.	Total Yield.	Increase over one cultivation
4	Cultivated once ...	238.6	253.8	388.5	980.9	327.0	—
3	Cultivated twice ...	258.0	315.1	420.8	993.9	331.3	4.3
2	Cultivated three times	230.1	373.6	423.9	1027.6	342.5	15.5
1	Cultivated four times	213.1	372.6	426.5	1012.2	337.4	10.4

Meat Production.—Baby Beef.

Feeding Treatment.	(1) Cost of Treatment.	Excess gain in weight.	(2) Value of excess gain (a)	(3) Value of excess gain (b)	Diff. 1 & 2.	Diff. 1 & 3.
No cotton seed cake ...	—	—	—	—	—	—
$\frac{1}{2}$ lb. cotton seed cake per head per day for 231 days	6.24	33.62	16.81	11.21	10.57	4.97
1 lb. cotton seed cake per head per day for 231 days	12.47	51.75	25.88	17.25	13.41	4.78
$1\frac{1}{2}$ lb. cotton seed cake per head per day for 231 days	18.71	52.01	26.31	17.54	7.6	1.17
2 lb. cotton seed cake per head per day for 231 days	24.95	64.20	32.10	21.40	7.15	3.05

Cotton seed cake valued at £6 per ton.

(a) Baby Beef valued at 6d. per lb.

(b) Baby Beef valued at 4d. per lb.

Consideration of these experiments will show very clearly that intensified production does not pay in a falling market. For a given price of produce and a given price of fertilizer, or cotton seed, etc., there is a certain point in the application of these agents of production which gives the maximum profit, and to push production beyond this point by increasing the factor in question will only cause a diminished profit or even a loss. This point may be defined as the economic maximum as distinct from the physiological maximum which is the point of maximum yield.

There is another way in which the law operates. We took land of the same good quality to begin with and then land of varying qualities and found the Law of Diminishing Return applying in both cases. There is still one further case to consider. Good land distant from the centre of activities is the equivalent of poorer land nearer the centre. It is more costly to farm. There are additional expenses and so the equally good land further away yields less profit than the same quality land nearer home. There is a decreasing return the further we extend from a centre. 12½ per cent. of the working time of a day can easily be lost in comings and goings. This adds to the cost of this distant land, and it soon becomes questionable whether this land is really profitable or not. At some point in this marginal land there is reached a point where profit ceases or vanishes to such an extent that the whole farming system must be brought under review with the idea of determining what change must be brought into being.

PRICE AND EXPANSION OR RETRACTION.

The price factor plays a great part in the expansion or retraction of the area. As the price of the product rises, costs of production remaining constant, it will pay to farm poorer land or what is the equivalent of this, i.e. land which is more distant. It is true too that the good land will be farmed more intensively before the area is extended to poorer or more distant fields. Conversely, as the price of the product falls there will be a restriction of the area. Poorer qualities of land will go out of cultivation, distant lands will be abandoned and even the good land will not be farmed so intensively. This Law of Decreasing Return is fully operative in the sugar belt. The future is certainly hidden from us. We do not know what the future costs of labour, etc., are going to be. If labour costs rise, as there seems every possibility of doing at the present stage of our wage determinations, etc., in the different industries and the lowered output whenever wages increase, conditions will arise which must be carefully studied. This may very readily be one of the ways in which Decreasing Return will operate.

Cane culture requires much labour. Only let the wages rise and it becomes evident at once that there may be a retraction of the margin, and the distant and poorer lands may quickly pass out of cultivation.

MONO-CULTURE IN THE SUGAR BELT.

Before considering the alternates to cane culture, reference should be made to the mono-culture which exists throughout the sugar belt. The whole sugar industry used to be dependent upon the health and good behaviour, not of an evacuee, but of an orphan, "Uba." To-day there are vastly improved varieties, both for early maturity and higher sucrose, lower fibre, etc., which all mean more sugar per acre. Yet these few varieties are not a sure bulwark against all the hosts of insect pests, fungal diseases, virus attacks and other untoward happenings which may come along. To some students of plant behaviour reliance upon one or two varieties is quite unsound. If there is any truth in the foregoing exposition of actual conditions in the sugar belt there should be an urgent searching for something with which to replace or to alternate sugar culture. There is another point upon which information is desired. To-day, with much thought directed towards the soils of the country and their conservation, there has sprung into the foreground something which was sadly neglected until about a decade ago.

