FARMING COSTS

BY

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Being
a new edition
rewritten and brought to date
of 'The Determination of
Farming Costs'
1917

OXFORD
AT THE CLARENDON PRESS
1921

OXFORD UNIVERSITY PRESS
London Edinburgh Glasgow Copenhagen
New York Toronto Melbourne Cape Town
Bombay Calcutta Madras Shanghai
HUMPHREY MILFORD
Publisher to the University

NOTE

THE interest in the study of Farm Management through the agency of scientific book-keeping has been greatly stimulated by the demand for information on the cost of farm products arising out of the control of agriculture necessitated during and since the War, and the first edition of this study of Methods and Principles of Agricultural Costing was exhausted within a few months of its appearance. This new issue has been largely re-written and to a certain extent re-planned, but the fresh experience gained during the further period of work has necessitated but few alterations in principle. Further consideration of some of the problems, as for example how to divide a total cost between two articles produced simultaneously, has led to the recommendation of new methods in a few cases, and other problems such as the costing of farmyard manure and the distribution of manurial residues, and of the cultivation-costs on bare fallows and fallow-crops, are still only tentatively solved.

New illustrations have been introduced in every case of methods, principles, and results, so as to bring the figures more into accord with present-day values, and all the Tables are derived from actual farm accounts.

Further attempts have been made to demonstrate the value of scientific book-keeping and recording on the farm for wider purposes than that of the information of the farmer alone, and in the fifth chapter examples are given of the fundamental importance of such data in the examination of the organization of the Agricultural Industry as a whole. The method described for the comparison of the efficiency of farm management in different cases is the work

of Mr. A. W. Ashby; the survey of the productivity of holdings of different sizes in a Welsh farming district was made by Mr. Pryse Howell; Mr. S. J. Upfold prepared the graphs illustrating the effect of the rise of wages on farming finance.

All members of the Institute have participated in the production of the various Tables used throughout the book by way of illustration, and an alternative method for arriving at Farm Costs based on the compilation of the cost of farm operations, which appears as Appendix I, has been contributed by Mr. A. Loose. This method has not yet been tested in practice.

The Bibliography appearing as Appendix II has been brought up to the end of September 1920.

Once more it is desired to record the indebtedness of the Institute for Research in Agricultural Economics to those farmers who have co-operated in its work by supplying records of their operations day by day throughout the year from which the illustrations have been drawn.

C. S. ORWIN.

OXFORD,
December 1920.

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PART I

METHODS AND PRINCIPLES

CHAPTER I

INTRODUCTION

THE need for cost analysis in connexion with productive enterprise is one which has grown up gradually with the growth of industry. It has been pointed out that when production was effected by manual labour, either under a more or less primitive factory system, or in a cottage industry, intricate accounting was not required; but the rapid changes in industrial conditions, due to the introduction of labour-saving machinery and the specialization of labour, have led to processes of manufacture so intricate and on such a scale that 'it is only by means of systematic records that leakage, waste, and fraud can be prevented, and that employers can know the cost of any article of their manufacture, and be able to determine accurately and scientifically, not merely approximately and by haphazard, the actual profit they make or loss they sustain, not only on the aggregate transactions during a given period, but also upon each individual transaction. . . . There is always the danger, where only the general result of a business is known, of departments or processes which are relatively unremunerative being unduly fostered, and of those which yield more than the average profit not receiving adequate attention'.[1] Side by side with these results comparisons can be made of the advantages of alternative processes, of the efficiency of different machines, and of various grades of labour, whilst a proper system of record-keeping enables the management to know, from day to day, the stocks of

[1] Garcke and Fells, *Factory Accounts*, 6th ed. (1912), p. 5.

goods and materials on hand as accurately as the cash balance is known, and so to prevent an undue accumulation of capital in unproductive forms.

Every enterprise working to supply a market has two sides, the technical side involving the use of special skill in the various processes involved in the production of the particular commodities concerned, and the managerial side working to control this technical skill to the end that effort may be economically applied so that the final product-cost will be brought out as low as possible. As a business grows in size so does the tendency increase to separate the functions of the technical and the managerial staff, until, in the great industrial organizations of to-day, we find a fairly complete division between them, and a demand has sprung up for individuals who, knowing little or even nothing of the technical side of a business, are able to control it successfully by a system of management based on the compilation of records of cost in every process and department. 'A man who is 100 per cent. efficient as the manager of one particular business is 90 per cent. efficient as the manager of any business' is the *dictum* of a certain successful manufacturer who values technical knowledge in a manager at no more than 10 per cent. of his total equipment, and it is certainly true that most of the large industrial enterprises of our day are controlled by men who are well versed in management and the means to analyse the processes of production rather than in their technique.

Thus, the analysis of adequate records is the keystone of the productive enterprise, upon which the stability of the whole structure of industry depends. Its advantages have received general recognition in all countries where the factory or industrial system has been developed, but in regard to the great industry of agriculture the possibility of closer and more intelligent control of production by its means is only very slowly being realized. Agriculture has advanced gradually, but continuously, from the self-sufficing stage, and, although the tendency to promote the greater efficiency of labour by an increase of capital in the

form of machinery equipment has been still more gradual,[1] the modern farm is approaching always more nearly, in its organization, to the urban industrial concern. Under the Corn Production Act a Wages Board has been set up for the agricultural industry, by which minimum time and overtime rates of pay for all classes of farm workers are fixed, leading many men, for the first time in their lives as managers of labour, to keep accurate time-sheets ; the control of food prices necessitated by shortage of supplies during and since the war has led to the investigation of costs of production on a large scale by individual producers, by associations of farmers and of consumers, and by Government Departments; only a short time ago a Royal Commission was sitting to inquire into the economic future of the agricultural industry, and in every direction the need is indicated for the application of the economic test to farm management at every stage. Under the factory system it has long been recognized that technical skill must be controlled by those who study organization, finance, and economic forces if the highest results are to be secured. The directors of the Great Western Railway are not necessarily capable platelayers, nor is the chairman of the Aerated Bread Company selected on account of a light hand at pastry, but these gentlemen are able to control their technical staffs and to judge of their capacity and skill by the results of their operations as revealed in their accounts. There is little indication, at present, that farming will develop along factory lines very rapidly, but it is all the more necessary for farmers to cultivate their managerial capacity and to combine with their technical training and knowledge the study of business control and general economics. The importance of the subject has only slowly been realized by those responsible for the education of the farmer. During the past five and twenty years educational and research work in agriculture has made much progress in certain

[1] The efficiency of labour employed in agriculture is higher, probably, in the United Kingdom than in any European country. See reference to German agriculture on p. 70.

directions, and an enormous amount of valuable effort has been applied, mainly along the lines of Natural Science, to discover means for increasing production both directly and indirectly. But the study of Agricultural Economics has not received equal attention. It is probable that with the means for examining the economy of farm management, the increase of production on the farm by the application of modern scientific knowledge may go hand in hand with the cheapening of production and the increase of the reward to those engaged in the industry; it is certain that any general effort after maximum production without the exercise of this control can only be disastrous. The economic law with which agricultural production has to contend is the law of diminishing returns, and the attempt to wring the last bushel of corn from the land and to produce the last pound of meat and the last gallon of milk, is only to be justified when it can be shown that maximum production is accompanied by maximum financial reward. It is the economic factor which controls, ultimately, all productive enterprise. The soil, climate, and other considerations are factors of very great importance, but poor light soils, for example, apparently of low agricultural value, may be adapted to forms of most intensive farming, given access to supplies of cheap organic manures and to a suitable market, whilst farms admirably suited by soil and climatic conditions, say, to milk production may be useless for this purpose in the absence of facilities for rapid transport to large consuming centres. The successful manager is he who produces not necessarily the largest output, nor that which soil or climate or personal inclination indicate, but that which a study of the economic factors, that is to say, of markets, of transport, and of costs of production, leads him to expect will yield the biggest reward for his enterprise. If farming in this country is to hold its own in competition with other forms of industry it can only be by the adoption of an organization which will result in a reward to the capitalist and to the worker compatible with that yielded by industrial production, and to enable it to do this

a study of the processes of production and of the results, by means of scientific book-keeping, is equally essential on the farm as in the factory. Experience teaches that the problem of the determination of costs in farming is difficult and complex, more so, probably, than in other industries, but it is, none the less, equally important that it should be examined with the same degree of detail and of thoroughness.

The object of this preliminary study is to discuss the method, and to show, in certain cases, illustrations of its application. There is, at present, too little agreement among research workers upon questions of principle. In many continental countries and in America, as well as in Britain, many investigations into agricultural costs have been made,[1] and the student cannot fail to be impressed with the fact that whereas, obviously, there can be no uniformity of practice in the technicalities of book-keeping processes in all countries, nor, indeed, is any such necessary, there is unfortunately no consensus of opinion upon vital matters of method and principle, upon which all must be agreed if results reliable in themselves and comparable one with another are to be obtained. Thus, the question at issue at this stage is less the production of costs from which generalizations can be drawn than the prior consideration of the determination of points which relate to an exact system of analytical or cost accounting applied to farming.

Nor is the question under discussion at the moment the consideration of whether such method, or some modification of it, can be adopted by every farmer. The question of farm accounts in practice is a matter for individual decision, and many men will think, particularly those in a relatively small way of business, that their managerial functions can be exercised most profitably exclusively in the field. In other industries it has been the experience of managers that it is economical to introduce methods of control which, in themselves, appear to add to the cost of production, and many of those who have made it their business to study

[1] See Bibliography, p. 116.

the problem of agricultural production are of the opinion that this will be, one day, the experience of farm managers likewise. There is, however, a degree of exactness required in cost determinations which may be so troublesome, and so expensive of time and labour when judged by the general standard of the business organization of the average farm, that it would not be profitable for the ordinary farmer. But this possibility does not affect the importance of having, in a number of cases, an exhaustive and scientific analysis of farming costs, and if this can be done on a number of typical farms the results will have a value as supplying standards of comparison.

In this country research work on these lines is still in its infancy, and it has not yet reached the stage at which generalizations can be made. It cannot be stated too plainly, therefore, that it is with the discussion and illustration of the method of scientific analysis of farming costs that this volume is concerned rather than with the results attained to, so far, by its application. But although information of general application is not yet forthcoming, students of the economy of agricultural production will realize that a thorough analysis, even of only a few actual cases, based on records carefully and systematically kept, is of interest and value, for it will be admitted that certain comparatively constant factors may be discerned even in a small amount of exact data, while, at the same time, contrasts and variations will be noted which challenge attention.

Further, the analysis of such accounts brings out the need for method even more exact than has yet been found possible. Problems are encountered which call for discussion amongst those interested before satisfactory solutions can be expected, and illustrations of this will be noted in cases which occur where information is lacking which should be available in an exact system of records (see, for example, pp. 78 and 91). It is hoped that the discussion and study of these matters will lead to an extension of research work, by means of scientific book-keeping, on the economics of farming, and that it may induce a certain

number of farmers who are interested in the thorough examination of their costs of production to undertake, for at least a certain period of time, the recording and analysis of their expenditure by exact methods.

Not only is a standard system of cost analysis essential to the determination of comparative costs in this country, but it is also demanded to enable comparisons to be made between Home costs and those of the Dominions and of Foreign Countries whose products compete in our markets. In many cases it is their costs, and not our own, which are the determining factor in fixing market prices. In the case of wheat-production, for example, the exploitation of virgin soils, with the aid of railway development and labour-saving machinery, may drive the price of wheat down below the home cost, through over-production, as was the case in the early nineties, or abnormal conditions combined with transport difficulties may lift the price above that which might be regarded as necessary in order to secure a fair reward to the producer, as was the case in the early years of the war ; but in the long run the determining factor is the cost of production in those countries which constitute our main sources of supply, so that accurate information on this point is of vital importance not only for the guidance of individual agriculturalists but also in the framing of national agricultural policy.

CHAPTER II

DETERMINATION OF METHOD

THERE are two methods in use for the determination of farming costs, (1) the analytical, (2) the synthetic. The latter is not practised in this country, but its use is advocated very warmly by its deviser, Ernst Laur, as giving certain results with less labour and at less risk of error than are involved in the analytical method. It consists in building up from the net profit, or loss, on production to find a so-called cost, cost being regarded for this purpose as the figure at which the article concerned can be sold so as to cover all expenses and give the same return on capital as that which is represented by current rates of interest on good security. Laur finds the difference between the net returns, and the interest on the capital invested calculated at the market rate current; this figure, expressed in a percentage of the gross returns, shows by how much the selling price must be increased or diminished (according as to whether the net returns are less or more than the return from an investment of an equal capital sum at the current rate of interest) in order to give the 'cost of production' as defined above. The method may best be explained by an example.

Calculation of the Cost of Production on a Milk-producing Farm by Laur's Method

	£
Total capital involved	5,000
Gross returns	1,000
Net returns	200
Average price realized for milk sold, 1*s.* 8*d.* per gallon.	
Interest on £5,000 at 5 per cent.	250
Net returns	200
Difference	50
Difference expressed in percentage of gross returns	5 per cent.

$$\therefore \text{ Cost of production} = 20d.\ (1s.\ 8d.) + \frac{5 \times 20d.}{100}$$

$$= 20 + 1d. = 21d.\ (1s.\ 9d.)$$

In this example the difference between interest on capital at current rates and the net returns on the farm shows a ' loss ' of 5 per cent., and this gives the measure of the proportion of the increase necessary in the selling price to indicate the cost. In cases where the difference is a ' profit ' there will be a proportionate deduction from the selling price. It is clear that the method must involve the inclusion of *all* outgoings in arriving at the net returns, together with an allowance for the farmer himself either as a manual worker or as manager, or in both of these capacities; otherwise the price would have to exceed 21*d.*, in the long run, to make it worth the farmer's while to remain in the business.

One obvious objection to this method of costing is that the result is not true cost, but cost *plus* interest on capital. Interest on capital is an allocation of profits, not a charge against cost, and its proper place is in the Profit and Loss Account, and not in the Cost Sheet. But if the method of calculation is otherwise useful this is not a serious objection, as due allowance can always be made for it in the interpretation of the results arrived at by means of Laur's system.[1] The most serious criticism of his method is that it is a guide only to price. It is important to have such a guide, but the main function of book-keeping is to provide an analysis of cost, so that waste may be detected and so that the manager may be able to consider means for effecting economies in production by an examination of the cost at all stages. This is quite impossible with the

[1] It is a common error in cost calculation to include interest on capital. For example, an account will be presented showing the cost of a wheat crop as £12 per acre, to which will be added 12*s.*, for *interest on capital at 5 per cent.* Apart from the fact that this is wrong in principle, it is also wrong in point of fact, for the capital sum of £12 invested in the wheat crop is not required in its entirety for twelve months, and a day-to-day calculation of the sum invested and of the interest on it would be needed if the true amount of interest calculated at 5 per cent. were required to be given. In the case of the wheat crop mentioned here the interest charged represents, probably, more nearly 20 per cent. than 5 per cent. This inaccuracy is absent, of course, from Laur's method of costing, though the objection to the principle of including any rate of interest in calculations of cost of production still remains. See p. 57, *post.*

method under review, and the utility of its application seems to be confined to simple forms of farming, where a few products are concerned, and where a considerable volume of evidence on the cost of some particular product is wanted in some particular district or from some special group of farms.

It is the analytical method which is pursued in connexion with the highly developed mixed farms of this country. It is practised with the aid of ordinary double-entry book-keeping, a familiarity with the principles of which on the part of the reader is assumed, and it is based on the compilation of accurate records of the application of capital and labour to production on the farm. The results of the analysis of these records, entered into account books on the double-entry principle, provide the manager with an economic review of the results of his management in all departments.

The first record necessary is that showing the distribution of the *Capital* invested in the farm. In the case of a farm already in operation this will be less a record than an estimation, for the farmer, or other investigator, will have no reliable data of the nature of records of cost from which to compile his figures. An appraisement of the capital laid out in the various branches of the enterprise, and in the means of production, must be made, about which more will be found in the following chapter (p. 37).

An important adjunct to the Capital record which is rarely or never met with on the farm, but the value of which is universally recognized in industry, is the *Stock Book*. This, as its name implies, is a register of the stock-in-hand on the farm, that is to say the dead stock. As a matter of convenience the Stock Book should be kept in sections under divisions such as these: (i) Manures, (ii) Feeding Stuffs, (iii) Granary, (iv) Implements and Machinery, (v) Miscellaneous Tools and Consumable Stores.

The Manures Book is ruled to show purchases of artificials, and their application to the various fields, dates and quantities being specified in either case. A separate page,

or pages, should be reserved for each class of manure purchased, and by balancing the record the stocks on hand at any time are disclosed, whilst by casting the field columns the charge against each field, or crop, is ascertained. It is hardly necessary to indicate the method of ruling such a record sheet, but with obvious modifications the form suggested for Feeding Stuffs (Table I) may be adopted.

The Feeding Stuffs Book is intended for use only in connexion with purchased foods of all kinds. Its purpose is to show stocks purchased and on hand at any time, and to give an analysis of the consumption of purchased food by the various classes of live stock on the farm. In Table I is given a convenient form for this record.

The Granary Book records the utilization of the home-produced corn. More detail is needed than in the Feeding Stuffs Book, because records must be kept of produce sold, and used for seed, as well as of that which is fed to live stock on the farm. A ruling suggested for this book forms Table II.

For an Implement and Machinery record and valuation a form of Stock Book is needed which will show the implements and machinery grouped as they are required for the various departments of the farm, and with provision for writing off their depreciation annually. All the items must be valued at the outset at cost less depreciation, or if they are newly bought, at cost, and in each succeeding year provision must be made for the depreciation which has occurred through use and age. The usual way of depreciating implements is to knock off a fixed percentage at the close of the year from the total value when the year began, and then to add the cost of purchases during the year. This is objectionable because it can be only a rough approximation. The better plan is to consider each implement by itself and to assign it a life. The depreciation will then be got by dividing the cost or value by the number of years' life. Many tools and implements will always retain a certain value, whatever their age, if they are kept in repair, so that it is not always desirable to depreciate the value of an article

down to nothing. A 'limit of depreciation' is fixed, and when that figure has been reached no further deduction is made, but the article is carried forward year by year at the same price. To take an example, a set of harrows may be worth 50*s.*, and if kept in repair it will be safe to give them a life of twenty years. This means that 2*s.* 6*d.* per annum must be deducted for depreciation, but if the harrows are kept in repair they will always have a certain value, say 10*s.*, so that after sixteen years, when they will stand in the inventory at 10*s.*, no further depreciation need be allowed.

This may appear for the moment a somewhat complicated and troublesome method of valuation, but by ruling the Implement Stock Book in the manner shown, the operation becomes a very clear and simple one, whilst it has the great advantage of reasonable accuracy. The value of each group of implements and the depreciation on them in any year becomes, first, a sum in subtraction and then a sum in addition. Several years can be provided for, but to avoid confusion in the future it must be remembered to leave a considerable space at the end of each group when writing out the Inventory for the first time, to allow for purchases in the coming years. In Table III is given an example of the Implements and Machinery Book.[1]

All the Miscellaneous Tools and Consumable Stores, such as hay-forks, hurdles, binder twine, spare parts, &c., should be inventoried and priced in a stock-book of their own, adding fresh purchases and detailing everything given out for use or consumption, so that a record is provided of the use of tools and materials and of the quantities in stock. The rulings for such a book will be readily devised to meet individual requirements. Table IV may serve as a guide.

The next essential is a record of the application of *Labour*, both manual and horse. Time-sheets are used to facilitate its preparation, and these can be handed out to the men on pay-day, to be filled up by them and brought back at

[1] From Orwin, *Farm Accounts*, p. 16 (Cambridge University Press).

TABLE I

Palm Kernel Cake

PURCHASED FEEDING STUFFS

PURCHASED										CONSUMED											
Date of purchase	From whom	Quantity			Price per ton			Total cost			Week ended	Cows	Cattle	Sheep	Pigs				Total			
		t.	c.	qr.	£.	s.	d.	£.	s.	d.		lbs.	lbs.	lbs.	lbs.				t.	c.	qr.	lbs.
Dec. 19	Mills Grinder and Co	4	0	0	15	0	0	60	0	0	Dec. 26	840	420							11	1	0

TABLE II

Wheat

GRANARY BOOK

THRESHING				HOW DISPOSED OF								
Date	Stack	Head Corn	Tail Corn	Date	Sold		Fed		Seed		Remarks
Nov. 16	No 2, from Field No. 6	43 qr. 3 b.	7b.	Nov. 17	Miffen and Co	3qr.	Transferred to Feeding Stuffs	7b.	Field No 17	10qr 3b	Price 75/6

TABLE

IMPLEMENT INVENTORY AND

Implement	Cost (or value)			Life	Annual Depreciation			Limit of Depreciation		
	£	s.	d.	Years	£	s.	d.	£	s.	d.
For Horse Labour:										
2 sets brass mounted harness	12.	0.	0	12	1.	0.	0		10.	0
1 set silver mounted harness	6.	6.	0	9		14.	0		10.	0
4 sets cart harness	16.	0.	0	10	1.	12.	0	2.	0.	0
(And so on for other items to the value of										
For Cattle:										
4 18-gallon steel churns	10.	0.	0	10	1.	0.	0	None		
Whitewashing machine	4.	0.	0	8		10.	0	None		
(And so on for other items to the value of										
For Crops:										
Manure Distributor	20.	0.	0	10	2.	0.	0	2.	0.	0
3 1-way ploughs	20.	0.	0	20	1.	0.	0	1.	10.	0
1 Cultivator	10.	0.	0	20		10.	0		5.	0
(And so on for other items to the value of										
For Poultry.										
2 large lean-to pens	4.	0.	0	20		4.	0	None		
10 black pens	10.	0.	0	10	1.	0.	0	None		
(And so on for other items to the value of										
For Dairy:										
Milk float	16.	0.	0	16	1.	0.	0	1.	0.	0.
Milk float	28.	0.	0	20	1.	8.	0	1.	0.	0
Cooler for milk	9.	0.	0	20		9.	0	None		
(And so on for other items to the value of										
For General Use:										
Oil Engine	60.	0.	0	5	12.	0.	0	10.	0.	0
Lorry	45.	0.	0	20	2.	5.	0	4.	0.	0
Cart	28.	0.	0	20	1.	8.	0	3.	0.	0
(And so on for other items to the value of										

VALUATION (STOCK BOOK)

1917			1918			Value in 1919			1920			1921			1922		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
12.	0.	0	11.	0.	0												
6.	6.	0	5.	12.	0												
16.	0.	0	14.	8.	0												
48.	11.	8)															
82.	17.	8															
10.	0.	0	9.	0.	0												
4.	0.	0	3.	10.	0												
50.	4.	0)															
64.	4.	0															
20.	0.	0	18.	0.	0												
20.	0.	0	19.	0.	0												
10.	0.	0	9.	10.	0												
135.	5.	0)															
185.	5.	0															
4.	0.	0	3.	16.	0												
10.	0.	0	9.	0.	0												
47.	16.	0)															
61.	16.	0															
16.	0.	0	15.	0.	0												
28.	0.	0	26.	12.	0												
9.	0.	0	8.	11.	0												
318.	8	4)															
371.	8.	4															
60.	0.	0	48.	0.	0												
45.	0.	0	42.	15.	0												
28.	0.	0	26.	12.	0												
37.	10.	0)															
70.	10.	0															

the close of the week, or they may be filled in each night by the farmer or his bailiff.

The Time-sheet provides space for detailing the work done by the man throughout the week, and for recording the number of horses worked by him on any job. The time should be recorded in hours, for in no other way can anything approaching accuracy be obtained when men are moving from one piece of work to another, sometimes at short intervals. Moreover, the Orders of the Agricultural Wages Board can only be interpreted in hours, for although the ordinary time-rates are weekly and not hourly rates they have reference to a week of a specified number of hours, whilst the overtime and Sunday rates are ordered definitely upon an hourly basis. Thus, time records must be in terms of hours for the proper information of the farm director, and it may be claimed, too, with some confidence, that the greater the minuteness of division, within workable limits, the greater will be the incentive to the men to make their entries carefully and to appreciate the value of time.

It is noted by Messrs. Garcke & Fells that to require men to keep simple records of time and materials has been found, in industry, to have a good moral effect and to inspire confidence in the management;[1] and in cases in which the custom of using Time-sheets has been adopted on the farm, a similar good effect has sometimes been observed.

As regards crops, the men can record their time either under the name of the crop on which they are engaged ('ploughing for wheat'), or under the name of the crops and also of the field in which it is growing, or is to be grown ('ploughing for wheat, field 43'). Whenever possible work done should always be recorded in the latter of these two ways, but the field-name or number should always appear. The farmer does not always know what crops he will be able to take in particular fields, and where several fields have been grouped to form one crop account in the cost-ledger at the beginning of the financial year, subsequent happenings may occasion a revision of the cropping scheme,

[1] *Op. cit.*, p. 9.

TABLE IV

MISCELLANEOUS TOOLS AND STORES

IN HAND, OR PURCHASED									ISSUED					
Date	From whom purchased	Particulars	Price £.	Price s.	Price d.	Ref.	Total Cost £.	Total Cost s.	Total Cost d	Date	Quantity	Cost £	Cost s	Cost d	To whom	Remarks
1919										1919						
Jan 1	Hill & Co	50 pkts. Sheep Dip @		1	6	C.B. 6	3	15	0	June 1	20 pkts	1	10	0	J Smith	
Feb 1	W. Anderson	6 Spades @		5	0	" 7	1	10	0	Apl 10	1		5	0	S. Brown	
April 2	P Robinson & Co	12 Plough Shares for Brown's plough @		1	9	J 14	1	1	0	May 6	2 Shares		3	6	S. Jones	
10	"	12 Coulter blades @		1	10	" 8	1	2	0	" 14	3 blades		5	6	S. Jones	(Tractor Plough)

with consequent confusion in the crop-accounts already open. Again, it is common knowledge, and in fact it is not infrequently urged as an insuperable difficulty in the way of anything like accuracy in agricultural costing, that the cost of production on the farm cannot be ascertained by clean-cut book-keeping methods, for it is a matter of everyday farm management to apply acts of cultivation and manuring to one crop for the ultimate benefit of two or more following. The allocation of such costs to the successive crops benefited is more easily performed, and with less liability to error, when the records relate to fields individually rather than to fields grouped for the purpose of one year's accounts under the title of a particular crop. The question is of some importance, and is dealt with again later (see p. 30). Men working with live stock (other than working horses) record their time according to the classification of stock adopted by the farmer for the purposes of cost calculation (for example, 'two hours milking, seven hours with sheep', or 'two hours milking, seven hours preparing food and feeding cows').

The Time-sheets when filled up record the time spent, whether ordinary time, overtime, or Sunday time, by men and horses in every department of the farm during one week. Provision is also made for entering up any piece-work performed, and by a summary at the foot of the sheet the cash due to each man for the week's work is shown.

The advent of the *Farm Tractor*, and the rapid extension of its use, makes it necessary to devise a means of recording the nature of the various classes of work performed by it, and the quantity of fuel, both petrol and oil, and of lubricants consumed by it during its operation. It is necessary to distinguish on the Record Form between the different operations, field-work, threshing, chaffing, barn-machinery work, and so on, as obviously the fuel consumption is by no means constant for all classes of work. Table VI shows a simple form on which to record the information required. It is ruled to provide for one week's work at sight, and is

TABLE V

CHILSWELL

TIME SHEET *For Week Ending* 24. October. 1919

Employee's Name .. A. Hewson .....

Sheet to be entered up every evening, and the exact time in hours to be charged to each separate job

Description of work and as far as possible amount done	Ordinary time	Weekday Overtime	Sunday Overtime	Piece work	Horses used	No. of field, or job where employed
1st day (Saturday)						
To Oxford for cake	5	4			2	feeding Stuffs
2nd day						
Feeding horses			2			
3rd day						
To Oxford for coal for engine	5				2	
Threshing wheat - 1919 crop	4					Stack-Yard
4th day						
Threshing wheat - 1919 crop	9					Stack-Yard
5th day						
Threshing wheat - 1919 crop	9					Stack-Yard
6th day						
Drilling winter oats	9					Field 19
7th day						
To Oxford for seed wheat	5					
Cleaning stables and harness	4					
Total	50	4	2			

Summary of amount paid (Wages and Piece Work):—

		£	s	d.
..... 50.	Hours ordinary time @	1	16	6
..... 4.	" weekday overtime @ 10d.		3	4
..... 2	" Sunday overtime @ 1/-		2	0
		2	1	10
	Piece work and extras			
		£ 2	1	10

self-explanatory. As with the man working with horses, so with the tractor driver, the time of the man must be entered on his Time-sheet against the work upon which the machine is engaged, and not against the tractor itself.

The next record necessarily kept on the farm is that of the *Live stock*, and the foods they consume. The information required is a weekly register of the various classes of live stock, with the numbers of each born and bought, died and sold, or transferred from one class to another during the week ; a statement of the foods consumed by each class, and a record of the place where the foods were fed—that is, whether on the land or in yards and buildings. To provide this information clearly and concisely a form has been prepared, and a copy is given as Table VII. Its use is fairly obvious. The only thing, probably, which calls for explanation is the provision of ' Transferred ' columns in the Live-stock register. These are to enable the farm accountant to keep track of the interchange of stock between the various classes. Thus, a heifer may be classed for feeding and costing purposes with ' dry ' cows one week, but having calved and come into the dairy herd during the week following the change is noted in the record by an entry against ' cows in milk ' in the ' transferred in ' column, and by a corresponding one against ' dry cows and heifers in calf ' in the ' transferred out ' column. The columns provided for the food-consumption record may be filled in either with the actual total weights of food used, or with a statement of the rations being fed ; in the latter case the weights must be multiplied out by the farm accountant.

Next, a record must be kept of the application of *Manures*, both farmyard and artificial, to the various fields. No special form need be used for this record—indeed, a mere note made on the Labour-sheet to the effect that the manure carting recorded on field so-and-so included so many loads, or that the men sowing artificials on such-and-such a pasture put on so many tons of fertilizer, is an excellent means by which to record these facts to ensure that they will not be overlooked, but the Stock Book (p. 16) method is the best

TABLE VI

.....Chilswell.....*Farm* *Week Ending*.....*19*.

PARTICULARS OF MATERIALS USED AND WORK DONE BY TRACTOR

	First Day	Second Day	Third Day	Fourth Day	Fifth Day	Sixth Day	Seventh Day	Weekly Summary
Quantity of paraffin in tank	6 galls.	5 galls	7 galls	5 galls	2 galls	Nil		
added	10 "	12 "	14 "	6 "	Nil	14 galls		
Total	16 "	17 "	21 "	11 "	2 galls	14 "		
" at end of day	5 "	7 "	5 "	2 "	Nil	4 "		Materials used:-
" of paraffin used	11 "	10	16 "	9	2 galls	10 "		58 galls. paraffin
" petrol used	1 pt	pt.	1 pt	1 pt	1 pt.	1 pt.		6 pts. petrol
" lubricating oil used	4 pts.	4 pts	6 pts.	4 pts	4 pts	4 pts.		3 galls. 2 pts. lubricating oil
								other materials
Particulars of work done:-								Work done:-
Nature of work	Ploughing	Ploughing	Ploughing	Ploughing	Ploughing	Ploughing		Ploughing - Field 17 - 12 acres
Field or yard	Field 17	Field 17	Field 17	Field 17	Field 1	Field 1		Field 1 - 3¾ "
Quantity of work done (as near as possible):-								15¾ "
Acreage ploughed etc.	3 acres	3 acres	4 acres	2 acres	¾ acre	3 acres		
Weight of roots cut								
hay chaffed								
(and kind of) straw chaffed								

Remarks :—

means by which to keep track of the distribution of artificial manure.

The only other record needed is one of *Receipts and Payments*. This, of course, is absolutely necessary, and it must include everything bought or sold for the farm, whilst excluding the farmer's private expenses. It is, in fact, a simple but complete cash account.

Nothing else need be required of a farmer co-operating with a research institution in the work of the determination of farming costs, or providing data for his own accountant, and the necessary information is so easily and simply provided on the particular forms suggested, or on something similar, that the returns should not occupy more than an hour or so in each week on farms where the number of men employed does not run above, say, a dozen. The objection urged against the system by critics on the score of time and trouble demanded is quite without foundation ; the Labour-sheet entails the most work, but this is nearly always reduced from the maximum theoretically required by the fact that a considerable proportion of the men will be found to have been engaged individually throughout the week on the same piece of work continuously, and one entry only, instead of six, is called for. Thus, however busy a man may be about his farm he cannot sustain the plea of having no time in which to put down the data necessary as a basis for the examination of his business organization.

It is a somewhat different matter when one turns to the analysis and elaboration of the farmer's data, and here, in all probability, he will always require assistance until such time as the provision of an office staff becomes recognized as an essential part of the equipment of every large farm. There is no reason at all why the farmer should not employ his own clerk, or an accountant in the nearest town, or why a group of farmers in one locality should not combine to employ a competent recorder between them. In other businesses of no greater magnitude than that of many farms it is not customary to dispense with all financial records, neither is it common for the head of the business

TABLE VII

LIVE STOCK REGISTER AND FEEDING-STUFFS CONSUMED

Chilswell Farm — Week Ended 24th October 1919

STOCK											FEEDING-STUFFS CONSUMED DURING WEEK						NAME OF FIELD OR YARD WHERE CONSUMED
Class of Stock	No. at beginning of week	No. born	No. bought	No. transferred in	Total	No. died	No. sold	Total died and sold	No. transferred out	No. at end of week	Hay lbs	Oats lbs	Offals lbs	Cotton Cake lbs	Barley lbs		
Work Horses	7									7	150	400					Stables and pastures
Colts	3									3		130					Pastures
Ewes	156						15			141							do
Rams	5						1			4							do.
Lambs	26						10			16							do.
Cows	26			1	27					27	140			560			do.
Heifers	13								1	12				84			do.
Bull	1									1	100			7			Boxes
Sow	1									1			35				do.
Fowls	45					1				44					20		

to act as his own accountant, and when farmers begin to assign to book-keeping something more nearly approaching to its proper value as being the only sure means by which to test and control their management, they will not grudge the comparatively trifling expenditure which will be called for in connexion with it. In the meantime those who are interested in the study and development of farm management might do well to consider if a joint effort could not be made by which the farmer would provide the data which the students of farm economics at the nearest agricultural research station would elaborate.

A few points of detail still remain for consideration before passing on to the question of the analysis of the records. These relate to the classification of the matter comprised in the records, so as to promote the accuracy of the final result. In describing the use of the Time-sheet it was stated that the record of the application of labour could be made either under the headings of the various crops, or of the various fields (p. 22). This statement calls for some elaboration. In working out the cost of the crops on a farm the most obvious thing is to allocate the expenditure of capital and labour on the land to accounts with crop titles, and as a matter of fact this is done not infrequently. Thus, the wheat fields constitute one account, the turnip fields another, the pastures a third, and so on, and all items of expense may be recorded with a view to their ultimate assembling under these various heads, to give the cost of production in every case. If the whole expenditure necessary to raise each crop began and ended within the year this arrangement might well be adopted, but unfortunately the determination of farming costs is not so simple a matter, and it will be found, in practice, that there are few crops which do not inherit some benefit from their predecessors, or which do not hand on some unexhausted value to their successors, all of which must be recorded. It is not impossible to keep track of such matters in an analysis of labour and of other expenditure based on the crops grown, but a basis of allocation more satisfactory is afforded by the

fields which grow the crops than by the crops themselves. It may happen that the barley crop of a farm is made up of fields on which it follows a variety of crops, such as roots and clover and wheat; and, in its turn, it may be succeeded by a variety of crops, such as clover, turnips, or a corn crop. Whilst it is not impossible in such a case to obtain a correct figure for the barley cost by means of a record based on the expenditure for the crop as a whole, it will be obvious that the liability to error would be reduced if the basis adopted were one of fields, for, in the absence of absolute uniformity in the rotation, the work of tracing values inherited or transmitted from crop to crop would be facilitated. Moreover, it happens frequently enough that at the time when the year's record-keeping begins the farmer's plans for the coming season's cropping are not definite, or, if arranged, it may be that circumstances unforeseen will compel some alteration in them. Thus, in the year 1919, many fields designed for the root crop on an East Midlands farm were never sown at all, owing to the drought, and the cost of all the workings on them, which would have been mixed up in the 'Roots Account' under a system of record based on crops, was readily transferred to the 'Fallows Account', under a system of field records, when it was found that the fields could not be cropped. Further, field records have a value of their own, for they facilitate the compilation of unit labour costs, both actual and comparative, and of other results which cannot be arrived at satisfactorily under the alternative system.

In the case of the farm live stock it is of equal importance to secure the proper classification in the records. It is not easy, sometimes, to arrange a division, say, of cattle, most suitable for the accounts which, at the same time, will fit in with the practice of feeding and management on the farm, particularly on small farms. It happens, not infrequently, that classes of live stock, the feeding and tending of which should be recorded separately for the purposes of cost determination, are not distinguished by the farmer. Probably his experience will one day confirm that of the

manufacturer, and the extra expense involved in the organization necessary for the compilation of complete records will be found to be more than repaid by the information acquired, but at present this stage has not been reached. On the other hand, it is of equal importance not to get involved in unnecessary detail. On a farm where the sole object of the management of the cattle is the production of milk it may fairly be said that the cost of raising calves to maintain the herd, and the cost of feeding-off old cows no longer profitable in the dairy, are both of them incidental to the milk production, and one record which includes the cost of feeding and tending calves, dairy cows, and fatting cows is all that is needed where the determination of the cost of milk is the only object. The account would be a composite one, including cost of calves, heifers, milking cows, and fatting cows, all of them contributing to the total cost of milk production.

One other difficulty which arises in the compilation of farm records is due to the partial failure, hitherto, to realize that agriculture is an industry as well as an art. No one would suggest that steel rails should be sold by the heap, or that tiles should be offered by the kiln-full, yet similar sale-units are the rule rather than the exception in agriculture. Hay is sold by the stack, potatoes change hands by the acre, and live-stock are bought and sold almost universally by the head. It is no answer to say that to the experienced farmer and dealer these conditions are no obstacle, owing to their ability to determine weights with reasonable accuracy by inspection, for this is not a fact. In 1916 a farmer of wide experience and sound judgement sold a stack of hay to a dealer at a price per ton, both of them agreeing as to an estimate of the weight of hay contained. Before delivery was taken the Army Purchasing Officer commandeered the hay, and, buying it by the actual weight at the same price as originally agreed, the farmer lost about £100 as compared with his first sale. Thus, an experienced farmer, and a dealer who was buying hay every day, both over-estimated the contents of the

stack by several tons. Probably dealers are more correct in their estimates, as a rule, than farmers, having greater opportunity for testing their judgements, but this is by the way, and leaving the question of relative loss and gain arising out of this slipshod method of marketing, the point for the moment is that the acquisition of knowledge of farming costs is impossible under it, and this alone should be sufficient to condemn it. In connexion with the analysis of the farm records used as examples in this volume, it has been found impossible to produce any figures for the unit weight of fat or of store cattle, of mangolds or of turnips, and the farmer will continue to be at a serious disadvantage in the control of his work until this disability is removed. As regards meat, the organization of public slaughterhouses, many of them owned and operated by farmers themselves on co-operative principles, which has been developed during the war in many places, should facilitate the preparation of meat costs in the future.