To-day we look upon the soil fertility as not determined by the available plant food in the soil alone, but by a combination of physical soil characters together with plant food. Soil structure and texture are occupying larger shares of our attention.

It is hardly the place here to launch into a full discussion of soil structure and how this is influenced by cane culture over a period of years, which includes the ploughing out, green manure crop and replanting with cane and the inter-row cultivations given, even if we had the data we should like to have.

In a recent work "Alternate Husbandry," by the well-known authors of "The Rape of the Earth" and others, attention is drawn to the need for alternate systems under European and American climatic conditions. It should be of paramount importance to the sugar industry to have definite scientific knowledge of the results of cane culture on soil structure and texture and whether under present cultural methods and under our climatic conditions any harm is resulting to our soils. The point is of great importance and I would suggest that provided a research station is established for "alternate husbandry," this study should be one of the first to be undertaken. There are apparently very considerable differences in the ability of different grasses to influence soil structure and quality, and whilst sugarcane is just a giant grass, little is known about this particular aspect of cane cultures.

There is another place where cane culture by itself is perhaps found wanting. That place is the shortage of farm livestock and their droppings on cane lands. What would be the influence of dung, urine and all the body secretions which are contained therein, apart from the usually noted nitrogen, phosphoric acid and potash on cane growth, composition, sugar percentage, etc., etc.? This is a question to which, in so far as I know, no answer from South African experience can be given, yet it is one which might be of very great importance.

If we consider now the alternate husbandry which might replace lands under cane there are a number of activities which might be undertaken.

We can consider these under two main headings. The first one is similar to cane, i.e. it is crops for crops' sake, whilst the second is plant growth for animal nutrition, the production of animal products and the sale of animal products.

CROPS FOR CROPS' SAKE.

Our thoughts turn at once to the main grain crop grown in the Union, i.e. maize, but I do not think that there is a very great future for maize for grain on these coastal lands. Maize seems to suffer very much from streak, and I am inclined to think that maize for "green mealies," a delicious vegetable, would be more profitable and would occupy the land for a shorter period and would make way for other crops. These green mealies would catch a market somewhat bare of fresh vegetables. This would only be a small outlet but it is well worth a trial.

Something different, more restorative, could well be a ground nut crop where the soils are on the lighter side, and there are many of them. The Natal ground nut has proved itself to be an excellent variety and there is a very large demand for ground nut meal, for oil for salads and cooking purposes. Most of our ground nuts have been imported hitherto.

Keeping in mind restorative crops there is a further legume, sunn hemp, which grows exceedingly well on the coast lands and which has been mainly used for green manuring, but which needs to be grown and studied for seed production purposes. As a broadcast crop it is a cheap crop to grow, it keeps the land clean, and can be handled by machinery. The suggestion is that extended trials be undertaken to find times, varieties and treatments to induce the greatest seed production and then to build these facts into a system for general adoption.

The ordinary beans, speckled sugar, Canadian Wonder, etc., require rather a lot of labour. As dry beans they always command a good price on the market, but the plants seldom carry a good inoculation on their roots. Hence their restorative effect will be small.

There are other crops which can be grown. I mention arrow-root, ginger, cassava, fibre. These should be thoroughly tried out. Nor should fruits be left entirely out of consideration. Pineapples, pawpaws, mangoes, certain types of citrus, roselle or sorrell, guavas, are worth mentioning. Much of this class of

fruit is reaching our markets from the Eastern Transvaal and efforts should be made to supply our needs from local sources.

Then there is the possibility of winter round potatoes, to catch the bare market about October and November when old potatoes are not very attractive and when the new crop up-country is hardly on the market. Small, damaged, and diseased tubers could very well fit in with some types of animal husbandry. It goes without saying almost that sweet potatoes can be grown. Keeping to the winter crops, there also is the chance to produce tomatoes. They could alternate with ground nuts, etc., but not with potatoes, as the ills of the one are likely to attack the other. There are other vegetables also which can be grown, and I cannot see why they cannot be produced by the European grower.

There is a further crop but one in which the economic lag is long and hence is a crop more for the large Estates than for the planter. This is the tree crop. Sandy, poor soils with underlying moisture will grow trees very well. Trees can be used for out-of-the-way corners, but good sugar land is too dear to grow trees on.

CROPS GROWN FOR STOCK.