With the records of the distribution of capital, of the expenditure of labour, of sales and purchases, and of the weight of products realized, all noted in a form as complete as may be, the work of analysis next calls for consideration. The Time-sheet figures are transferred to a Labour Analysis-sheet, a copy of which is printed here as Table VIII. It consists of sets of columns, each set headed with the title of an account or of a department of the farm. At the beginning of each line is the name of the man whose time is analysed on it, and then, by inspection of his work during the week as recorded on his Time-sheet, an analysis is made, and the work in the different departments is recorded in hours in the case of day-work, and in money in the case of piece-work. The record of hours of horse-work begun in the Time-sheet is continued also in the Analysis-sheet, a column headed 'Horses' being attached to each set of columns for the purpose. The man-hours and the horse-hours in each department are cast up week by week, and by dividing the total number of hours at the end of the year into the total cost of labour and of horse-keep, the cost of

a man-hour and of a horse-hour is found, and the labour costs thus arrived at, both manual and horse, are posted to the departmental ledger accounts.

In arriving at this flat rate for labour certain precautions are necessary. The wage-rates of adult workers vary considerably with the nature of their employment, and if all of them are combined together it may result in the undue reduction of the real cost of one or more departments at the expense of others. In the first place, therefore, all piece-work should be charged direct to the department in which it is applied. Secondly, the wages of special men engaged whole-time in particular occupations should be eliminated from the flat-rate calculation; thus, the bailiff's wages may be charged direct to the Establishment Account (see p. 53), the shepherd's to the sheep, and so on. Thirdly, where boys and women are customarily employed their time should be recorded on the Analysis-sheets separately from that of the men by grouping the latter at the head of the sheet, and the former at its foot. Separate records, both of time and money, for each group will thus allow of the calculation, at the end of the year, of separate unit time-rates, and the cost of a 'man-hour' and of a 'boy-hour' can be found at which to price the work done by men and boys respectively in any department.

Coming to the Live Stock and Foods record, all foods are debited as bought, in the first instance, to a Foods Account, and then by means of the food-consumption record the quantities and prices of bought foods are worked out, and also the value of the food-residues as given in Voelcker and Hall's or some other recognized tables (modified, as may be needed, to bring them into accord with present values). Thus, the charge against the stock is arrived at, and also that against the manure. It is in this connexion that the value arises of the record of the place where consumed, i.e. 'field or yard'. If consumed on the field, the value of the residue is charged against that field; if consumed in yards, the value is charged against the farmyard manure account. Home-grown foods are priced at their

TABLE VIII

Chilswell Farm, *Labour Analysis for week ended* 24th October 1919

Account:—	Feeding Stuffs					Horses					Wheat 1919					Field 19					Wheat 1920																										
Man's Name	Man Hours	Horse Hours	Piece Work			Man Hours	Horse Hours	Piece Work			Man Hours	Horse Hours	Piece Work			Man Hours	Horse Hours	Piece Work			Man Hours	Horse Hours	Piece Work			Man Hours	Horse Hours	Piece Work			Man Hours	Horse Hours	Piece Work			Man Hours	Horse Hours	Piece Work			Total Man Hours	Total Cost Hour Work			Total Cost Piece Work, etc.		
			£	s	d.			£	s	d			£	s.	d.			£	s.	d.			£	s.	d.			£	s.	d			£	s.	d			£	s	d.		£	s.	d	£	s.	d
A Hewson	9	18				6					27	10				9	18				5	5																			56	2	1	10			
(and so on for all men and horses employed during the week.)																																															

cost to the farmer.[1] Sometimes the cost cannot be determined until the end of the year, and then it is only necessary to calculate weights, and carry these on until prices can be assigned to them. Judgement can be exercised in avoiding unnecessary calculations. For example, although it is very desirable to be able to work out the cost of growing a ton of turnips it is not necessary to try to estimate the weight of roots consumed by sheep folded on turnips, and to multiply it out, week by week, by the number of head, and then to price it at the cost per ton. If the sheep consume the whole of the crop, or the whole of the crop in any particular field or fields, it will be necessary only to refer to the cost of the whole crop, as worked out in the field accounts in the ledger, or of that part consumed by the sheep, and then to charge it against them by one entry. Analytical accounting makes sufficient work without the undertaking of more than that which will be productive of useful knowledge.

The analysis of other cash payments involves no special machinery. Tradesmen's bills can be split up in the cash-book or purchase day-book where necessary, and the component parts carried to the respective departmental accounts. Or, in particular cases, as for example, bought foods and manures, it may be more convenient to debit a ledger account with the whole item and charge it out by piecemeal with the aid of the Stock Book. (See p. 16.)

[1] This involved a question of principle which is discussed on p. 43.

CHAPTER III

QUESTIONS OF PRINCIPLE

In view of the extension of the work of investigating farming costs in the United Kingdom it is very important to secure uniformity of method and general agreement on certain questions of principle, so far as is possible. In no other way can a proper basis of comparison be established, and standard results achieved. Reference has been made already to the wide divergences of opinion on vital questions exhibited in the work of continental and American investigators, and an effort should be made, while this field of research is still practically unexplored in this country, to bring about a general agreement on essentials. In this chapter some of these questions are raised, less, it should be remarked, with the object of answering them than with that of initiating the consideration and discussion of them.

Valuation. In making valuations of goods produced on the farm the basis must be, in every case, the cost of production of the matter concerned. Under no circumstances must the market price be allowed to exert any influence, or serious misconceptions may result. The worth of any article to the farmer is the amount which it has cost him to produce it, and the time to introduce the market value into the account is at the moment when it is sold, and not until then, so that the farmer may be in a position to make a comparison between the value to him, as shown by his books, and the value on the market as shown by the price realized. Thus he is able at once to appreciate the results of his management. If market values are introduced at intermediate stages in the process of production the whole basis of comparison is lost, and thus the farmer is deprived of the only reliable means by which to estimate the success of his policy, and by which to determine his future actions.

The common practice of basing farm valuations upon

market prices is an illustration of the misconception of facts which may arise, in connexion with farm management, owing to the absence of proper records. A valuation of live and dead stock and of tenant-right may be needed, and there are no figures on the farm from which to extract it. An inventory is easily made, and when it becomes necessary to assign a price to each of the items composing it the obvious and natural thing is to apply the only known values, namely, those current at the time in the market, regardless of the fact that these represent that which the articles are worth to other people rather than their value to the individual most concerned. Indeed, in the absence of accounts it is almost impossible to make a valuation except on the basis of market prices, for these, at least, can be ascertained and applied, whereas there is nothing to indicate to the farmer what his actual outlay has been on the various subjects of the valuation. Where an adequate system of records exists, the process of valuation is quite mechanical. The departmental accounts will show, at the moment when the valuation is to be made, the cost of every item at that date, and this cost is the measure of their value to the farmer. If the cost proves subsequently to be above the market value, the farmer makes a loss on his product ; if it be below the market price he makes a profit. In the former case he will review the figures, and the circumstances attending the production, to determine whether the loss is due to causes beyond his control which are not likely to recur, or whether the probability of a repetition makes it undesirable to continue along this particular line ; in the latter case he can contrast one profitable venture with another with the object of narrowing down his system of management, so as to concentrate his efforts on those which are most profitable with a view to developing them still further by a reduction of the unit cost.

It is of importance to remember that an unusually high final cost may be due to the use by the farmer of home-grown products at a higher price than that at which their equivalent could have been purchased in the market. In

an unsatisfactory wheat-cost the fault may be found to lie in the cost of farm-yard manure, and it may be proved that an equivalent of manurial value could have been purchased at a lower figure. Thus, the real fact that emerges is not that wheat-growing is unremunerative, but that farm-yard manure is too expensively produced. It is with the desire to show the loss where it really occurs that many accountants adopt a system of valuation at 'cost or market value whichever be the lower', and the prices at which raw materials are transferred from one account to another are written down from costs to market values where the latter are lower. Thus, they get a guide to the directions in which substitution of purchased materials for home-produced may be profitable. The motor manufacturer may find that owing to specialization in production of certain parts by other firms, he can buy them at a lower cost than that at which they are produced in his own factory, but on the farm the possibility of the substitution of similar products is less common. Thus, though it may be shown that bought mineral manures are cheaper than home-made dung, or that maize may be substituted for home-grown oats, with advantage, it would not be desirable to introduce any valuation figures into the manure or the oats accounts based on the market prices of mineral fertilizers or maize, respectively, in substitution for the cost valuation indicated by the accounts, though final product-costs must be analysed with care in order that their true meaning may be disclosed.

In all farm accounts, then, whilst it is most important always to watch the cost of home-grown raw materials in comparison with that of purchasable substitutes, the basis of valuation must be the cost price in every case. The application of this principle, however, raises certain problems which call for further consideration and discussion amongst investigators before it can be assumed that the most satisfactory solutions have been found. What, for example, is the cost of a new-born animal? In the case of a foal it might be said to be represented by the stud fee, the foaling risk insurance (if any), and the cost of food and attendance

for the mare for the period during which she is not at work ; calves from a dairy herd maintained for milk production for direct sale, or for cheese-making, may fairly be treated as by-products. Milk is the object of production and milk cannot be produced without the calf, so service fees, or the cost of maintaining the bull, as well as the cost of the cow whilst dry, are charges against milk, not against the calf. The calf is accordingly taken as costing nothing at birth, and it is only necessary to take steps to record against it the cost of food and labour employed in its subsequent maintenance. Calves from a non-dairy herd, and lambs, cannot be treated in this way, for they are in no sense by-products but are themselves the main objects of the management of the herd or flock respectively. Just as, therefore, the cost of maintaining the dairy herd, in the former case, gives the cost of the milk produced, so in the latter case, that is, the non-dairy herd or the ewe flock, the cost of the herd or flock represents the cost of the young stock or lambs raised. If this point of view be accepted it is then an ordinary routine matter to calculate the subsequent cost of the young animal, year by year, until it is sold as a store or fat to the butcher, until it is taken into the breeding stud, herd, or flock, or until, in the case of horses, it is sold or put to work on the farm. Those animals retained on the farm for breeding purposes or for work should be valued thereafter at the total cost of bringing them up to that stage, and no more. Thus, if a heifer has cost, say, £28 to keep up to the time of her first calf, she will be valued so long as she remains in the herd at this figure, and a young horse that has cost, say, £45 up to the time when it is broken for work will stand in the books at this price thereafter—less the annual deduction for depreciation calculated upon its probable life. These are the sums that it has cost the farmer to bring these animals to a productive stage. The further expense of maintaining them year by year is not an addition to the cost of the animals, but represents the cost, to the farmer, of their produce, whether it be work done, as in the case of horses ; milk and calves, as in the case of cattle ; or

lambs and wool, as in the case of sheep. Thus, the breeding animals on a farm are valued year by year at a constant figure of so much per head, representing their cost to the farmer at the earliest productive stage. A little experience will tell the farmer what that cost is, under normal circumstances, and will enable him to apply an average figure to all animals in the same category. Under no circumstances whatever must the market value at the date of the valuation be allowed to obtrude itself. To introduce market values robs the figures entirely of their use, for it is impossible, thereafter, for the farmer to make the comparison necessary from time to time to decide him in the matter of the sale or retention of any individual or group of individuals in his flocks and herds. With their costs before him a familiarity with the trend of the market will enable him to consider the advantages of either course, but if once the true facts of his own experience, as revealed in his books, give place to values assigned by others as applicable to their own purposes, all basis for the comparison is lost.

Moreover, valuation of live stock on the basis of market values at the time will confuse the farmer by the introduction of paper profits and paper losses into his results. Farm management is not subject, usually, to violent or sudden changes, whereas markets are apt to experience considerable fluctuations. In the case of breeding stock, particularly, which is not shortly to be realized, the fluctuations of the market introduced into the account may bring about startling results. A shortage of keep at home, or the closing of foreign ports, may bring about a fall in prices sufficient to turn a profitable year into one, apparently, of serious loss if these prices are employed as a basis for valuation of stock which is not for sale ; similarly, a temporary inflation of market values from any cause might lead the farmer to unwarranted optimism regarding his financial position. It follows that in valuing home-produced stock no account must be taken of ' pedigree ' value. Pedigree value is essentially a market value, not a cost value, and anything may happen to make it of no value at all. A colt with

a pedigree back to *Eclipse* may prove of no more worth than to pull a greengrocer's cart ; a heifer with a splendid milk pedigree proves, not infrequently, to be of no special value at the pail, and even though it be otherwise, an accident, or an outbreak of disease, may wipe off the whole of the value due to long pedigree in a few minutes. There must be no departure under any circumstances from the principle of valuation at the cost of production ; on no other basis will the farmer's accounts act as an index of the success or otherwise of his management. On these principles the process of valuation, in an established system of farm accounts, is in fact, the ascertainment of cost results, and the value placed upon any item in the valuation is the ascertained cost at that date, or the cost less depreciation in certain cases.

In the case of *purchased* pedigree stock the principles of valuation suggested here seem to contradict themselves, in that if the cost to the farmer is to be followed then pedigree value must be recognized. The difficulty is more apparent than real, for in purchasing pedigree stock the farmer is really buying two things, and the purchase price is resolvable into two parts : (1) the cost of the animal as one of its class ; (2) its additional cost arising from its pedigree. Having regard to the disparity in the prices paid for pedigree as compared with ordinary or market stock, not only is it the right course, but as a matter of prudence it is the necessary course, to split the total value, as marked by price, into the cost of the animal as stock of normal class at ordinary prices, and its additional cost as stock of an abnormal or pedigree class. The former, which should in most cases be calculated by weighing, will be charged against the particular live stock account to which the animal properly belongs, and the latter will be debited to a 'Pedigree-value' account. If the purchased pedigree stock is retained for service on the farm, and is thus decreasing in value, a proportionate part of the pedigree value should be written off each year. If the animal is sold at any time at less than the combined costs at which it appears in the ordinary stock

account and in the Pedigree-value account, the amount of the deficiency should also be written off in the year's Profit and Loss account, and similarly, if a higher price than the combined costs were realized the difference would be treated as profit. If by disease or accident the value of purchased pedigree stock is reduced, the Pedigree-value account should be reduced to correspond, or should be entirely written off if necessary.[1]

Valuation of Intermediate Products. The need for accurate analytical accounting is evidenced in nothing, perhaps, so much as in the confusion of thought which prevails on the question of the valuation of the raw materials grown on the farm, the hay, straw, roots, pasturage, &c., produced for home consumption in the process of manufacturing milk and meat. There is only one possible basis of value, namely, the cost to the farmer, but, just as happens in other valuations, the fact of there being no records of cost drives the farmer too often to use other figures, and the market value, or in rare cases figures got by a scientific calculation, such as the application of the starch equivalent method, are substituted for the sum which the farmer has actually paid.[2] As a matter of fact, the bulky feeding-stuffs usually produced and consumed at home rarely have any market value at all. A market value is one that can be realized in the market. Thus, corn, meat, and certain other commodities have clearly market value because they are always saleable, but if all the farmers in the country decided to sell their mangolds they would find that the market for mangolds is non-existent, and that the prices quoted in market reports repre-

[1] A Pedigree-value account has some analogy to Goodwill account, though it is suggested that a closer comparison could be established with Patent Rights account as being exposed to greater vicissitude than Goodwill.

[2] The almost continuous newspaper controversy of the past few years upon the increased cost of food-production has shown how universal is this misconception of facts. All the writers make such assertions as that their horse labour costs them double what it did, because oats are selling for twice as much as they used to do, or that as hay has doubled in price the milk their cows produce is so much the more costly. This is as much as to say that if a man secures an 8 per cent. investment by buying a 4 per cent. stock at 50, he is only getting 4 per cent. on his money if the stock rises subsequently to par.

sent a few deals to satisfy an infinitesimal demand. The same is true of straw, and, in a slightly less degree, of hay in normal times.

Even if the difficulty of fixing the market prices of certain products, such as turnips, or even hay, be ignored, and if it be assumed that there be a free market in such things, a fuller consideration of what the farmer really does in feeding them to his stock will show how inapplicable such values are to his case. The market value of an article is the figure at which a willing buyer and a willing seller can agree to do business. The farmer who contends that he is justified in 'selling' his roots or hay to his stock is selling them, in point of fact, to himself, and seeing that there is only one party to the transaction there can be no market, and consequently no market price. In the majority of cases each of these things is grown because the farmer has need of them in the production of the article or articles of food towards which his management is directed. If he could buy them more cheaply than he can grow them he would surely do so, but to regard himself as a merchant instead of as a manufacturer, and then to trade with one department of his farm against another is to involve himself in paper transactions which have no foundation in fact, and which may lead to disastrous conclusions. Some years ago a well-known firm of manure manufacturers found themselves handicapped in the production of superphosphate by the high price of sulphuric acid. To meet this they decided to put down a sulphuric acid plant, and found that the cost of their 'super' was immediately reduced. Had they followed the principle of valuing the acid at its market value their superphosphate would still have appeared to be an unproductive line, and the only conclusion to be drawn from their books would have been that they should give up manure manufacturing and concentrate their efforts on the production of acid, for which, probably, they would have had no sale. The same argument holds good in the case, so often quoted, of the price of hay and the cost of milk. It may well be that in consequence of a temporary or of

a local demand it will pay a farmer better to sell hay rather than to produce milk, and one of the main functions of book-keeping is to enable him to make a decision on such points as this. But he cannot expect to have it both ways ; if he sells hay he cannot produce milk, and vice versa. Many farmers contract at summer prices for their winter's supply of feeding-stuffs, but a man who has bought linseed cake at a pound per ton less than the price current at the time when he is consuming it would hardly think of charging it to bullocks at any other price than that which he actually paid, and it is this figure, the actual cost to him, which must be the measure of the value of *all* raw materials, whether they be bought in the market, or whether, for the sake of convenience and economy, they be grown on the farm.

The mistake of valuing crops consumed on the farm at their supposed market value instead of at cost price is so generally made[1] as to call for the fullest discussion and consideration by those engaged in cost determinations. It arises partly, no doubt, from a want of clear thinking on the question of what is the cost of an article, but mainly from the lack of adequate records on the farm. In the absence of information as to what he has paid for his hay or for his roots in the process of their production the farmer turns once again to the market in order to fix their value, and the market price of hay at the present time, when a crop costing probably some 80*s*. per ton to produce will sell readily for £12,[2] is an indication of the magnitude of the error which this system of valuation may introduce.

A difficulty which presents itself in this connexion is that of how to value the parts of a crop produced simultaneously by the same expenditure of capital and labour, but used separately. For example, how is the cost of a wheat crop to be divided between the grain and the straw? The practice advocated in the earlier edition of this book

[1] See, for example, G. F. Warren in *Farm Management*, p. 55, where he refers to the ' absurd practice of some institutions of charging feed to animals at the cost of producing it rather than what it can be sold for, less the cost of marketing '.

[2] 1919.

was to base this division upon a comparison of the market values of the two products, the justification suggested for this course being that in a prairie country, where the straw is usually burnt, as being worthless, the whole cost of the crop will be borne by the corn, and if it were possible to find a locality, or a crop (flax is sometimes a case in point) where the straw alone is utilized, the total cost would be chargeable against the straw. Between these extremes it was suggested that the cost should be shared between the two commodities according to their relative market values. One objection to this principle is the fact that one of the components may have no real market value, and the division of cost has then an unsubstantial basis. This is certainly the case, for example, with barley and barley straw, for there is no market in the latter, and it is probably true equally with other crops. Another division has been suggested, based on a comparison of the food values of the two parts of the crop. On an East Midland farm where a total crop-cost of £5 6*s*. 10*d*. per acre was incurred in the year 1915 to produce 3·9 quarters of barley and 1·5 cwt. of barley straw, a division of cost was made on the basis of a market value of £2 per quarter for barley and £1 per ton for the straw. This brought the cost of growing the barley to £1 4*s*. 6*d*. per quarter, and of the straw to 14*s*. 5*d*. per ton. But when the comparison was made on the basis of feeding value, calculated by the starch-equivalent method of Kellner, the cost of the corn was about 18*s*. per quarter and of the straw about 47*s*. per ton, regarding the former as a production food, and the latter as a maintenance food, or about 21*s*. per quarter and 28*s*. per ton if both were regarded as production foods. These divergences suggested an urgent need for further consideration of the matter, and the practice now adopted at Oxford is to charge the whole cost of production against the principal object of production, treating the secondary product as a by-product and assigning no part of the cost to it. Thus, straw and wool are taken as having no cost; they are charged only with any labour-cost incurred in handling them, and any

sales go merely to increase the profit (or to reduce the loss) on the primary product, i. e. corn and mutton.[1]

The Cost of Horse Labour. Where the farm horses are regarded solely as a source of motive power no difficulties of principle are involved. The animals are valued at their cost price, whether they are home-bred or bought, and the depreciation, calculated on their probable length of life added to the expense of feeding or otherwise maintaining the horses, represents the cost of their work for the year. Where the farmer is a breeder of horses for sale, or a dealer, these are businesses quite distinct from the performance of horse labour, and special provision is necessary to prevent the partial obscuration of the actual costs of his horse labour. This is made by having two accounts for horses, a 'Stock' account and a 'Working' account. The stock account is simply a debtor and creditor account of horses on hand, bred, bought and sold, together with the cost of feeding and maintaining brood mares and young stock not at work on the farm. The balance represents the farmer's profit or loss on his year's breeding or dealing. The working account is composed solely of the cost of maintaining those horses which are worked on the farm. Maintenance includes food, shoeing, &c., and also a charge for depreciation debited to this account, and credited to the 'stock' account for the use, so to speak, of the working horses. Even though the horses be all of them young ones, appreciating in value instead of depreciating, this charge must be made, otherwise the profit due to the farmer for his skill in the management of his horse stock, as evinced by his keeping only young horses increasing year by year in market value, will not appear as such, but will go fictitiously to reduce the cost of the horse-work. Obviously the cost of ploughing an acre should be the same whether performed by young horses or old ones, other things being equal. The actual amount to be charged for depreciation depends upon the cost of the horse stock and its effective life duration. For example, the depreciation of horses costing £75 at the date of coming

[1] See also p. 39, *ante*.

into use on the farm, with an estimated effective life of fifteen years, is £5 per annum.

Depreciation of the Farm Tractor and its allocation is a matter which still requires investigation before any clear rule can be laid down. There are as yet no data as to the life of the various makes of tractor now on the market upon which to base a charge for depreciation. It will be wise to assume that the effective life of all of them is short, and until more exact information is forthcoming, to write off the cost over a short term, say five years. Allocation of depreciation must also be the subject of further consideration, but in the meantime the most obvious course is to apportion it on the basis of fuel consumption ; a light load accompanied by a relatively low rate of fuel consumption may not unreasonably be supposed to induce a corresponding rate of wear and tear, but there may be other factors involved, such as the relative effect of stationary and locomotive working under equal loads. These are matters about which nothing is known at present, and the fuel consumption basis of allocation may serve until a better can be substituted.

Manurial and Food Residues. In calculating the value of these items the basis, once again, must be the cost. The principle is to take the initial food cost, and to depreciate it according to the methods laid down by agricultural chemists. (See, for example, the tables of Lawes and Gilbert, as revised by Voelcker and Hall.) The fact that the conditions of making and storing farm-yard manure, and that the influence of atmospheric and soil conditions upon the effect and duration of it and of artificial manures too may produce wide differences in their action is inevitable, but no better principle has been devised, though chemists differ amongst themselves as to figures. It may be noted that whereas in an outgoing valuation the valuer for the landlord (or incomer) may justifiably claim to substitute the price at which the manures or foods could have been purchased for that at which they were actually bought, and this, indeed, is commonly done, the farmer keeping records of his transactions must not depart from his own

experience, but must start from the actual cost to him of the materials concerned, however disadvantageously they may have been acquired.

The Distribution of the Cost of Cleaning Land. The fact that the effect of certain manures endures beyond the removal of the crop to which they have been applied has long received recognition, not only in theory but also in practice, for it is the custom of agricultural valuers to allow two years before the residues from purchased foods are held to be exhausted, whilst to certain manures an even longer duration of effect is allowed. In the same way the duration of other improvements beyond the year in which they are effected is recognized. These matters afford a precedent for an attempt to distribute the cost of cleaning the land as performed at the time of fallowing, or before and during the growth of the root crop, over all the crops which intervene until this operation falls due to be done again. The simplest case is that of the bare fallow. The land has grown a rotation of crops, ending with a corn crop, and it is too dirty to be cropped again until it has been fallowed. Whether this be cheap or costly will depend very largely upon the season, but wet or fine there will be a considerable expenditure of labour and a year's rent and rates from which the farmer will reap no return in the form of a crop. It is not unusual to put all this outlay to the charge of the following wheat crop, and the cost of 'wheat after bare fallow' may amount to a very large figure, in an outgoing valuation. As a matter of fact it is not justifiable to look upon the fallowing expenses as being the cost of work necessary to grow the wheat crop alone, for all the crops following in the rotation will benefit by it, and a division of the total cost should be made between all the crops accordingly. The same case arises when fallow crops replace the bare fallow in the system of management, with the difference that here a distinction must be drawn between work done as being necessary to secure the crop, and that which is performed only to clean the land.

In either case a certain figure is found which represents

the cost of cleaning the land for the next succession of crops. As to the division of the cost between them, only an arbitrary basis has been found possible hitherto. The charge may be divided equally between the crops, that is to say, in a four course rotation 75 per cent. of the cleaning cost would be carried forward from the first crop, 50 per cent. from the second, 25 per cent. from the third, and nothing from the fourth. (See A.) Or it may be argued that the first crop will derive a much larger benefit from the cleaning operations than the subsequent ones, and the basis of distribution adopted by the author, and employed in the illustrations of farming costs appended, is that of charging 50 per cent. of the total cleaning cost to the first crop, 50 per cent. of the remainder (i. e. 25 per cent. of the total) to the second crop, and to divide the residue equally between the last two crops (i. e. 12½ per cent. each). (See B.) By experiment upon the farm it would be a fairly simple matter to determine the actual respective shares of each crop in the rotation in the cleaning benefit; in the absence of this information the second of the above principles may be preferred to the first.

DIVISION OF THE COST OF CLEANING LAND OVER THE CROPS IN A FOUR-COURSE ROTATION

Method A.			*Method B.*		
Crops following cleaning.	*% of total cost charged.*	*% of total cost carried forward.*	*Crops following cleaning.*	*% of total cost charged.*	*% of total cost carried forward.*
First	25	75	First	50	50
Second	25	50	Second	25	25
Third	25	25	Third	12½	12½
Fourth	25	—	Fourth	12½	—
	100			100	

It may be pointed out that the necessity for apportioning the cost of this work is quite independent of its actual advantage to the land. After a wet and difficult season, which leaves the land almost as dirty as it was at the beginning, a tenant-right valuer may well contend that nothing is due to an outgoing tenant under this head, on the ground that no benefit to the incomer has accrued from the work.

But this argument does not concern the farmer who is farming by his books, to whom a knowledge of costs is essential; once more it is the cost incurred that he must know, and the value, or otherwise, of the work will be revealed when he comes to market the crops, a part of the charge for which is represented by the expenditure upon the attempt to clean the land which grew them.

In connexion with the fallow crop it is a question whether rents and rates ought not to be included with the unexhausted cleaning costs, and carried forward for distribution over the rotation. This, of course, is what is done where land is bare-fallowed; and having regard to the nature of the fallow crop, that is to say, that it is a crop introduced, in the main, to make the bare fallow less of a dead loss, it might be proper to relieve it of this charge, or anyhow of some part of it. The practice of the writer is to include rent and rates in the cost of the crop. This process of carrying forward cleaning costs incurred on fallows, whether bare or cropped, for distribution over all the crops which follow until the fallow comes round again is a laborious one. Moreover, the distribution of the items between succeeding crops rests upon an arbitrary basis, for no one can foretell the measure of the benefit which may be expected to accrue to each. At the same time some apportionment must be attempted for the reasons already stated. It has been suggested, however, that in certain cases much of the work may be avoided without any loss of accuracy in the result. Where a clearly defined rotation is followed on the farm, and where the annual acreage assigned to each crop in it is virtually the same, there is no gain in carrying forward the costs of cleaning land and writing them off over the rotation, for the same result may be secured by distributing them over the crops of the same year. It is true that a fallow made in any year cannot benefit the crops of that year, but assuming the conditions of farming indicated above, together with stable conditions in the labour market, the costs of the fallow in any one year will approximate closely to those of any other year, so that there is no reason why, for simplifica-

tion of book-keeping, they should not be apportioned to the crops of that year. This is the suggestion; the objections to it are that it is not always possible to adhere rigidly to a rotation, that the acreages under the various crops of the rotation are seldom equal, that labour costs are varying from year to year at the present time, and that even where none of these difficulties arise the cost of a fallow in any year depends upon the weather, and the number of workings consequently necessary, which will seldom be the same in any two years. It may thus happen that the crops in a drought year following a wet year will carry a very small item for their share of fallows easily and cheaply performed, whereas they should more accurately be saddled with the expenses of a wet and difficult season. However, cases may arise where the method might be applied, and the simplification of the work which would result makes it worthy of mention.

Another suggestion may be noted which is designed to eliminate the arbitrary apportionment of cleaning costs and at the same time to reduce the labour of book-keeping and to bring the work more within the scope of the farmer. It is that no costing for arable fields or crops should be attempted, but that one 'Arable-land Account' should be opened for them all. Thus, the arable land would be regarded as a single department, and the total debits against it would give the cost of the arable farming for the year, as a whole, whilst the debits less credits would be the total net profit. The advantages of this proposal are obvious; it may be argued that the difficulty of costing with accuracy for crops is such that the whole rotation should be regarded as the unit, and that it should be costed for as a whole, and if this were done there would be an immense simplification in the accounting. Further, that the loss of information which would result as to the cost of particular crops would not be a vital objection seeing that these costs contain certain speculative elements. That these last are liable to introduce errors of sufficient magnitude seriously to affect the results cannot be admitted, but the real objection to

this suggested simplification of farm costing is that it deprives the farmer of all basis for valuing his produce. A man producing milk knows the cost of all his arable crops collectively, but how can he arrive at the cost of mangolds, or of clover-hay, or of cabbages, or of any other arable crops used in milk-production, and consequently at the cost of the milk itself ? The method drives the farmer to guess at costs for which a more accurate basis is necessary, and this is a very serious objection. At the same time it is a method which might prove useful in education as an introduction to more intensive methods, whilst there may also be not a few farms where the whole of the produce of the arable land is consumed at home, on which one cost figure for all arable crops collectively would be all that was required for accurate costing work.

On-cost and Establishment Charges. No matter how carefully the analysis and distribution of expenses may be effected, there will always be certain items which cannot be apportioned or assigned directly to any account. Such matters as lost time, the foreman's or bailiff's wages, repair of roads, fences, &c., keep of the farmer's nag-horses or motor, these and similar things are part of the cost of production, but they cannot be allocated at the time of payment to any department or departments. At one time it was not customary, in industry, to take account of these things in cost determinations, but they were carried to the debit of the profit and loss account. It is now almost universally recognized that, although this method had simplicity in its favour, ' an efficient check upon the indirect expenses can only be obtained by establishing a relation between the direct and indirect expenses ',[1] and the indirect costs must be collected into an account the balance of which is distributed over the accounts of the productive branches of the enterprise. The basis of the distribution is various. In some concerns this balance is divided in proportion to the amount expended on labour, or on materials ; in others, in proportion to the labour and materials ; in others, again, where

[1] Garcke and Fells, *op. cit.*, p. 89.

the quality of the labour may vary very much in different branches, and with it the amount paid in wages, the time during which the labour is employed is adopted as the basis rather than the amount of wages. In farming the fluctuations in the quality of labour used in the departments of the farm are generally very slight, and the principle of distribution of general expenses adopted in the examples given later is that of a percentage on the labour of all kinds, that is on manual, horse, and tractor labour together, the assumption being that the department which has had the greatest expenditure on it of labour has benefited to the greatest extent by the general expenditure.[1]

On the farm establishment expenses as distinguished from on-cost are very few. Clerical assistance employed is usually *nil*, and not infrequently there is scarcely any other item of any magnitude. Messrs. Garcke and Fells point out that whereas establishment expenses are most certainly elements in the cost of production, yet in industry they are more properly left out of calculations of cost price. 'A large increase in the value of orders received would not necessitate a like augmentation of the office staff, nor would a sudden and serious falling-off in trade enable a firm to effect an immediate or proportionate reduction of general expenditure.'[2] In agriculture, however, there is not this dependence upon orders, and the fluctuations in manufacturing costs due to the changes in the cost of labour are also very little felt in normal times. Thus, there is not the objection to the inclusion of establishment charges in the cost price of farm products which arises in the case of factory products, and on-costs and general establishment expenses may well be included in one account in the books, and distributed together over the productive branches of the farm. Only the productive accounts are concerned in this apportionment,

[1] In the first edition of this volume a distribution on the basis of labour *and materials* was advocated, and this method was used in the illustrations given. Further consideration has led to adoption of the cost of labour alone, as it appeared not infrequently that certain heavy charges for material (i. e. stock bought in) had, quite obviously, no direct connexion with the charge for on-cost.

[2] *Op. cit.*, p. 93.

because the balances of all other accounts are themselves distributed over the production accounts in due course.

Rent. In the sense in which the term is used by economists rent is not an element of cost, for it represents nothing more than the measure of the value of production due to variations in situation and to the inherent capabilities of different soils. 'Rent is due to differences in the productivity of different pieces of land, the users of which are working for the same market, differences over which the owners have no control. From this the corollary is drawn that rent does not enter into the cost of production. Corn, in Ricardo's words, is not high because a rent is paid but a rent is paid because corn is high.'[1] This theory of rent is interesting as an economic conception which in certain special cases may even have a practical application, but to the English farmer in most places it is merely an abstraction, and to give the term the peculiar limitations assigned to it by economists and then to say that rent does not enter into cost of production is to create a set of conditions having no existence in fact on most of the farms of this country. The rent paid by the farmer has little or nothing to do with the inherent capabilities of the soil except in particular cases which do not bulk large in the agriculture of the country as a whole, for it represents nothing more than a certain return to the originator of the enterprise, or his successors, on the cost incurred in bringing virgin soil into a condition precedent to the production of food and other agricultural produce. If we imagine a tract of unreclaimed wild in an average agricultural district its rental value, both 'economic' and actual, is virtually *nil*, and it can only be brought into a rent-earning condition by the application of capital.[2] Rent paid by the farmer is the interest which

[1] Clay, H., *Economics*, p. 356.

[2] In fact, there is no need to exercise the imagination, for a case can be cited of virgin soil in the heart of England, surrounded by reclaimed land letting at some two pounds per acre, and within reach of transport facilities and markets as good as any in the kingdom, which has been handed over for a term of years at a peppercorn rent to an enterprising individual who is prepared to sink capital in the work necessary to make it available for food production.

the capitalist expects to get as an inducement to him to invest money in draining, enclosing, road-making, erection of houses and buildings, and in other works of reclamation and equipment necessary to turn virgin soil into farm lands. It is true that farms created at equal unit cost in the past may let to-day at different unit rentals, but this is not necesssarily to say that those commanding higher annual values include in this value an element of rent as defined by economists; rather does it mean that those letting at the lower figures are giving to the capitalist a lesser reward for his enterprise.[1]

It follows that rent paid by the farmer, except in particular and relatively unimportant cases, *is* an element in the cost of production, and must be included in cost determinations. There seems to be no common agreement as to the method of its distribution over the farm, but if it be accepted that rent represents some return on the cost of reclamation and equipment and nothing more, it is obvious that it should be divided over the farm upon an acreage basis. It may be permissible to make deductions from the total rent of items estimated to represent the rent of the farm-house and the rent of the cottages, charging the former to the Establishment Account (see p. 53) and the latter to the Labour Account, and then distributing the balance over the land, but the attempts which are sometimes made to divide the rent between buildings and land and then to subdivide these two amounts between particular buildings and particular fields is an impossible task, and moreover it

[1] From an inquiry undertaken by the Land Agents' Society in the year 1909 it appeared that about 30 per cent. of the farmers' rent payment had to be expended by the landlord on management and repairs for the maintenance of the rent. This figure was the average of several years, and is made up approximately as follows:

Repairs	20 per cent.
New works necessary to maintain rents	3 ,,
Management and legal fees	6 ,,
Insurance	1 ,,
	30 ,,

See *Journal of the Land Agents' Society*, vol. viii, p. 214.

completely ignores the true origin of rent. In spite of this, an apportionment of rent is sometimes necessary. In cases where farms have attached to them an area of upland grazing a rent distribution on an acreage basis is impossible, for a large part of the holding, very often the greater part of it, is unreclaimed land, upon which no capital has been laid out beyond possibly a small expenditure on inclosure. In such instances there are, in fact, two separate units to be considered, and it will be legitimate and necessary to differentiate between each by assigning to the hill-land some small portion of the rent and confining the distribution of the major part to the enclosed and cultivated lands.

In the case of farms owned by the occupier, no rent is paid and no charge must be made against production in respect of it. The owner-occupier is in the same position in respect of interest on capital sunk in purchase as in respect of that on working capital, and this will now be considered.

Interest on Capital. If it be accepted that the cost of an article can be nothing more than that which is paid for it, it is perfectly clear that interest on capital is not a charge against cost. As a general rule accountants appear to be agreed about this, though in certain trades, printing, for example, there is a recognized custom to the contrary (introduced apparently to secure uniformity in tendering for contracts), and with the demand by the public, which has arisen recently, for the publication of costs of all kinds compiled hitherto solely for the private information of those responsible for the control of productive enterprises, there seems to be a general tendency to inflate the figures with items not previously included. Consumers, however, are not likely to be deceived by these expedients for very long. In estimates of agricultural costs appearing from time to time in the press the practice of charging interest is one of the commonest errors, the argument being, apparently, that the farmer is entitled to charge as part of his cost such a sum as the capital involved could have earned had it been invested in some other security. Money in the form of capital invested in, say, War Loan, cannot be used to produce

milk or other farm produce, and therefore there cannot be a charge against milk for what the money might have earned if it had been employed in War Loan. It is, of course, of vital importance to the farmer to consider, from time to time, what rate of interest he is getting on his farming capital, but he must not attempt to anticipate this calculation by including interest charges in his costs. The proper time to do it is when his balance sheet for the year is before him. A milk producer finds that on a capital of £10,000 invested in his farm he has got a profit of £1,500. From high-class securities he could have got an income of £600 by the investment of a similar amount; from good industrials £800; from speculative investments £1,000 or so, and in each of these cases he would be left free to employ himself in some salaried capacity. It is then for him to decide whether he will do well to continue milk producing, or whether, having regard to other opportunities available to him for the investment of his capital and for the employment of his own time, he would be better advised to give up farming. Interest on the farmer's own capital must always be an allocation of profits; interest on any borrowed capital is a charge against profits; in neither case can it ever be a charge against cost. To include it in cost is to produce a figure which is not cost at all, but cost *plus* a certain margin of profit. It follows, therefore, that interest on capital is a matter to be considered in price, not in cost. In the special case of the owner-occupier the margin of profit must be sufficient to include interest on the fixed capital (i. e. rent) as well as interest on the working capital.

Management. Another common error in statements of costs is the inclusion of a charge for the farmer's reward as manager. This again has to be considered in the price, not in the cost, and as indicated above the amount earned by the farmer is a matter to be ascertained from the profits. If charges for the farmer's own management[1] and for interest on his capital are included as costs, the resultant

[1] The salary or wages of a paid manager are, of course, a legitimate charge against costs.

figure represents the price at which the article can be sold to the consumer to give that margin of profit to the producer necessary to retain him in the business, and to call it the 'cost of production' is either a misconception of fact or an attempt to impose on the credulity of the public. In the long run, of course, both these charges have to be reckoned if supply is to be maintained, but since they are not actual cash transactions, and there is no basis for assessing them, they are not charges with which the costings-clerk can deal.

PART II

RESULTS

CHAPTER IV

PRIMARY RESULTS

THE first results afforded by cost accounts are those which give the management information as to product-costs and the cost of the various processes leading up to them. In the case of crops these processes are mainly cultivations, including manual and horse labour, and mechanical power; farm-yard manure; harvesting or lifting; threshing, delivery, &c.; in the case of live stock and live-stock products, labour; foodstuffs, both purchased and home-grown; distribution.