Here, without doubt, the main crop is grass, by far the most important crop in the whole world. It is nature's opportune crop, growing under all kinds of conditions whenever it gets a chance. So suppose we give it a chance and treat it well, even better than cane, with a view to seeing just what it can do under coastal conditions. A 40-inch rainfall, no frost, free working soils which do not set into concrete-like masses should be nearly ideal for some kinds of grasses. There will undoubtedly be other grasses in addition to what we know to-day and of which we have experience, in the future and the job of alternate husbandry will be to dovetail these into a system which will provide food for stock all the year if possible, and if not all the year, then for as long a part as possible and practicable. Accepting these statements regarding grass it must be understood that grass is the alternate husbandry. The crops aforementioned are not really alternate husbandry because under them the land does not enjoy its rest. It is under grass only that the soil rests, compared with cultivations. The price of even marginal land in the sugar cane belt is high, and on high-priced land, with costly labour, you cannot produce extensive products effectively. It has always been my own personal view that costly land, expensive labour and a high priced product go hand in hand.

Beef Cattle.—If beef cattle are correctly farmed on cheap land, i.e. under ranching conditions, then they cannot be correctly farmed on intensive land with intensive applications of fertilizers. Rearing of young stock, i.e. potential profit earners, if they ever will be profit earners, cannot balance annual expenditures of several pounds per acre. Could the grass lands or pastures (established) on the coast turn autumn stores from up-country into spring slaughter stock on the coast? If the grass is only to be used from May to September-October, what is going to be done with it during the rapid growth of the summer months? It seems to me that established pastures correctly fertilized and properly managed cannot compete in the summer months with high veld grazings, natural pasturage with no fertilizer cost attached to it.

There will have to be many more trials and on an extended scale compared with what has been done in isolated trials hitherto, before the fattening of beef steers on the coast can be looked upon as an economic possibility fitting into a farming system. There seems to be some reason for the belief that stock of the British breeds, even the beef breeds, cannot put on condition in the hot summer months on the coast. Cattle with Zebu blood to a fair extent can withstand the higher temperatures much better. When it comes to the provision of shelter, shade, drinking places, etc., these will add considerably to the already high cost of land and pasture establishment. Then there is the further problem of the rapid deterioration of fences, particularly barbed wire fences with iron standards and droppers. Whilst the life of such a fence on the high veld and drier interior, where the humidity of the atmosphere is considerably less than on the coast, extends to twenty-five to thirty years, on the coast it will be less than half this, even down to a quarter of this time in certain conditions. This again is going to add considerably to the cost, and the doubt is again stressed that extensive produc-

tion as beef cannot stand up to these costs. If slaughter bullocks are going to be sold at £30 to £45 per head instead of £10 to £15, some of the cost could be borne, but beef consumption would be greatly reduced.

Dairy Cattle.—When we turn to dairy cattle we bring the intensive animal into an intensive environment, a true balance between stock and environment, the only balanced production where stock is concerned. Dairy cattle will return a very much higher production per acre in milk than beef cattle can ever do, even should milk fall in price to 1s. per gallon, or even somewhat below this price on the farm. It is quite true that there will be more working capital required per acre; and since a dairy cow will be in production for at least 3 to 5 years, making her 6 to 8 years old on the average when disposed of, there will be less than half the number of dairy cows required than there would be beef steers over a number of years. This supply of dairy cows may be possible where a double supply of suitable beef steers would be difficult to obtain. Once pastures are established, the labour required for their management and maintenance is not high. The labour required will be at milking time, and labourers will have to be taught the skilled job of efficient milking.