These primary results supply the farmer with the bare facts of his various costs and the results of his year's work, by which he may test his efficiency as a manager in every branch of his organization, thus concentrating his attention on the means by which to reform or otherwise to tighten up the control of his business. At a later stage it will be necessary to see what further results can be abstracted from the records with the object of throwing light upon the economic position of the whole agricultural industry.

1. LABOUR

(*a*) *Horse Labour*

The cost of horse labour on the farm is one of the first results to be extracted from the records, as being an essential preliminary to the compilation of other costs. The account from which information on this subject is derived is the 'Horses, Working Account'. It has been charged during the year with all expenses of horse maintenance. These will include home-grown foods and any purchased foods, all of them at purchase price or cost of production as the case may be; grazing, at cost (see p. 88); veterinary and

smithy accounts; labour, and depreciation. As regards labour, this is a small item, for the time of men working with horses is charged to the job upon which they are engaged, and not to the horses, so that the only manual labour recorded in the 'Horses, Working Account' is the few hours employed on stable work, taking horses to the forge, &c. The only other charge to be included is that for depreciation, and it must be noted that this charge has to be made irrespective of whether the horse stock has actually fallen in value or not. The principle upon which it is based is that the depreciation on a horse, from his cost at maturity for work down to his death, should be divided equally over his whole working life, for obviously the cost of ploughing, say, an acre of land, should be the same whether it be performed by young horses or by old ones—other things being equal. The advantage accruing to the farmer who works a large proportion of young horses, or the disadvantage of working mainly with ancient animals rapidly depreciating, must not be applied fictitiously to reduce or to increase the cost of horse labour on the farm.[1] The farmer's success or otherwise as a horse breeder or as a horse dealer is a matter entirely apart from the cost of horse labour on the holding, and must not be confused with it, but must be recorded in a separate account kept for this purpose (see p. 47). Thus it follows that the capital invested in horse-stock does not enter into a labour-cost calculation, whilst, on the other hand, depreciation is a charge which must be included irrespective of the age of the animals concerned. It will be observed that the sum charged in the example given below is £3 per annum. Whether this is the proper figure depends entirely upon the cost of a three-year-old horse on the farm in cases where the horse-stock is home-bred, or upon the purchase price if the farmer is a buyer and not a breeder. The figure represents a maximum cost at three years old of about £50 per horse, allowing an effective life of fifteen years and a knacker value of £5; it must, of course, be varied on every farm to bring it into accord with

[1] See Orwin, *Farm Accounts* (Cambridge University Press, p. 139).

the facts, and only where all the horses are home-bred can a uniform figure be applied. Bought horses must be depreciated upon an individual figure based on the cost in each case and the probable life.

The following tables, like all others given in this volume, are only to illustrate results and the figures in them cannot be used as evidence of the average cost of keeping a horse. They relate to costs in the year 1917–18 and certain facts emerge from them. It is noteworthy, for example, that cheapness in horse labour is dependent mainly on the elimination, so far as possible, of idle days. The biggest single factor in the cost of a horse-day is the proportion of days worked to the maximum possible. Every one realizes, of course, the importance of keeping horses busy, but not every one thinks how heavily the cost of manual labour is increased by idle horses. It is a common practice at threshing time to take the horsemen from their work to assist at threshing, and as this operation can only be performed in dry weather it may be assumed that the horses might usually be employed on threshing days. With manual labour costing about 7*s.* 6*d.* a day and horses about 5*s.* a day the advantage of hiring casual labour for threshing, even at high rates of pay, will be obvious when it is remembered that the horseman whose horses are standing idle represents a daily cost for the manual work performed by him of some 18*s.* On a midland-counties' farm, where the maximum possible horse-hours in a certain week in November were 238, the time actually worked by horses was found to be 87, owing to threshing operations, and the wastefulness of the labour management in such a case is obvious. Again, employers in certain cases object to paying Saturday overtime to men willing to work, because overtime payments are at a higher rate than those for ordinary time, but they overlook entirely the fact that the Agricultural Wages Board provides no overtime payments to the horses, and that the cheapest horse labour on the farm is that performed on Saturday afternoon at overtime rates.

The variations in the number of working days from year

TABLE IX. Cost of Farm Horses and Horse Labour, 1917-1918

Locality	No. of Horses	No. per 100 Arable Acres	Manual Labour			Foods: Purchased			Foods: Homegrown			Foods: Grazing			Vet. & Blacksmith			Depreciation			Possible Working Days	Days worked	Days worked per Horse	Cost of Horse Labour: Per annum			Per Horse			Per day possible	Per day worked
			£	s	d	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d				£	s	d	£	s	d	d	d
South Eastern No. 4	3·5	3·9	6	1	6½	10	7	9	103	9	1	10	4	1	11	6	0	10	10	0	1095½	641	183	151	18	5½	43	8	1	33·3	56·7
East Midlands No. 1	24	2·48	4	13	0	822	8	6	190	16	0	35	18	5	47	10	3	72	0	0	7512	5839	243·29	1173	6	2	48	17	9	37·48	48·22
Scotland No.	12	3·1	8	17	11	183	1	3	143	14	2	35	8	4	104	5	0	30	0	0	3756	2525	210½	505	6	8	42	2	3	32 8	48
Eastern Counties No. 2	7	4·4	14	4	1	24	3	0	107	11	3	33	17	4	13	1	7	21	0	0	2191	1283	183	213	17	3	30	11	0½	23·4	40

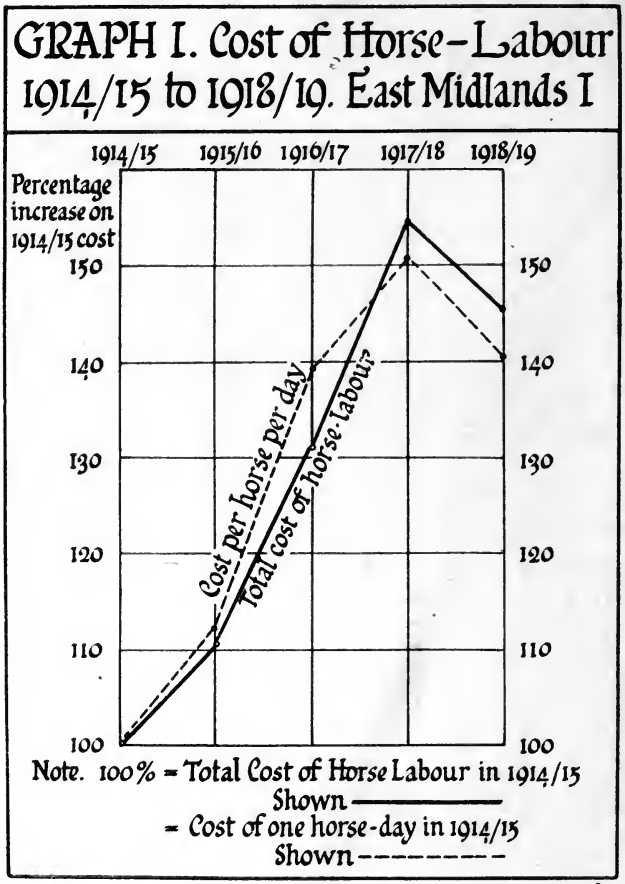
TABLE X. Cost of a Farm Horse, 1917-1918

	Highest				Lowest				Average of four			
	£	s	d	%	£	s	d	%	£	s	d	%
Manual Labour		3	10½	·40	2	0	7	6·64		14	10	1·69
Foods: Purchased	35	5	4½	70·10	3	9	0	11·30	22	7	4	50·87
Foods: Homegrown	7	19	0	16·26	15	7	4	50·30	11	14	7	26·67
Foods: Grazing	1	19	11¼	3·05	4	16	9	15·83	2	9	6	5·63
Vet. and Blacksmith	1	19	7	4·05	1	17	4½	6·11	3	15	8	8·61
Depreciation	3	0	0	6·14	3	0	0	9·82	2	17	5	6·53
	48	17	9	100·00	30	11	0½	100·00	43	19	4	100·00

to year are very slight on farms where the labour is carefully planned and well directed. On an east-midlands farm employing twenty-three horses, the days worked per horse during the past six years have been as follows :

Year . .	1913–14	1914–15	1915–16	1916–17	1917–18	1918–19
Days worked per horse . .	250·25	247	243	236	243	244·5

The tendency of the change in the *total cost* of horse labour on the farm during these years, and the influence on the *cost per horse-day* of the proportion which days worked bear to the possible working days, is shown by the following graph :



The maximum number of working days in a year is 312, a total obviously impossible of attainment in practice. Such records as are available show that the days actually worked by horses on the farm will not usually exceed four-fifths of the maximum.[1] More time may be lost in summer than in winter, a fact not generally realized, and the period of maximum unemployment falls between hay-making and harvest. The busy seasons are, of course, the autumn and the spring, when the preparation of the ground for winter and spring corn is going actively forward. In the following graph the time lost by forty-one horses on four farms, distributed pretty evenly over the whole of England, during the year 1918, is shown for each month of the year in percentages of the maximum working days per month, that is to say, deducting only Sundays and Christmas Day.

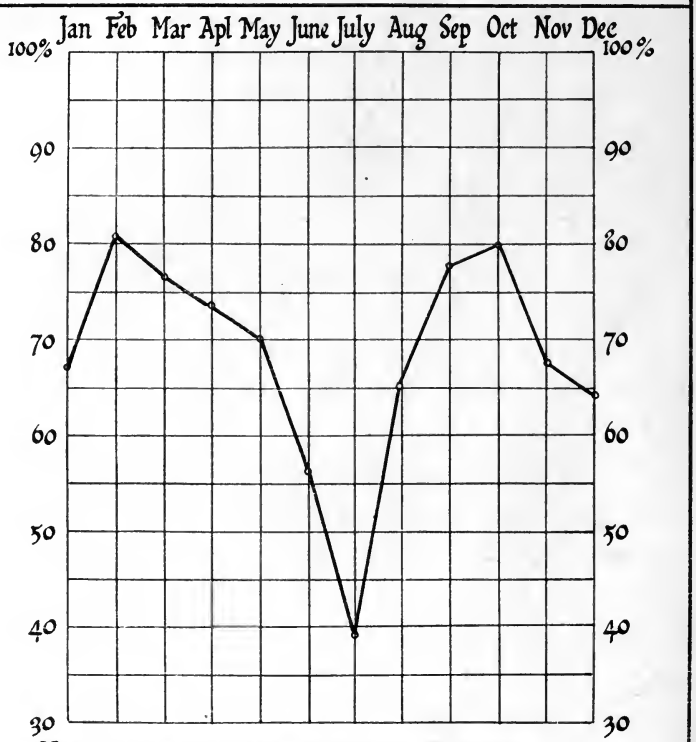
Although the curve represents an average of four farms it is noteworthy that the results on the individual holdings varied one from another in degree only, and that the months of maximum and minimum employment were the same in every case. The fact that the busiest times of the year synchronize more or less with the seasons when the weather is more uncertain directs attention to the advantages which should accrue to farm-management from the application of speedier mechanical power to field operations in substitution for the slower horse labour (see p. 73).

The horse account, in conjunction with the manual labour analysis, furnishes the cost of all acts of tillage. When the allocation of manual and horse labour is properly made, and the cost of each is known, it is a simple matter to extract the cost of ploughing, cultivating, harvesting, and all similar operations, and it may be possible to establish 'unit costs' for the farm, or even for a district, which in certain circumstances might be applied to cost calculations for a short period in substitution for the more laboriously

[1] It is probable that there may have been an occasional omission of a horse from the record sheets from which the table is compiled, and if allowance is made for 'experimental error' the total days worked must be regarded as slightly under-estimated.

collected annual records. Such results could be used by individuals only with the exercise of due consideration as to their applicability; in any particular case it is the annual variations in cost which are of importance to the farm

GRAPH II. Seasonal Employment of Horses on four Farms in the year 1918.



manager for the purpose of arresting his attention and thus of enabling him to review the circumstances attending them, and any application of average unit costs to individual farms might be very misleading; for general statistical purposes, however, it would be of no little value to have evidence of average costs of cultivation and acts of husbandry

in each of the more sharply defined farming districts. The figures would also have a directly practical application, for they would be of much service, for example, to local tenant-right valuers' associations, whose figures from which to work out the compensation due to the outgoing tenant for tillage and acts of husbandry must necessarily be made up from average costs. Again, such information is required for contrasting the relative cost of horse and mechanical labour, though in this case it must be remembered that relative cost may have very little to do with relative advantage, when other factors are considered.

In Table XI is shown a Field-labour Sheet, designed to give in diary form the expenditure of manual and horse labour upon the various acts of husbandry performed for any crops. It is entered up from the daily Time-sheets (see p. 25). The man and horse days or hours are recorded weekly on each crop as employed, under the necessary headings ; the total of each is priced either week by week or at the end of the year, and the unit cost of the various operations is ascertained by dividing by the crop acreage.

(*b*) *Mechanical Power*

Farmers have long been accustomed to the application of steam power to ploughing and cultivation, and the advantages attending its use in certain conditions are fully recognized. Few farmers, however, are the owners of steam cultivation outfits, and in the great majority of cases the cost of the work performed is a simple calculation dependent on the contractor's price for the work, the cost of coal and carting it, and the cost of carting water. Similarly, for such operations as threshing and chaff-cutting by steam the work has been specialized by contractors and the cost is readily ascertained in the same way. The advent of the agricultural tractor, however, has made very many men their own machinists, and at the present time the collection of data as to the cost of the application of tractor power is a matter that calls urgently for investigation. The demands

TABLE XI. Field Labour Sheet. East Midlands I. Field-2nd Cliff. Acreage-22. Crop-Barley 1918

	Operations 1917-18																											Operations 1918-19											
	Ploughing					Dragging					Harrowing					Drilling					Rolling					Applying artificial Manure					Weeding					Stooking					Binding					Carting				
	Days	£	s	d	Hor	Days	£	s	d	Hor	Days	£	s	d	Hor	Days	£	s	d	Hor	Days	£	s	d	Hor	Days	£	s	d	Hor	Days	£	s	d	Hor	Days	£	s	d	Hor	Days	£	s	d	Hor	Days	£	s	d	Hor
1917																																															
Sept. 22	2		10	8	6																																									
29						1		5	6	3	1		3	4	2																															
Oct. 13	3		16	9	9																																									
20	3		15	5	5																																									
27	3		10	10	7																																									
Nov. 3	1		5	9	2																																									
17	3		14	11	8																																									
24						3		14	6	11																																					
1918																																															
Jan. 12	10	2	5	2	20																																									
26	17	3	17	3	34																																									
Feb. 2	2		8	3	4																																									
Mar. 9	1		5	7	4																																									
16						1		5	6	4																																					
23											4		15	11	4	6	1	12	3	6																									
Apl. 27																					2		8	9	5																					
May 4																										9¾		17	-	3																
11											1		5	1	1																														
25																										1		4	10	1	1		1	9											
Aug 17																																			P.W.	1	2	11	P.W.	1	2	2	18					
Sept 7																																			P.W.		4	6						P.W.	2	10	7	12
	45	10	10	7	99	5	1	5	6	18	6	1	4	4	7	8	2	2	4	10	2		8	9	5	4¾	1	1	10	4	1		1	9		P.W.	1	7	5		P.W.	1	2	2	18	P.W.	2	10	7	12

which the agricultural labourer has been making, very rightly, for an improvement in his standard of living is driving the employer to a closer consideration of the problem of how to make labour more effective. When wages were low it may have been that the labourer was the cheapest machine, but in proportion as his remuneration approaches more nearly to the standard of reward in competing industries, so will the necessity for making his work more productive be intensified. The value of the output from the farm per man employed is not the only measure by which to gauge the efficiency of the management, but it is certainly one of primary importance. A man with a spade can dig an acre of land in about two weeks at a cost to-day (1920) of about £4 10*s.* 0*d.*; a horseman and a pair of horses can plough an acre in about a day and a half at a cost of about £1 15*s.* 0*d.*; a farm mechanic on a tractor can break up an acre in about a quarter of a day, and although in the absence of sufficient data the comparison cannot yet be completed by reference to the cost of motor ploughing it is fairly safe to suggest that when all the factors are considered—speed, less dependence upon atmospheric and soil conditions, as well as actual cost—there will be a still further advantage to be derived by investing the manual worker with the control of mechanical power. Indeed, it seems likely that the solution of the wages problem on the farm will be found in the more general application of machinery to the processes of agricultural production, whereby the output per unit of labour will be increased and higher wage-rates made possible. The tendency in this direction is already noticeable and it demands more serious attention and study than it has received. The national policy in agricultural development is directed towards the breaking up of the large farm into the smaller holdings from which in most cases it has been evolved, thus running counter to the general experience in all industry, namely that cheap commodities and high wages are only procurable under systems of large-scale production. In Sir Thomas Middleton's well-known work, *The Recent*

Development of German Agriculture,[1] it has been shown that the production of food per hundred acres in Germany is much greater than in England ; on the other hand, if the number of workers engaged in agriculture be brought into the account it appears that the production per man is fully 20 per cent. higher in this country. It is not desired to discuss the relative merits of large and small holdings here. That small holdings offer certain advantages not afforded by large farms cannot be denied, though probably these are political and social in their nature rather than economic. As long, however, as the great mass of rural workers remain workers for wages, so long will it be necessary for the farm manager to study methods of production which will make the most effective use of their labour as measured by output.

In the following table is given the cost of a variety of farm operations performed in 1919–20 by a Titan tractor bought in 1919 at a cost of £410. Petrol is used to start it, but as soon as the engine is warm it runs on ordinary paraffin. Records have been kept of the number of days worked, of the labour employed, and of the petrol, paraffin, and lubricant consumed at each class of work. The costs have been analysed under the headings of 'Driver', 'Petrol', 'Paraffin', 'Lubricant', 'Repairs, &c.', and 'Depreciation'. The driver received a weekly wage at about current rates for wages and overtime, being under contract to occupy himself on any farm work at such times as the tractor was not in use, and an additional sum by way of bonus on work done when engaged with the tractor. The bonus was at the rate of 1*s*. per acre for ploughing, 4*d*. per acre for cultivating (any kind), and 3*d*. per acre for harrowing or rolling. The fuel consumption was recorded from day to day by means of the Tractor Record-sheet already described (see p. 27, *ante*), and lubricant—a very heavy item —was recorded in the same way. The item 'Repairs, &c.' covers actual repairs and replacements to the tractor and driver's time on same and on cleaning and casual adjustments, together with the comparatively trifling outlay on

[1] Cd. 8305.

TABLE XII. Analysis of tractor costs for the year 1919–20 (Berkshire No. 1)

	Driver's wages and bonus			Petrol			Paraffin			Lubricant			Repairs etc.			Depreciation			Total			Work done	Cost		
	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d		£	s	d
Ploughing	94	16	3½	2	8	4	72	16	0	26	18	9	17	6	9	45	0	0	199	6	1½	95 acres	2	2	0 per acre
Cultivating etc.	5	12	6½		7	7	11	1	0	4	9	8	2	1	2	5	19	11	29	11	10½	73 acres		8	1 per acre
Chain-harrowing or Rolling	18	3	1		16	10	22	7	6	10	18	2	4	3	4	12	18	0	69	1	11	501 acres		2	9 per acre
Disc Harrowing	1	1	11		1	10	2	18	0	1	6	5		9	10	1	8	9	7	1	9	22 acres		6	5 per acre
Chaff-cutting	6	4	6		11	6	7	9	1	5	6	8	1	7	10	4	13	11	25	13	6	239 cwt.		2	2 per cwt.
Grinding	2	10	2		4	5	4	9	0	1	19	9		16	7	2	8	3	12	8	2	147 cwt.		1	8½ per cwt.
Hedge grubbing	5	8	0		9	9	10	0	2	3	12	9	1	17	4	5	8	8	26	16	8	25 chns.	1	1	6 per chn.
Wood sawing	6	1	5		10	0	10	19	1	4	18	1	2	0	10	6	4	2	30	13	7	?		?	
Hauling	6	6	1½		10	11	13	4	4	6	8	2	2	9	3	7	3	6	36	2	3½	?		?	
Total	86	4	0½	6	1	2	154	19	2	65	13	5	32	12	11	91	5	2	436	15	10½				
Percentage analysis of total cost	19·74 per cent			1·39 per cent			35·48 per cent			15·03 per cent			7·47 per cent			20·89 per cent			100·00 per cent						

grease, licence, insurance, and the depreciation on the paraffin cistern (calculated at 10 per cent. of its cost). The total cost under this head has been distributed over the various operations performed by the machine on the basis of fuel consumption, the assumption made being that there must be some fairly close relation between the cost of the fuel required for any piece of work, and the destructive effect. Repairs and replacements to tractor implements, &c., have been eliminated from the general repairs account, and have been taken direct to the particular operation concerned, in addition to the apportionment of the general items. Thus, the charge of £17 6*s*. 9*d*. against 'Ploughing' includes the share of the general repairs apportioned on a paraffin basis *plus* the cost of repairs and replacements to the tractor plough; the items £1 7*s*. 10*d*., 16*s*. 7*d*., and £2 0*s*. 10*d*. charged for repairs against the operations of 'chaff-cutting', 'grinding', and 'sawing' respectively include an apportionment of the general item on the same basis *plus* depreciation on belting, and so on for the remainder of the various operations.

The 'Depreciation' on the machine is calculated on a life of five years, that is £82 per annum in this case. There are obvious objections to this basis, for depreciation should depend on the amount of work done rather than on the passage of time, but the work done varies so much in its destructive effect, as, for example, in the case of road haulage on the one hand, and chaff-cutting on the other, that no satisfactory method of distribution along this line alone suggests itself. Moreover, in an industry so much in its infancy as the manufacture of agricultural motors, the element of time cannot altogether be ignored, for it is probable that the patterns of machines now in use will have been superseded entirely during the next few years. In distributing depreciation over the various operations performed the same assumption has been made as in the case of repairs, namely that the wear and tear should be roughly proportionate to the fuel consumption, and thus the paraffin used has been made the basis of the apportionment.

It is not possible to draw any useful conclusions as to the economy of tractor labour from experience on one farm or from one set of figures. The table given above as an example does not suggest that tractor work is cheap in itself. The economic employment of the machine must depend very largely upon ability to keep it in regular use, for whilst labour, fuel, lubricant, and repairs will vary directly with the number of days worked the item of depreciation, which forms the second highest element of cost, accounting as it does for more than one-fifth of the total, will vary more or less exactly in an inverse ratio. It is commonly remarked that, in comparison with horses, a tractor costs nothing when it is not at work, but this hardly states the true facts, and it is obvious that tractor labour cannot stand more than a certain percentage of idle days without an excessive inflation of its cost, though when the advantages of ability to carry out work at speed are taken into account it is equally clear that maximum employment is not the only factor to be considered. The tractor taken for purposes of the illustration given will plough 4 acres *per diem*, and will harrow or roll 30 acres *per diem* when running without stoppage. It worked for 193 full days in the year ; the farm extended to 405 acres of which 125 acres were arable land ; one of the questions still to be settled is the minimum limit of area on which the tractor can profitably be employed.

2. Farm-yard Manure

The determination of the cost of farm-yard manure is one of considerable importance to the farmer. In compounding rations for stock the idea prevails so generally that what is wasted as food is recovered as manure, that there is a danger of piling up the cost of dung beyond its value, by too heavy allowances of concentrated food. The high cost of purchased foods and the difficulty of getting supplies during the past few years have done something, doubtless, to counteract this tendency towards extravagant feeding, but the danger still exists and it would be reduced

TABLE XIII. Analysis of the Cost of Producing Farmyard Manures - 1918-1919

Farm	Value of Manurial Residues of Foods fed in yards and in buildings			Purchased litter			Labour						Total Cost			No. of Loads made	Cost per load		
							Manual			Horse									
	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d		£	s	d
E. Midlands 1	222	16	2	—	—	—	17	13	8	3	1	2	243	11	0	1300		3	8
S. Eastern 4	10	12	11	1	10	0	12	15	0	9	0	0	33	17	11	220		3	1

if the book-keeping on the farm were such as would direct the attention of the management to the question of relative costs of farm-yard and mineral manures of equivalent fertilizing value.

The figures given here show the cost of farm-yard manure on two farms. The cost is made up from the cost of food residues, the cost of purchased litter, and the cost of certain labour items.

The cost of the manurial residues of foods is calculated from Voelcker's and Hall's tables brought up to date as regards unit values. The whole cost of the foods has been charged against the live stock consuming them in the first instance, and they have been credited, subsequently, with the value of the residues; this figure is then carried to the debit of the farm-yard manure account.

No charge is made for the home-grown litter in the manure. The justification for this omission has already been given (see p. 45, *ante*) and is, briefly, that straw is to be regarded as a by-product in the production of grain, not as an object of production itself. Any straw or other

substance *purchased* for use as litter must, of course, be charged, and the second example in the table below includes an item of this nature. Ordinarily there will be no charge for labour, either manual or horse. Labour on littering yards, stalls, and boxes is charged against the stock ; labour on filling, carting, and spreading dung is chargeable against the field or crop receiving it. It sometimes happens, however, that the manure is not spread direct from the yard but is stored for some time in heaps near the field to which it is to be applied. In this case it is advisable to charge the cost of filling, carting, and heaping to the manure account, and to charge only the subsequent spreading to the field or crop. This was the position in the case of the first example in the table (East Midlands I), and the manual and horse labour there recorded represents the cost of making the dung-heap. The second example (South-Eastern IV) illustrates another case in which a considerable labour charge may arise. Here there was no home-grown litter available, and considerable quantities of bracken were cut and carted to supply its place. The cost of this labour appears as a charge against the manure, and represents, in effect, an additional charge for ' purchased litter '.

As regard the total cost this, unfortunately, can only be given per load, as in neither case were any weighings performed. Nor has it been possible to distinguish between the cost of manures from different classes of stock or from varying systems of feeding ; these results can only be obtained when more supervision can be given to the recording on the farms, unless, indeed, they belong more properly to the work of an experimental station.

3. Crops

(*a*) *Fallows and Fallow Crops*

Just as the root crop, or the bare fallow, must be regarded as the starting-point of the rotation, so also is it the foundation for the determination of the cost of all farm produce.

The reason for this is that the cultivations performed at this stage in the rotation are rendered necessary largely to clean the land after the preceding corn crops, and to prepare it for the coming ones. Few farmers would bare-fallow or grow turnips for any other reason, and so a portion of the cost of this work must be carried forward and distributed amongst all crops that intervene until the fallow comes round again.

It is no new principle. It has long been recognized that the action of certain manures and of food residues endures for more than one crop, and that proportions of their values must be carried forward to the charge of the crop following that to which they are applied, and the cost of certain of the cleaning processes in the growth of turnips, or the whole cost of the bare fallow, must be treated in the same way. Thus, the determination of the cost of all succeeding crops, and consequently, too, of all live stock and live-stock products, is influenced by the cost of the fallow or of the root crop.

The figures in Table XIV give the analysed gross cost of growing turnips on four farms in 1917–18.

From this table of the *actual gross* cost of the crops, a second table (Table XV) showing the *estimated net* cost has been prepared by the elimination of all labour not strictly required for the growth of the roots, and further, of all manures which, by the established practice of farm valuations, are held to be unexhausted and available for the following crop or crops. With the aid of the time-sheets and, more particularly, of the field labour-sheets (see Table XI) a list of all operations was made in the case of each farm, and they were then classed as those necessary for the growth of roots, and those done solely to clean the land.

The 'Manual and Horse Labour' represent that which was considered to be fairly chargeable against the root crop, and amount approximately to two-thirds of the cultivation, &c., performed. The rest of the cost of workings, and the cost of manures have been eliminated from the

gross cost and are carried forward for distribution amongst the succeeding crops.

This method of apportioning the cost has already been discussed, and it is not so arbitrary a division as might seem

TABLE XIV. Analysis of the Gross Cost of Swedes & Turnips Crop per Acre 1917-1918.

	Highest				Lowest				Average of 4 farms			
	£	s	d	%	£	s	d	%	£	s	d	%
Labour {Manual	3	5	8	22·04	1	13	0	29·64	2	1	7	27·25
Labour {Horse	1	18	0	12·76	1	8	3	25·37	2	2	6	27·87
Manures {Purchased	4	4	1	28·22		17	8	15·87		19	2	12·56
Manures {Farmyard	4	13	4	31·83					1	9	0	19·01
Seed		3	6	1·17		4	1	3·67		3	2	2·07
Rent and Rates		13	4	4·48	1	8	4	25·45		17	2	11·25
Total gross cost per acre	14	17	11	100·00	5	11	4	100·00	7	12	7	100·00

TABLE XV. Analysis of the Net Cost of Swedes and Turnips Crop per Acre 1917-1918.

	Highest*				Lowest				Average of 4 farms			
	£	s	d	%	£	s	d	%	£	s	d	%
Labour {Manual	1	12	4	46·98		16	8	26·15	1	11	7	41·83
Labour {Horse		19	8	28·57		14	8	23·01	1	3	7	31·23
Seed		3	6	5·08		4	1	6·40		3	2	4·20
Rent and Rates		13	4	19·37	1	8	4	44·44		17	2	22·74
Total net cost per acre	3	8	10	100·00	3	3	9	100·00	3	15	6	100·00

* It will be noted that this farm although showing the highest gross cost per acre in Table XIV does not show the highest net cost when the cleaning and manurial charges have been credited.

probable at first sight. With a statement of the work done before him, there is no reason why a sharp and accurate division should not be drawn by the farmer, or by his accountant, between those operations performed to clean the land and those necessary to grow the crop.

The charge for 'Rent and Rates' represents an acreage apportionment of these items for the farm as a whole. After

deducting the estimated amount of rent and rates chargeable in respect of the farm-house which is charged against the 'Establishment Account', and of the cottages which is charged against the 'Labour Account', the balance is divided between arable and grass land on an acreage basis (see p. 56, *ante*). Buildings are pooled with the land, because land unequipped with buildings is useless, generally speaking, and thus it may be made quite properly to bear whatever proportion of the whole rent might be considered to issue out of the buildings.

'General Expenses' do not enter into the Roots accounts. In distributing the balance of 'General Expenses' or 'Establishment' account it was decided to bring in only the productive accounts, as thereby work is saved without any sacrifice of accuracy. For example, no share of general expenses is charged to such departments of the farm as 'Purchased Foods', or 'Manures', or 'Horse Labour', for the balances of these accounts are in their turn distributed over the more directly productive departments, such as 'Corn Crops', and 'Live Stock'. The method is to charge general expenses only against accounts capable of showing a profit, and the principle on which the distribution is made is to vary the amount directly with the labour-cost shown in these accounts—an account with a labour-cost of a hundred pounds bearing twice as much of this charge as one in which the total labour items amount only to fifty pounds. The assumption made is that the advantage gained by each department from general expenses should bear a close relation to the labour outlay in which each is involved. Other methods of distribution have been tried, but none has been found that appeared so satisfactory. (See p. 53, *ante*.)

No attempt was made on the farms to record the weight of roots grown, so that the costs in the table have to be left at per acre instead of at per ton. An analysis on an acreage basis does not possess the interest which would attach to the analysis of the cost per ton of roots. In the former case the percentages are upset for purposes of

comparison by variations in the matter of rent, and of rates of pay; in the latter case these points should adjust themselves, for more highly rented land and more highly paid labour should be proportionately more productive, and some interesting and valuable information on these points will be forthcoming when crop-yields are available.

The suggestion was made by a well-known economist, to whom some of the figures appearing here were shown, that rent should be omitted from the calculations altogether, as not entering strictly into the cost of production. This suggestion has been considered very carefully, but, in order to give effect to it, it would have been necessary to make a valuation of each farm with the object of separating interest on the capital outlay on reclamation and equipment from true rent, and the result would show in most cases that the farmer pays no 'economic rent' at all. The subject has been fully discussed already. (See p. 55, *ante*.)

The cost of fallows where no root crop is taken is carried forward in its entirety, as an asset, to be written off year by year through the rotation.

(*b*) *Mangolds*

The cost of the mangold crop is given on three farms only, and in Table XVI the *gross* cost is stated.

The details of gross cost have been arrived at exactly in the same way as in the case of the turnip crop, and call for no further explanation. The calculation of the *net* cost differs in two particulars. In the first place, no deduction has to be made from the cost of labour in respect of work done to clean land rather than to grow the crop. That mangolds are a cleaning crop is undeniable, but they are not grown as such to the extent that turnip and kindred crops certainly are. The deduction from the gross cost in respect of 'Cleaning Costs' which appears in the table below represents the proportion of this item carried forward from an earlier fallow, or cleaning crop, to be exhausted amongst the remainder of the crops in the rotation of which

the mangold crop is one. In the second place, only one-third of the cost of dung applied to mangolds is credited to them and carried forward to other crops, whilst no part of the cost of artificials applied is carried forward, except in the case of basic slag, or other manure of long duration. In the case of turnips consumed on the land it will be remem-

TABLE XVI. Analysis of the Gross Cost of Mangold Crop per Acre 1917-18

	Highest				Lowest				Average of 3 farms			
	£	s	d	%	£	s	d	%	£	s	d	%
Labour (Manual	6	3	5	35·85	2	9	10	34·17	3	18	11	33·14
Labour (Horse	3	2	6	18·15	1	13	8	23·09	1	13	4	13·99
Manures (Purchased		10	3	2·96	1	2	6	15·43	2	4	0	18·48
Manures (Farmyard	5	18	3	34·35					2	12	4	21·98
Seed		9	1	2·64		11	7	7·94		10	6	4·41
Rent and Rates	1	0	10	6·05	1	8	3	19·97		19	1	8·00
Total gross cost per acre	17	4	4	100·00	7	5	10	100·00	11	18	2	100·00

TABLE XVII. Analysis of the Net Cost of Mangold Crop per Acre 1917-18

	Highest				Lowest				Average of 3 farms			
	£	s	d	%	£	s	d	%	£	s	d	%
Labour (Manual	5	18	4	39·76	2	7	3	33·53	3	15	3	35·59
Labour (Horse	3	0	4	20·27	1	11	4	22·24	1	11	8	14·98
Manures (Purchased		10	3	3·44	1	2	6	15·97	2	1	11	19·83
Manures (Farmyard	3	18	10	26·48					1	13	0	15·61
Seed		9	1	3·05		11	7	8·22		10	6	4·96
Rent and Rates	1	0	10	7·00	1	8	3	20·04		19	1	9·03
Total net cost per acre	14	17	8	100·00	7	0	11	100·00	10	11	5	100·00

bered that the whole cost of manures was credited, these being generally consumed on the land, but mangolds are invariably carted off, and except as above the whole cost has been taken as being absorbed into the crop.

The net cost for the mangold crop (Table XVII) has been analysed on the basis of the cost of one acre. Unfortunately, in this case, as also with the turnips, no records of yields by weight were kept and no ton-costs, nor an analysis of them, can be given.

(*c*) *Potatoes*

Only one account of the cost of this important crop can be given, namely, one for a Lincolnshire farm situated outside the great potato district of the Fens. The costs are arrived at in the way already described, that is to say, the crop is charged with all labour, manure, seed, rent and rates, and share of general expenses. The last item is included for the first time in a root crop, because the potato is a marketable crop, and so the principle of excluding the apportionment of any part of the cost of general expenses

TABLE XVIII. Analysis of Cost of Potato Crop per Acre 1917-1918 East Midlands I

	£	s	d	%
Labour {Manual	6	19	7	27·95
Labour {Horse	4	11	5	18·30
Manures {Artificial	5	16	4	23·30
Manures {Farmyard	2	3	11	8·79
Seed	1	17	7	7·52
Rent and Rates		13	10	2·77
General Expenses	2	16	9	11·37
Total cost per Acre	24	19	5	100·00

Total Yield - 90 tons. Yield per acre - 7·66 tons
Cost per ton---------£ 3 . 5. 2

over produce grown and consumed on the holding (see p. 54) does not apply. The labour items include the cost of preparing for market and marketing, and the yield refers only to marketable produce, the balance of small stuff being treated as a by-product.

(*d*) *Barley*

Barley follows naturally after roots, and the cost of this crop on three farms in barley-growing counties has been analysed here for purposes of illustration.

Manual and horse labour on the crops were recorded in each case as already described. With regard to the manures, nothing has been allowed to the crop for the unexhausted

values of those applied except in the case of farmyard manures. Two-thirds of the cost of this have been charged against the barley crop, and one-third has been carried forward to the debit of the following crop. This practice has been followed in all cases where farm-yard manure is applied to crops other than turnips. The 'Cleaning and Manurial Costs' charged have nothing to do with work done or manures applied directly to the barley crops, but

TABLE XIX. Analysis of the Cost of the Barley Crop per Acre 1917-18

	Highest				Lowest				Average of 3 farms			
	£	s	d	%	£	s	d	%	£	s	d	%
Labour {Manual	2	5	10	22·01	1	5	4	18·00	1	8	0	17·98
Labour {Horse	1	14	2	16·40	1	3	2	16·46	1	4	3	15·57
Manures {Purchased		2	9	1·92	1	0	3	14·39	1	0	3	13·00
Manures {Farmyard						3	1	2·19		2	5	1·55
Rent and Rates	1	8	4	13·61		13	6	9·59		18	3	11·72
Seed		18	0	8·64		9	1	6·45		13	1	8·40
Cleaning and Manurial Costs brought forward	1	14	0	16·33		18	5	13·09		18	1	11·61
Thatching, Threshing and Delivery	1	7	9	13·33		15	5	10·95		16	11	10·86
Establishment (or General) Expenses		17	5	8·36		12	6	8·88		14	6	9·31
Total Cost per Acre	10	8	3	100·00	7	0	9	100·00	7	15	9	100·00
Total Acreage	25				164							
Total Yield (Qrs)	85				346½							
Yield per Acre (Qrs)	3·4				2·11				2·72			
Cost per Quarter	£3.1.3				£3.6.9				£2.17.4			

represent that proportion of values brought forward from previous crops which is held to be worked off in the barley crop.

The apportionment of 'General Expenses' has been explained already (p. 54), and the charge for 'Thatching, threshing, and delivery' does not call for comment. In calculating the cost per quarter, the whole of the expenditure has been charged against grain, the straw being treated as a by-product in the production of corn.

(e) *Wheat*

The cost of wheat growing is illustrated by figures ascertained on four farms. The principles on which the calculations are based, and the methods followed in making them, have been described already in connexion with the barley crop, and call for no further statement in detail. As with the barley, the total cost of the wheat crop has been charged against the grain only.

TABLE XX. Analysis of the Cost of the Wheat Crop per Acre 1917-18

	Highest				Lowest				Average of 4 farms			
	£	s	d	%	£	s	d	%	£	s	d	%
Labour { Manual	2	9	5	21·15		19	3	15·72	1	8	8	17·59
Labour { Horse	1	5	9	11·02		16	2	13·20	1	1	3	13·04
Manures { Purchased		16	11	7·24		3	1	2·32		9	2	5·62
Manures { Farmyard		12	0	5·13						15	6	9·51
Rent and Rates	1	8	4	12·13		13	11	11·35		15	0	9·20
Seed	1	7	0	11·56	1	2	10	18·64	1	4	2	14·82
Cleaning and Manurial Costs brought forward	1	8	5	12·16		15	7	12·72		14	11	9·16
Thatching, Threshing and delivery	1	6	10	11·48		5	0	4·08		17	4	10·63
Establishment (or General) Expenses		19	0	8·13	1	6	8	21·77		17	0	10·43
Total Cost per Acre	11	3	8	100·00	6	2	6	100·00	8	3	0	100·00
Total Acreage	25				12							
Total Yield	87				44							
Yield per Acre (Qrs)	3·48				3·66				3·36			
Cost per Qr.	£3.7.2				£1.13.8				£2.8.6			

(f) *Oats*

The oat costs given in Table XXI relate only to spring oats.