The provision of shade, shelter, fences, water supplies, etc., will be even more necessary for the dairy cow than for the beef steer, and hence if the cost is nearly the same, the return must be much higher. I do not know what returns have been secured by good management of good dairy cows and good pastures in the coastal belt, but there is no doubt in my own mind that 600 to 800 or 1,000 gallons per acre could be secured. At 1s. per gallon the gross return would be £30 to £50 per acre to offset the cost factors mentioned. The use of the electric fence must be borne in mind when thinking of fences in the coastal belt. The planned location of a number of milk producing units could cool the milk co-operatively, distribute or transport it by the same co-operative effort, thus lessening costs and increasing efficiencies. This type of farming would provide the alternate husbandry which is being largely advocated at the present time where frequent cultivations have destroyed soil quality, and constant cultivations prohibit the remaking of this soil structure so essential for the health of the soil and the crop it produces. Here again we come up against a definite lack of knowledge. I quote p. 25 *Alternate Husbandry*: "Pastures or leys in the form of a turf sward of mixed grasses and legumes are virtually not found in the tropics, whereas alternate husbandry as a means of maintaining soil fertility depends for its success on the establishment in rotation of effective short term leys capable of restoring and improving soil structure in the relatively short period the land is kept under grass. The improvement in soil granulation and general fertility induced by such leys in non-tropical regions appears to be retained for several years after the grass is ploughed up, but in the tropics, the time taken for the loss of soil structure when grass land or bush is brought under cultivation is likely to be measured in terms of months rather than years. On the other hand, the rate of growth and yield of tropical grasses are several times greater than what can be achieved in cooler climates, and this rapid development of an extensive and massive root system may shorten proportionately the time required to restore soil structure by means of a crop of grass."

How will a grass sward crop that has been ploughed in influence the soil structure and the growth of cane to follow on that soil? Will dairy cows on pastures, the soil structure, the organic deposits from leaves, stems, roots and the dung and urine from the cows improve considerably the yield of cane and for how long after a grass ley has been ploughed in? This is certainly something we should like to know. Cane culture with the rather frequent cultivations, green manuring with sunn hemp and the cultivations associated therewith do not allow the soil to rest as it does under permanent grass, nor do the animal droppings amount to the same as those of cows on good pasture where the stocking is somewhat intense. I certainly am of the opinion that this line of farming promises much scope and success, a success not measured solely in the milk or profit per acre, not per cow, whilst under grass, but from increased growth and production after the grass has been ploughed under. It is not my intention to-day to enter into any detail about laying down land to pasture, fertilizers needed, pasture management, dairy cow management, and the handling of the milk and/or cream,

etc., etc. I am surveying the position and I believe the dairy cow with efficient management will play an important role yet in farming on the coastal strip. Please do not run away with the idea that I am saying that light, wind-blown sands, with the merest trace of plant food and no structure will grow good productive pastures. They won't. Whilst far too little experimentation has been carried out on the influence of specific grasses on soil structure, and particularly under semi-tropical conditions, yet from indications which have been recorded, *Paspalum notatum* has been favourably commented upon. It has excelled *Paspalum dilatatum*, *Paspalum malacophyllum* and *Digitaria eriantha*.

Soil level in inches.	Paspalum notatum	P. notatum (Paraguay)	P. dilatatum	Mala-cophyllum	Ur-vil-lei	Digitaria eriantha	Axon-opas affinis	Mean root wt. all grasses
0-4 ...	23.76	17.79	12.80	10.71	7.71	7.62	10.38	12.89
4-8 ...	11.95	13.42	6.60	4.80	2.39	4.12	3.32	6.66
8-12 ...	4.72	6.12	1.51	1.22	0.63	1.69	0.79	2.38
12-16 ...	3.48	4.44	0.90	1.27	0.41	1.13	0.58	1.74
Mean ...	10.97	10.44	5.45	4.50	2.65	3.94	3.77	—

The above table shows the weight of roots found in the first 16 ins. of soil, under 100 sq. ins. of sod of seven grasses and eight months after seeding.

The following table shows the extent and distribution in grams of the roots under 100 sq. ins. of sod of seven grasses eight months of growth.

Soil level in inches.	Paspalum notatum	P. notatum (Paraguay)	P. dilatatum	Mala-cophyllum	Ur-vil-lei	Digitaria eriantha	Axon-opas affinis
0-4 ...	25.89	23.58	11.43	12.78	6.23	8.58	10.10
4-8 ...	17.23	17.58	4.08	5.98	1.73	3.57	2.30
8-12 ...	6.81	8.07	1.54	1.81	0.59	1.77	0.21
12-16 ...	5.21	5.56	1.08	1.06	0.35	1.28	0.22
16-20 ...	5.16	5.63	1.28	1.08	0.52	0.99	0.17
20-24 ...	5.81	5.04	0.87	1.12	0.35	0.74	0.20
24-28 ...	5.38	4.34	0.82	1.02	0.22	0.59	0.23
23-32 ...	4.41	3.70	0.63	1.17	0.11	0.67	0.12
32-36 ...	1.72	2.16	0.25	0.67	0.07	0.30	0.06
36-40 ...	0.58	0.29	0.10	0.09	0.03	0.22	—
40-44 ...	0.02	—	—	—	—	—	—
Total ...	78.22	75.95	22.08	26.78	10.20	18.71	13.67

These tables are from Imperial Agricultural Bureau Joint Publication No. 6. These are only one or two grasses. There are many more to be studied. What about all our Panicums, Setarias, Brachyarias, Pennisetums, Chloris, etc., etc.?