It will be noted that the whole of the cost in all the foregoing Corn Tables (i.e. barley, wheat, and oats) is attributed to the grain alone. At first sight it would seem desirable to make some division of cost as between grain and straw, and a variety of methods by which to do this suggest themselves. Thus, a division may be made by

a comparison of the respective market values of the grain and of the straw, or, again, upon their respective feeding values. Circumstances may arise in which an attempt to make some such division could be justified, but in the great majority of cases the reasons already given for treating straw as a by-product in the production of corn (see p. 45, *ante*) will hold good, and the total cost of the crop becomes then a charge against the grain only. Examining the

TABLE XXI. Analysis of the Cost of the Oat Crop per Acre 1917-18.

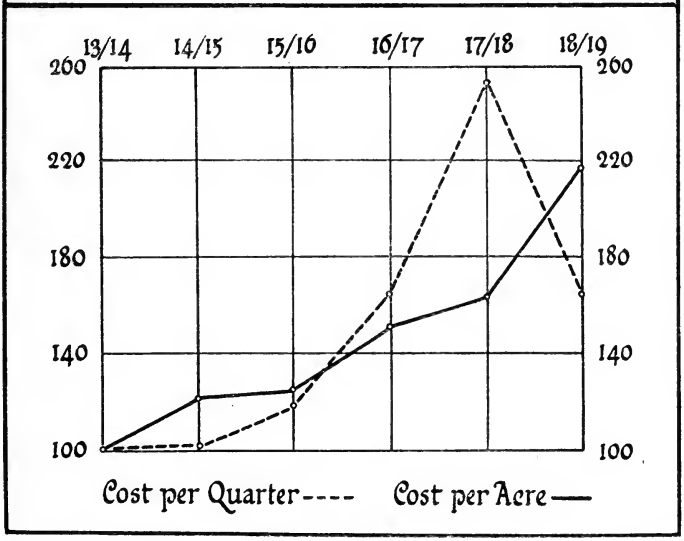
	Highest				Lowest				Average of 4 farms			
	£	s	d	%	£	s	d	%	£	s	d	%
Labour {Horse	1	17	7	21·95		15	8	14·09	1	6	2	18·20
Labour {Manual		19	0	11·09		9	9	8·77		17	6	12·17
Manures {Purchased		8	4	4·87	1	0	11	18·82		12	10	8·93
Manures {Farmyard										1	6	1·04
Rent and Rates	1	8	4	16·54		14	1	12·67		19	3	13·39
Seed	1	0	0	11·68		9	5	8·47		15	8	10·90
Cleaning and Manurial Costs brought forward		18	1	10·56		6	2	5·55		16	10	11·71
Thatching, Threshing and delivery	1	7	6	16·06		9	4	8·39		17	0	11·83
Establishment (or General) Expenses		12	5	7·25	1	5	10	29·24		17	0	11·83
Total Cost per Acre	8	11	3	100·00	5	11	2	100·00	7	3	9	100·00
Total Acreage	36				31·7							
Total Yield (Qrs)	200				188							
Yield per Acre (Qrs)	5·50				5·93				5·21			
Cost per Quarter	£1.10.10				18s. 9d.				£1.7.7			

analysis of the three grain crops ('average' columns) it will be noted that although the total cost per acre varies from 144*s.* per acre in the case of oats to 165*s.* for wheat, and 184*s.* for barley, the percentage distribution of the component parts of the total cost varies very little. Thus labour in each case accounts for about one-third of the total cost; manures and cleaning costs collectively for about one-quarter; threshing, thatching, and delivery for about one-tenth. In fact, the only noteworthy divergencies are in rent and general expenses.

Another matter which should be noted is the importance

of yield on cost per unit of production. Examining the three Tables XIX–XXI it will be observed that not always does the farm showing the lowest acreage cost produce at the lowest cost per quarter. This point, namely the influence of yield on cost, is brought out particularly clearly in the Table of Barley Costs (No. XIX) in which it is seen that the average cost per quarter of barley on three farms is actually less than the cost on either of the farms with the highest and the lowest costs per acre, owing to the very high yield on the farm with a total acreage cost between these two. In the following graph the relation between the cost per unit of land, and the cost per unit of production on a farm growing a large acreage of barley in the East Midlands is shown for a period of six years. The unit cost in either case for the first year (1913–14) is taken as 100. The increase in cost per unit of land is seen to be progressive, and fairly steady, whilst the cost per unit of production shows no direct relation to it.

GRAPH III. Influence of Yield on Cost of Production. Barley Crop, 1913/14 to 1918/19



(*g*) *Hay*

The cost of hay is arrived at in the way already described in connexion with other crops, except that an allowance has to be made for the value of the aftermath. No means for making any accurate measure of the proportion of the year's growth of grass turned into hay and of the proportion grazed in any year has suggested itself. It is probable, however, that the greater part of the year's growth, and certainly the better part of it, goes into the hay crop, and

TABLE XXII. Analysis of the Cost of Clover Hay Crop per Acre 1917/18

	Highest				Lowest				Average of 3 farms			
	£	s	d	%	£	s	d	%	£	s	d	%
Labour { Manual		14	7	22·26		7	0	11·85		11	9	18·85
Labour { Horse		9	1	13·87		4	9	8·04		6	6	10·43
Manures { Purchased		1	5	2·16						2	10	4·54
Manures { Farmyard		7	0	10·69						3	5	5·48
Rent and Rates		9	0	13·74		18	11	32·01		13	3	21·26
Cleaning and Manurial Costs brought forward		7	7	11·58		8	5	14·25		6	5	10·30
Establishment (or General Expenses)		9	1	13·87		6	9	11·43		8	2	13·10
Total Cost per Acre	3	5	6	100·00	2	19	1	100·00	3	2	4	100·00
Yield per Acre (Tons)	1·74				1·03				1·49			
Cost per Ton	£1.17.7				£2.10.10				£2.1.0			

in making an arbitrary division of the total cost between the two parts of the crop the method followed in the figures given in Tables XXII and XXIII has been to charge all labour on hay-making against the hay, and to apportion the remaining costs as to two-thirds to the hay and as to one-third to the aftermath.

It is doubtful whether 'General Expenses' should be included in all cases in the cost. Following the principle laid down that this item is only to be charged against the final products of the farm (see p. 54), it would be included where hay is sold, but omitted where it is produced only to be consumed on the farm.

TABLE XXIII. Analysis of the Net Cost of Meadow Hay Crop per Acre 1917/18

	1.				2.				3.				Average of 3 farms			
	£	s	d	%	£	s	d	%	£	s	d	%	£	s	d	%
*Labour — Manual		2	11	3·91						2	2	6·72		1	6	3·47
*Labour — Horse		4	6	6·03						1	9	5·42		1	8	3·86
*Manures — Purchased		3	0	4·02							7	1·81			10	1·93
*Manures — Residues of Purchased and Farmyard Manure brought forward		5	7	7·47		6	3	16·93						3	8	8·49
*Manures — Manurial Residues of Foods brought forward											7	1·81			3	0·58
*Rent and Rates		13	11	18·64	1	0	0	54·18		14	1	43·67		16	4	37·84
*Establishment (or General) Expenses		4	11	6·58		2	2	5·87			4	1·03		2	1	4·83
Haymaking																
Labour — Manual	1	8	1	37·61		6	1	16·48		9	8	29·98		12	2	28·20
Labour — Horse	.	8	7	11·50		2	5	6·54		3	1	9 56		4	0	9·26
Straw for Thatching (purchased)		3	2	4·24											8	1·54
Total Cost per Acre	3	14	8	100·00	1	16	11	100·00	1	12	3	100·00	2	3	2	100·00
Total Acreage	12				22				22							
Total Yield (Tons)	15				32				23							
Yield per Acre (Tons)	1·25				1·47				1·05				1·25			
Cost per Ton	£2.19.8				£1.5.2				£1.10.9				£1.14.8			

* These charges are two-thirds of the gross amount. One-third of the gross costs down to Haymaking have been taken to Pasture as the estimated cost of the aftermath which was grazed.

(*h*) *Pastures and Grazing*

In no case did the farm records, used here for purposes of illustration, allow of a distinction being drawn between permanent and temporary pastures. The stock, more especially the sheep, are moved about from grass-land to seeds, and from one field to another, and, although there is not the slightest reason why an account should not be kept of the number of days spent on each, it has not yet been attempted, and the grazing, both permanent and temporary, have necessarily been treated as one crop.

As pasturage is nothing more than a food for the live stock of the farm which it is more convenient to produce than to buy, no question of profit or of loss is involved, and it is only necessary to ascertain its cost to the farmer, and to charge this against the stock grazed on it. Any profit or loss which may arise from its use will be realized on the sale of the stock.

To determine the cost of the grazing, the expenditure on manual and horse labour, for operations such as harrowing, rolling, thistle-cutting, &c., is got from the farm labour-sheets, and the horse account; purchased manures applied are charged at that proportion of the total cost which represents the amount held to be exhausted during the year, the remainder being carried forward to the years following. The actual proportion will vary with the nature of the manure; thus, in some parts of the country, such as the East Midlands, where chalk is applied to the land, it is customary to regard no part of it as being exhausted during the four following years—presumably because it may take that time to become properly incorporated with the soil—after which one-eighth is held to be exhausted annually, and when twelve years have passed from the date of the application the item passes out of the books. Nitrate of soda, on the other hand, would generally be regarded as having no lasting effect, and the whole of its cost would be charged against the crop of the year following the application. Farm-yard manure is treated according to the same principle, two-thirds of the cost being charged against the

first season's growth, and the remainder carried forward. The method of apportioning rent and rates has already been described (see p. 56). The values of the manurial residues of the foods consumed on the pastures are got, with the assistance of Voelcker's and Hall's tables as corrected to give current values, from the Food Record Sheets, which indicate the nature and quantity of foods fed to grazing stock. The cost of these residues is written off completely after two years, that is, in the year following their application.

It is not easy in every case to get a reliable basis for the distribution of the cost of forming temporary pastures. In the first place, a farmer does not always know how long he will leave a seed-ley down, for this may depend upon how well it stands, or upon other uncertainties. Where the ley is intended to be left for a definite period, the cost of seed and sowing is written off by equal annual amounts; where the period is uncertain, the cost may be distributed as to one-half over the first year, and as to the other half over the second year, or over the second and third years if the ley remains so long. After the third year of an indeterminate period, nothing is carried forward. It is admitted that this method is to be justified chiefly on the grounds of convenience; a better method may be devised for application in particular cases, but the figures involved are low, and, fortunately, any possible error is a slight one. There is no charge under this head on two of the farms given in Table XXIV below, because in both of these cases the only temporary pasture included in the account is that following clover mown for hay, so that the proportion of the cost of seed and sowing chargeable against the grazing appears in the item 'aftermath'. On most farms it is not merely sufficient to ascertain the cost of the pastures in order to arrive at the cost of the grazing. Commonly the aftermath from clover and meadow-hay fields is grazed, and this grazing must be brought into the account. The most satisfactory way of doing this has not, in all probability, been found as yet. An arbitrary assumption has been

made that the cost of the aftermath grass is one-third of the whole cost of the field, excluding hay-making costs (see p. 86). Thus, the hay crop is not charged with this portion of the cost, and it is now brought into the grazing account. Perhaps a better way of dealing with this item would be by comparing its stock-carrying capacity with that of the pasture fields, or by a comparison of the feeding value of the grass and of the aftermath.

Having now arrived at the total cost of grazing, both seeds and grass, pastures and aftermath, it becomes necessary to devise a means of distributing it among the various classes of live stock. It will happen only rarely that one class of live stock alone is met with on the farm ; in certain forms of sheep-farming, or where dairying is practised, it may be possible, sometimes, to charge the whole cost of the grazing to sheep or to cows ; but in the great majority of cases the grazing will have been enjoyed by horses, cattle, and sheep indiscriminately. A system has been adopted, therefore, by which all classes of stock are converted into their equivalents as sheep. In the Table of Grazing Costs given below (No. XXIV) the following conversion scale has been used :

1 horse	equivalent	to	7	sheep
1 cow or bullock	,,	,,	7	,,
1 yearling beast	,,	,,	3·5	,,

It is obvious that no scale can have a general application,[1] and a better way of arranging the figures would be by a comparison of weights if such were possible. When a basis has been settled the live stock are reduced to their sheep-unit equivalents, the cost per unit is calculated, and the

[1] In the first edition of this book the following scale for the conversion of different classes of stock into units comparable for grazing-cost distribution was used :

1 horse	equivalent	to	8	sheep
1 cow or bullock	,,	,,	6	,,
1 yearling beast	,,	,,	4	,,

Experience has indicated that this scale was too high in the generality of cases.

distribution of the grazing cost can be effected. On the three farms under consideration, though widely separated, it was found that the cost of grazing varied hardly at all.

TABLE XXIV. Analysis of the Cost of Grazing 1917/18

		1.			2.			3.		
		£	s	d	£	s	d	£	s	d
Labour	Manual	3	10	3	11	7	8½			
	Horse				1	5	3			
Manures	Purchased 1917/18				2	18	4			
	Food Residues 1916/17	25	8	7	26	1	4½	2	14	5
	Food Residues (brought forᵈ unexhausted)				3	17	6½			
For temporary pastures	Unexhausted Cost of Seed and Sowing brought forward				42	16	8			
	Seed				38	18	4			
Rent and Rates		214	12	0	251	6	6½	48	4	3
Estimated Cost of aftermath of hayland		9	1	8	53	16	7	13	6	9
Total Cost of Grazing		252	12	6	432	8	4	59	5	5
Total Sheep Units carried		638			1176			168		
Cost per Sheep Unit per annum		7s. 11d.			7s. 4d.			7s. 1d.		

4. Animal Products

(*a*) *Meat*

The custom prevailing almost universally of selling fat stock without any attempt being made to ascertain the weight of the animals changing hands has made it impossible to give figures illustrating the cost of production of beef, of mutton, or of pork. No doubt the value of the weigh-bridge to the parties concerned will come to be realized by them as time goes by, and until its use becomes general the means for controlling extravagance in meat production will always be wanting.

Given the weight of the finished product, the determination of cost should be a simple matter. The cost of the stock, whether bought or bred, forms the starting-point of the calculation ; and to this is added all labour for feeding and attendance, all purchased foods at their purchase price, all home-grown foods and grazing at the cost of production in each case, and the due proportion of the overhead charges. From the gross cost thus arrived at is deducted the value of

food residues, and the resultant figure is the cost of the animal or animals in fat condition. Given the live-weight, the cost per live-hundredweight or stone is determined. No charge is necessary for rent in the case of housed animals. The reason for making no apportionment of rent between buildings and land has already been stated (see p. 56, *ante*), and the live stock will pay their share of this charge in the cost of the home-grown foods which they consume. In the case of sheep an additional deduction from gross cost may be necessary in respect of wool sold. Just as it is impossible to separate the cost of grain from that of straw, both being produced simultaneously by the same expenditure, so it is impossible to divide the cost of sheep between meat and wool. It is suggested, therefore, that the wool should be regarded as a by-product in the production of mutton, and any sum realized by its sale will then appear in the account as a credit, going to reduce the net cost of the meat. A sheep account kept in this way will show at once to what extent mutton production is profitable *per se*, and to what extent the profit depends upon the price of wool.

The only difficulty likely to arise in the determination of meat costs is in connexion with the initial figure of cost for home-bred store stock. In the case of herds it is not always necessary, nor is it ever requisite in the case of flocks, to ascertain the cost of the young stock to be fed. The breeding stock can be valued, year by year, at a fixed price per head (see p. 40, *ante*) and when this figure is credited the balance of the account represents the cost of producing a certain weight of meat. Although this method simplifies the work without loss of accuracy, and should be applied wherever possible, it cannot be used exclusively except in cases where the marketing of the finished product is completed before the closing of the financial year. Where there is unfinished stock on hand at the date of closing a valuation by some method other than that applied to breeding stock becomes necessary. Where the records of labour and foods are kept in sufficient detail it may be possible to value this class of stock at actual cost; otherwise, in view of the fact that they are shortly to be marketed,

it may be permissible to value them at their estimated market value at the date of the valuation. The former of these methods is in every way preferable, as being less likely to introduce values outside the farmer's own experience—in fact, reference to market values should only be had in the absence of data essential to a calculation of true cost.

(*b*) *Milk*

The calculation of the cost of milk production has received, probably, more attention than that given to any other agricultural commodity. It is the only home-produced article of food for which the Government has attempted to fix prices based on cost calculations. This fact is explained partly by the importance of milk to the consuming public, which made it necessary during the period of food control so to regulate prices that the supply would be maintained without undue exploitation of the public, and partly by the assumption (probably erroneous) that milk production lends itself more readily to cost determination than do other forms of farm produce.

Nothing has illustrated more clearly the confusion of thought on the question of what constitutes the cost of an article, and the need for careful consideration of questions of method and principle, than the public discussion of milk costs during the past few years. The attempt to cost separately for 'winter' and 'summer' milk (a distinction not recognized by the cow), the application of fictitious market prices to foods such as roots and straw, guesswork calculations of the cost of herd-maintenance, and so forth, all of which have been commonly made, indicate a looseness of thought and a lack of principle which make it impossible to arrive at conclusions even approximately accurate.

It is necessary to consider very carefully what, exactly, are the items entering into the cost of milk. An attempt was made in the earlier stages of the work to keep the costs of the various age-classes of dairy stock in water-tight compartments; the plan was to ascertain the cost of the young stock, up to the time of the first calf, by recording the

foods and labour, &c., spent on them, and to bring them into the dairy herd on calving at a valuation based on this cost. The herd itself was valued at a fixed price per head represented by this figure so that the fluctuations of the market were eliminated and the capital value of the herd became a matter of numbers only; the cost of labour, foods, and other expenses were recorded, and cows drafted out of the herd on account of old age, or other cause, were credited to the herd at the valuation figure. In this way the net cost of the dairy herd was to be calculated, and from it the cost of the milk was to be found with the aid of the records of milk yields.

This plan had speedily to be abandoned. It was found to be impossible, in practice, to divide the stock into these classes, and then to account accurately for them. Labour could only be apportioned roughly, for it was difficult to divide the men's time satisfactorily where dry cows and young heifers were being tended indiscriminately, and where calf-rearing and milk production were going on side by side. Similarly, with the feeding, the difficulty of keeping the food costs distinct in cases where there was little or no attempt made to separate the stock for feeding purposes into the classes appearing in the books was insuperable, and was still further complicated by the practice of fattening off old cows for the butcher—a process which will begin while the cow in still in milk, and defies all attempts on the part of the farm accountant to distinguish between the food which produces milk and that which produces meat.

This plan was therefore abandoned, and on reviewing the position it became obvious that the subdivision of the stock thus attempted was quite unnecessary. Where milk-production is the object of the management, both the raising of the young stock and the fattening off of the old cows are essential parts of the whole process. It is not necessary to keep the cost of labour and foods expended on rearing heifers to take their place in the herd separate from the cost of maintaining the herd itself, neither is it necessary to eliminate the cost of feeding off the old cows. Both of these things contribute to the system of management for

milk production on farms where the dairy stock is raised by the farmer, and thus both of them must enter into the cost of the milk produced. The cost of raising the young stock *minus* the profit derived from feeding the old cows for beef (or *plus* the loss consequent on this process. as the case may be) represents the cost of maintaining the capital value of the herd—in other words, the depreciation on the cows, a figure very difficult to determine by any direct means.

Thus, the cost of keeping the bull, the cost of raising young cow-stock to replenish the herd, the cost of feeding off old cows for beef, all these items can be slumped with the cost of keeping the milking herd, and together they make up the cost of milk production on the farm.

This method of calculation can be followed only where milk production is the main object of the herd management, whether for butter, cheese, or new milk. Where the raising of store cattle, or the feeding of beef, is practised other than as an incident of dairying, it is necessary, of course, to take account of these matters separately.