Poultry and Pigs.—There are one or two other branches of production but not alternate husbandry as it is known overseas, which can be undertaken on the coast. If land goes out of cane cultivation then we want to utilise that land for other crops and perhaps ultimately bring it back to cane culture. The other branches I have in mind are poultry and pigs.

In most countries dairy cows, poultry and pigs form a trio. Each one is intensive; each has a short economic lag, and the former supports both the latter. If cream is sold, the butter fat contains no soil fertility. If the separated milk is fed to fowls and pigs, then roughly half the nitrogen, three-quarters of the phosphoric acid and all the potash find their way into the excreta. Care of this manure and its return to the soil with the least possible loss ensures that the fertility of the farm is not being reduced. Both of these branches, poultry and pigs, do not require much land. They can be kept in their thousands and hundreds on relatively small areas because much of their food is in the nature of purchased concentrates, and a farm is not necessary to keep many head of poultry or pigs. The purchased foodstuffs bring fertility and if this is wisely used it

can play a valuable part in helping grass land to restore fertility to "tired of the plough soils" and those lacking in fertility. Certain crops can be grown to ease the burden of purchased foodstuffs. Good grass supplies considerable food for fowls on range and in-farrow sows, etc. Artichokes, sweet potatoes, groundnuts and so forth produce considerable foods commendable as pig foods especially.

Well-planned piggeries and poultry houses enable much stock to be cared for with very little labour, though fairly constant supervision is necessary. That is the boss's job and is not looked upon as labour. World experience shows that land can be enriched with the droppings of these animals fed on concentrates so that the land will be able to produce higher crops. Unfortunately pigs and poultry cannot enrich the very many acres of impoverished land to be found in this Province. They can, at best, only do this on a few acres. What must be done, therefore, to improve all the other acres not stocked by pigs and poultry? I suggest that the only possible way for the larger areas is by means of grass, correctly fertilized, properly managed, stocked with well-bred, good producing dairy cows where expensive labour is required in moderate amounts only.

Mr. HAMMOND said that the term "marginal land" was at present often used with reference to certain land under sugarcane. Dr. Fisher mentioned it frequently, and he did attempt in the beginning of his paper to tell us what it meant, but there was such a wide range of interpretations. Many cane growers resented their lands being described as marginal. He would therefore appreciate it if Dr. Fisher would give a concise definition of the term "marginal lands."

Dr. FISHER in reply said that marginal land was land from which, when planted with the main crop—in this case sugarcane—a profitable return was doubtful. Whether land was marginal or not very largely depended on the driving force and insight of the farmer, its geographical position and distance from the centre, its fertility and cost of cultivation.

Mr. HAMMOND said that Dr. Fisher's reply dealt mainly with a farm; he nevertheless thought the definition would apply to an area as well. The South Coast area was often referred to as being marginal land. From the definition, however, no one could justly apply the term to the South Coast as long as cane was being profitably cultivated in that area.

Mention was made of "crops for crops' sake." Agricultural schools might plant crops for crops' sake, but the practical farmer had to take economic considerations into account. Sugar farmers were very much in the same position as the settlers at Pongola had been. It was found that the soil at Pongola was excellent and almost any crop could be grown there, but there were no markets for these crops, hence the failure of the settlement. Until adequate markets were assured, further settlement there was inadvisable.

Potatoes were mentioned in the paper under discussion and the speaker had had some experience of planting potatoes. He found, however, that on the coast a crop could only be obtained once in about ten years.

Another point to be borne in mind considering alternate crops was that cane farming was a full-time job. All the labour, transport and equipment on the farm were required for long stretches of time for cultivation and harvesting cane, and experimenting with anything else would require extra labour, equipment, etc. Farmers on the Natal coast had been concentrating on the crop that gave them the best economic return and that was why they were planting sugarcane. At the same time they had not seen sufficient proof that the suggested alternate crops were going to increase fertility.

The Experiment Station had advised farmers to plant green manure crops and that advice had been followed with excellent results. Now Dr. Fisher advocated planting grass and resting the soil. He would like Dr. Fisher to tell us what he meant by resting the soil.

There was a suggestion that the Government was going to establish an experiment station for alternate crops on the coast.

What was required was, however, not to know which crops would grow on the coast, but whether the contemplated system of mixed farming was going to pay, and how economically it would fit in with the present system. That was the information desired by the cane growers. He would therefore suggest that the Government should buy a cane farm and try dairying, pig farming, alternate crops, etc., in conjunction with cane farming, and then present a balance sheet of costs and profit.

Dr. FISHER said that his idea was that the land should get a rest from ploughing. That would, however, not lessen the profit from the farm as good grassland, properly farmed with good cows would have a greater earning capacity than caneland. It was quite true that cultivation in cane growing was not nearly as intense as it was in growing maize, but the principle was the same. Arable lands were very liable to erode and it was only by putting the land under grass that it was allowed to rebuild its crumb structure and to collect fertility. Although he had mentioned other alternate crops he had made it quite clear that grasslands and dairying was the only alternate system of husbandry he had in mind. It was, moreover, the class of farming with the smallest risk attached to it. When after some years of grassland the land went back to sugarcane a much better yield could be expected as a result of the greater fertility of the soil.

Dr. McMARTIN said that the underlying theme of Dr. Fisher's paper was that sugarcane mono-culture was for some reason unsound, and therefore had to be alternated with some other form of husbandry. This, however, he considered a fallacy as he was definitely of the opinion that there was nothing unsound in continual cane culture provided it was periodically alternated with a good legume crop. In "Alternate Husbandry" quoted by Dr. Fisher in his paper, Wakefield found the statement very questionable that sugarcane mono-culture was economically unsound, and had a harmful effect on soil fertility. Our data indicated an increase in sugarcane productivity and there were no signs of a general decrease in soil fertility.

Experiments had been carried out at the Experiment Station to grow various crops other than sugarcane, but few, if any, proved economical. We introduced a number of varieties of sweet potatoes and distributed them through the coastal belt. Arrangements were made to market them in the best possible way, but the price realised was only 4/- a bag. Peanuts were also distributed but were found uneconomical to grow.

Mr. DYMOND could not agree with Dr. McMartin that our soil fertility had not decreased. He contended that soil fertility and productivity were essentially different. Virgin soils were generally associated with fertility. Productivity could, however, temporarily be increased with artificial fertilizers. A stage would, however, be reached where productivity could not further be increased with artificials as the fertility, the humus and associated earthworms and micro-flora had decreased or disappeared. Tomatoes grown in water cultures would represent productivity but not fertility, and he thought seed from such crops would in time degenerate.

Mr. CUTLER said he thought it would be very difficult to disassociate productivity from fertility with the biological influence on both sides. Provided rainfall remained constant he could not see how the two terms could be disassociated.

Dr. DODDS said that the yield of cane per acre had increased progressively in recent years. That was largely due to the introduction of new varieties, but the increase would not have been so great had there been any decline in productivity. Uba too was still grown in small areas and shewed no serious decrease in yield.

Land under sugarcane was given a rest every seventh year, as the agricultural census shewed that the average time after which old ratoons were ploughed out was seven years. The soil wanted a change more than a rest, however, for good fertile soil would not be idle and would grow weeds if not planted. He did not agree, however, that a grass cover crop would provide the best alternative as sugarcane itself was a grass and he thought that it would be much better to give the soil a year's fallow with a legume or a succession of legume crops. There would be many advantages in this procedure from the point of view of conservation of fertility.

Land intended for sugarcane planting was ploughed deeply twice in a seven-year cycle, and apart from that, only shallow cultivation was practised after each cutting. Moreover, sugarcane was a big crop with a very intensive root system which remained in the soil after cutting, and it was not therefore likely that the soil would be readily depleted of organic matter. In Hawaii large crops of sugarcane were grown which were believed to ensure an increase in organic matter in the soil as a result of the accumulation of root residues.

Dr. FISHER said in the system he advocated the soil would

be improved not only as a result of the grass crop, but also because the urine and manure from the stock that would graze the pastures would enrich the soil, and there would, of course, be a complete rest from the plough.

The PRESIDENT said that the immediate return from the land was not all that had to be considered; it was necessary to ensure the productivity of the soil for future generations. He therefore recommended that Dr. Fisher's message be taken to heart and alternative crops seriously considered.