The valuation includes bulls and young stock, as well as cows. It is made on the basis of a fixed figure per head for each class of stock, and this figure should not be varied in an attempt to conform with temporary fluctuations of the market. Where breeding stock is being dealt with the importance of keeping the valuation free from the influence of market prices, which are no concern of the man who is not selling, and which are bound to bring about fictitious results, has been stated already.[1] The valuation of the stock will remain constant, therefore, from year to year except in so far as the numbers of any age-class may vary. The figures used for valuation purposes should represent as nearly as possible the cost at the various ages. In most cases the amounts can only be estimated, but with reasonable care they may be made fairly accurate, and the effect of any error will be eliminated after the first year, if the same scale be adhered to. Table XXV gives an analysis of the

[1] See *ante*, p. 41. Also Orwin, *op. cit.*, p. 10.

cost of milk production on three farms, two for the year 1917–18, and one for a more recent period.

The accounts are charged with the value of the dairy stock of all ages at the beginning of the year, to which is added the cost of stock purchased during the year; the manual and horse labour costs; the cost of purchased and home-grown foods. From the cost of foods is deducted the value of the food residues chargeable against the Farm-yard Manure or the Pastures, according as to whether the foods were fed to housed stock or to stock on grass. The addition of the cost of grazing, calculated as already described (see p. 88), completes the food costs. Then follow sundry cash disbursements, and General Expenses which include the share of the establishment expenses chargeable against the cows. The composition of this item and its distribution have been dealt with already (see p. 54).

Thus the *gross* total cost of the milk production is arrived at, and by deducting the sales of draft cows, calves, &c., and also the valuation of the stock at the end of the year, the *net* cost is got. The milk record-sheets provide the number of gallons of milk produced during the year, and so the cost per gallon is got by division.

In the case of the Gloucestershire farm a number of cows were taken in to graze at a weekly charge. The grazing and other foods given to them were included with those of the farm cattle, and thus it was necessary to give the dairy account credit for the receipts from the agisted stock.

(*c*) *Distribution of Milk*

From the consumer's point of view the cost of distribution is an essential part of the cost of production. Except in dairy farming, however, the producer-retailer is rare in agriculture, and opportunities for examining costs of distribution of farm produce are not often met with. In Table XXVI is given the cost of retailing milk for a series of years from a midland-counties farm situated in the suburbs of a large industrial town. A dividing line in the total cost of milk was drawn at the point where the milk

TABLE XXV. Cost of the Production of Milk

	South Midlands II. 1917/18						East Midlands I. 1917/18						Gloucestershire I. 1919/20					
	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d
Initial Valuation of Stock (Cows, Heifers, Calves and Bulls)	1748	10	3				1575	0	0				432	6	0			
Cattle Purchased	1308	13	5				141	19	6				698	13	3			
				3057	3	8				1716	19	6				1131	1	3
Manual Labour	485	7	5				139	8	7				133	12	10			
Horse Labour	4	5	5½				3	13	0				1	4	4			
				489	12	10½				143	1	7				134	7	2
Purchased Foods	804	18	5½				233	13	10				202	7	4			
Home-grown Foods	1035	11	7				156	2	0				147	8	6½			
	1840	10	0½				839	15	10				349	15	10½			
Less value of Manurial Residues	149	11	7				42	7	0				28	8	3			
				1690	18	5½				347	8	10				321	7	7½
Grazing				231	6	3				86	6	11				58	16	10
Sundry Cash Payments, viz:–																		
Vet. Surgeon, Medicine, Subscriptions to Milk-recording Society, Shorthorn Society, etc.				34	6	1				11	3	6				39	19	7
General Expenses (including rent of cowhouses, depreciation on implements and utensils, etc.				218	6	6½				45	15	3				50	3	1
				5721	13	10½				2351	5	7				1736	5	6½
Stock sold (Cows, Calves, etc.)	1458	17	4				265	10	0				161	5	4			
Sundry receipts, viz:–																		
Cow-keep													174	3	6			
Service, etc.													4	10	0			
Final Valuation of Stock (Cows, etc.)	1981	0	0				1175	0	0				969	8	3			
				3439	17	4				1440	10	0				1309	7	1
Total Cost of Milk				2281	16	6½				910	15	7				426	18	5½
Number of Gallons produced				30,847						13,937						4292		
Cost per Gallon				17,753 pence						15,684 pence						23,87 pence		

TABLE XXVI. Cost of the Distribution of Milk 1915/16 to 1917/18

Year	Locality	Labour						Rent			Sundry Purchases, Depreciation, General Expenses, etc.			Total Cost			Number of Gallons of Milk Distributed	Cost per Gallon
		Manual and Clerical			Horse													
		£	s	d	£	s	d	£	s	d	£	s	d	£	s	d		d
1915/16	Midland Manufacturing Town	1050	13	8½	303	3	0½	75	0	0	161	15	5½	1590	12	2½	Gallons 95,900	3·98
1916/17		1163	5	4½	352	5	8½	75	0	0	337	15	5½	1928	6	6	104,169	4·44
1917/18		1242	10	2½	497	0	9½	75	0	0	430	2	1	2244	13	1	112,833	4·77

left the refrigerator, and all expenses subsequent to this stage were treated as distribution costs.

'Manual labour' includes all work on handling the trade, from the dairy up to the consumers' doors, the roundsmen being paid by commission on sales, and other labour in the usual way. 'Clerical labour' represents the time of clerks engaged on keeping customers' accounts. The column for 'Horses' gives the cost of the milk-float ponies, and 'Rent' is an apportionment of the total rent on that part of the premises used for the retail trade. 'Sundry purchases, depreciation, and general expenses, &c.', include the purchase of dairy requisites of every kind, the repair and replacement of utensils and depreciation on them, and the establishment charges. It should be noted that the milk distributed includes a large quantity purchased in addition to that which is produced on the farm, but the account deals only with the handling of this milk, the consideration paid for it having been eliminated for the present purpose.

CHAPTER V

SECONDARY RESULTS

It has been stated already that the objects of this work are the discussion of principles and methods and the illustration of their application. In the foregoing chapter figures have been given to show the value of records and statistics to the farm manager in the control of his business, but the collection of materials of this nature on a sufficient scale would serve a much wider purpose, for it would facilitate the study of the organization of the agricultural industry as a whole. The extent of the information to be gained under this head would be limited only by the degree of completeness of the statistics collected, and a few examples of the methods of attacking certain agricultural economic problems and of the results to be expected are given here.[1]

1. The Measurement of the Standard of Production in Agriculture

It is a matter of common observation that even in the same agricultural district and under similar economic conditions the widest variations are to be met with not only in systems of farm management but also in the organization for production on different farms managed under the same system. The position seems to be that as regards style of farming, and also as regards the system of organization for any particular style, the farmer is guided by no definite principles; rather does he follow some personal inclination, some practice learned during his apprenticeship, or some principle no more trustworthy than these, than study the economic conditions of his particular locality and the

[1] Once again it must be emphasized that the figures following, though drawn from real statistics, are introduced for purposes of illustration only and do not admit of generalization. Until a greater volume of evidence can be secured it will not be possible to make contributions towards the solution of the various problems discussed

equipment of his holding to meet them with a maximum of efficiency. Most farmers know the technical side of their business; many of them have some knowledge of the sciences upon which success in raising crops and stock depend. But nowhere nor at any time have they been taught to regard the market, considered with reference to the capabilities of their own particular holdings, as the only guide to the proper style of management to be pursued, and then to organize their farms so that maximum output is secured with the minimum utilization of the factors of production.

From the records of five farms in 1919–20 it is possible to illustrate a method of comparing standards of production in agriculture. The Census of Production of 1907 has made people familiar with the standard of production *per man* in the industry as an index of efficiency, but agriculturists have long used, and often still favour, the standard of production *per unit of land*—usually *per acre*. These two results, used separately, afford a very partial indication of the results of farm organization, and if they be combined they are still inadequate for the provision of any satisfactory measure of the efficiency of any farm, or farming system, as represented by its net output in relation to the factors required to produce this. There are three original factors in all farm organization for production—labour, capital, and land. The two former terms need no explanation, but it is necessary to point out that the use of the mere term 'land' is apt to lead to somewhat serious error. This factor is really the contribution of the landowner to production (in the English system of tenant-farming), and consists of land and all its permanent equipment (see p. 55, *ante*). This factor, when measured merely by surface area, varies enormously in quality from district to district and even from farm to farm. There are differences of quality in any units of quantity of the three factors, but differences of quality in parcels of 100 acres of land are greater than will be found in various groups of three farm workers or even in various units of £1,000 of farmers' capital. For this

reason it is necessary to find some method of securing greater uniformity of quality in the units of land and its equipment even when using land alone as *a measure of the standard of output*. However, the familiar methods of measuring production may be illustrated from the records of these five farms, before the necessary amplifications are indicated.

TABLE XXVII

Farm.	Totals.		Net Output.		
	Land acres.	*Men employed.*	*Total.*	*Per 100 acres land.*	*Per man.*
			£	£	£
A	965	23	6,717	696	292
B	196·5	6·4	1,366	694	213
C	88·5	3·7	746	842	201
D	371	17	5,213	1,405	307
E	323	5	1,780	551	356
Total	1,944	55·1	15,822	814	287

Measuring the production of these holdings by the unit of land Farm D would be judged the best of the five, but when the production per man is used, Farm E would be reckoned the best.

But, as has just been said, the production per unit of land varies with the quality of the land itself much more than the production per man varies with the quality of the men. It is therefore necessary to find some method of equalizing the units of land as regards their quality. This may be done by estimating the value of the landowners' capital in land and its equipment. The records for these farms do not include valuations of the land and its permanent equipment, but reasonable estimates may be obtained by capitalizing the rents at twenty years' purchase. If this is done the following comparison of production per unit of land and per unit of landowners' capital will be obtained.

In this Table the variations in the rate of production per £1,000 of landowner's capital are much smaller than those in the rate per 100 acres of land, as shown in Table XXVII, and it is clear that some of the errors due to differences in the quality of land have been reduced by the assessment

of the productive capacity of the land and its permanent equipment on the basis of its capital value.

TABLE XXVIII

Farm.	Totals.			Net Output.	
	Acreage.	Rent.	Capital Value.	Per 100 acres of land.	Per £1,000 of Landowner's Capital.
	Acres.	£	£	£	£
A	965	785	15,700	696	421
B	196·5	254	5,080	694	270
C	88·5	100	2,000	842	373
D	371	898	17,960	1,405	290
E	323	365	7,300	551	244
	1,944	2,402	48,040	814	329

But whether area, or a certain amount of capital value of land and equipment, be taken as the unit for measurement of production, the standard provided is quite inadequate for the purpose of estimating the productive efficiency of the organization; and this is still the case even if the standard per unit of land or landed capital be combined with the standard per man, for the calculation takes no account of the amount of farmers' capital used in production.

The following Table shows the rate of output for all the standards which have been mentioned, and also the rate per unit of farmers' capital. The total figures are shown only in the case of farmers' capital, as other totals have been shown already in the Tables above.

TABLE XXIX

Farm.	Net Output per Unit.					
	Labour.	Landowner.		Farmer.	Farmers' Capital.	
	Per Man.	Per 100 acres Land.	Per £1,000 Landowner's Capital.	Per £1,000 Farmer's Capital.	Total	Per Acre.
	£	£	£	£	£	£
A	292	696	421	695	9,660	10·0
B	213	694	270	607	2,250	11·45
C	201	842	373	373	2,000	22·6
D	307	1,405	290	1,438	3,623	9·76
E	356	551	244	247	7,200	22·29
Average	287	814	329	640	24,733	12·72

From this Table the efficiency of the farm organization

in the use of the primary factors in production may be judged by any one of the four standards. But the fallacy of any single standard when a general view is required will be seen quite clearly if the Table is studied. Thus, judged by the standard per man, Farm E gives the best results, whilst by that of the yield per unit of farmer's or landowner's capital it gives the worst. Nor is it clear from this Table which farm gives the best results throughout. At the same time it is true that if on any occasion, or at any place, one of the factors were exceedingly scarce and valuable, and great economy in use had to be considered, such a Table would prove to be a useful guide to the right organization of farm production in that it would indicate the results that might be expected from combinations of the factors of production in various quantities. It is realized, of course, that a much larger number of records would be required before definite conclusions could be obtained, but the present purpose is to indicate methods only.

However, as there may be at any time considerable difference in opinion as to which factor should be used most economically, and as no factor can be entirely eliminated, it is necessary to find some method of combining all the factors and of judging by a single standard. This can be obtained by stating the quantity of each factor used in the production of a given amount of net output on any number of farms or of farming systems. For this purpose the mere unit of land must not be used, and the land and its permanent equipment must be quoted in terms of its capital value.

TABLE XXX

Quantity of Landowner's Capital, Farmer's Capital, and Labour required to produce £1,000 of value of Net Output.

Farm.	*Landowner's Capital.* £	*Farmer's Capital.* £	*Labour Men.* £
A	2,337	1,438	3·42
B	3,718	1,647	4·69
C	2,681	2,681	4·95
D	3,445	695	3·26
E	4,101	4,045	2·81
Average	3,036	1,563	3·48

By reducing the contents of this Table to similar form, indicating the differences in numerical quantity without reference to the character of the factors, it is possible to show the variations in their total combination, and to make some comparisons of the results. The amounts of the three factors used by Farm A in the production of net output are taken as the unit of comparison.

TABLE XXXI

Farm	*Landowner's Capital.*	*Farmer's Capital.*	*Labour.*	*Total Combination.*	*Net. Output.*
					£
A	1	1	1	3·0	1,000
B	1·58	1·14	1·36	4·08	1,000
C	1·15	1·86	1·44	4·45	1,000
D	1·47	0·48	0·95	2·90	1,000
E	1·75	2·81	0·82	5·38	1,000

On the whole Farm A gives the best result, for although Farm D requires less of the total factors to produce the amount of net output, it is almost certain that better results would be obtainable on this farm if the farmer's capital were slightly increased, for the capital equipment furnished by the farmer is too low in proportion to the quality of the land and the amount of labour used. On the other hand, in the case of E the amount of labour might be increased with advantageous results. B could probably be better organized if a little more of labour and of farmer's capital were applied to the land. But in the case of C, the results would be better if the labour and farmer's capital were spread over a little more land.

With more numerous records it would almost certainly be possible to estimate the best quantitative combination of the factors of production on land of known character for given systems of farming, and it would be quite easy to assess the value-producing capacity (as shown by the value of net output) of different combinations of land, labour, and capital as used in different systems of farming.

It should be added that throughout this study no attention has been paid to the quantity of food or other materials produced, for it is assumed that under normal conditions

the market value of the materials expresses their real value to the whole body of consumers.

2. The Size of Agricultural Holdings in Relation to Efficiency

Much controversy has centred round the question of what is the most economical unit of land for farm production, and it must be obvious that there can be no absolute answer to it. The quality of the land in certain cases, and market, transport, and climatic conditions in many more, make it impossible to determine even within wide limits the size of the holding on which the principal factors of production can be employed with maximum effect. Within similar areas, however, and in limited districts much work can and should be done to collect evidence on this point for the information of those concerned with the administration of land. Comparisons of the results of farming large areas and smaller ones have not infrequently been made, but most if not all of them are unsatisfactory in that they are based as a rule on a comparison of the yield per acre only, instead of on a comparison of the results of the application of all the factors of production, and the fallacy of this system of measurement has already been shown (see Tables XXVII and XXVIII). Moreover, no regard is had to the fact that in many areas there has been a tendency to select the best land for the smaller farms and to organize the management of less productive soils in larger areas. Thus, comparisons of productivity based on unit areas are faulty in two ways.

To determine the most productive farming unit in any area the method to be pursued must be, first, to select farms under similar economic and soil conditions ; second, to group them according to their extent ; third, to collect the statistical data necessary for a comparison of their economic results to be made. An inquiry of this nature was undertaken in a Welsh county recently, and although the statistical data is not sufficiently complete to allow of

a full test being made (for the difficulty of obtaining a full valuation of the farmers' capital in every case owing to the lack of proper books of account prevents the measurement of efficiency according to the method described above), the results have considerable value as an illustration of method and of a line of investigation well worthy of pursuit.

The total area investigated was 9,390 acres divided into fifty-two farms of various sizes, and the conditions throughout were sufficiently uniform to admit of comparisons being made—in fact, the area was selected for this reason. The farms were classified into five groups according to acreage, and particulars were obtained on each holding of the acreage, percentage of arable land, altitude, rent, number of men employed, and the total sales. To complete the data particulars should have been obtained of the farmers' capital invested, and of the purchases and other expenses, but in the great majority of cases nothing in the shape of book-keeping was attempted on the farms, so that this information, essential to a complete investigation, could not be got. The figures serve, however, to illustrate a line of inquiry which should have important results if carried out more fully with the aid of systematic book-keeping.

The results obtained from this partial investigation are, however, not without interest. The figures collected from each farm have been thrown together and averaged according to the acreage grouping, and the results are given in the following Table.

TABLE XXXII

Group	*No. of Farms in each group.*	*Average size of Farms.*	*Average Arable Land per cent.*	*Altitude.*	*Average Rent per Acre.*	*Average Men per 100 Acres.*	*Sales per Acre.*	*Sales per Man.*
Acres.				*Feet.*	*s. d.*		£ *s. d.*	£ *s. d.*
I. 0–50	5	39	17	341–369	32 10	7·1	11 19 11	168 19 0
II. 50–100	10	78	22	319–384	33 0	6·4	9 19 2	156 2 0
III. 100–150	14	138	21	370–453	27 2	4·2	7 19 1	189 0 0
IV. 150–250	11	201	11·7	330–411	28 4	3·3	7 5 8	222 12 1
V. over 250	12	356	18·0	286–435	26 5	2·6	8 4 4	316 19 0

It will be noted that the conditions under which the farming is carried on in the various groups show no material differences as between one group and another, except in the matter of area. There is a tendency for rent to fall as the size of the holdings increases, but it is not pronounced, and in one case (Group IV) the percentage of grass-land to arable land is considerably higher than in the rest; but considering the variations which must be expected in the conditions prevailing over any area of fifteen square miles in extent, it may be claimed that in respect of altitude, quality of land and proportion of arable to grass the holdings in these five groups are fairly comparable.

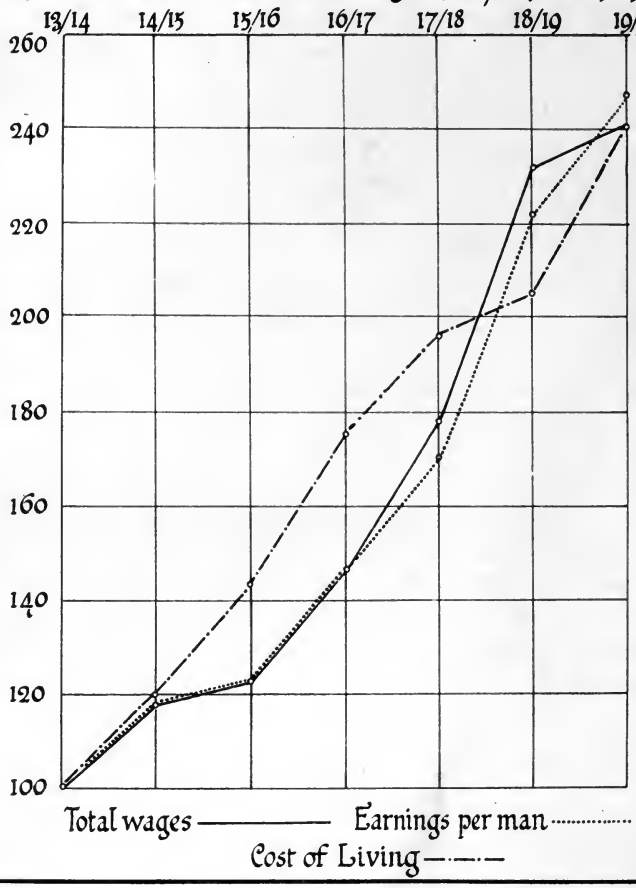
In general the results show very clearly that employment and production vary inversely with the size of the holding, but that the production per man employed varies directly with the size of the holding. In the absence of the further statistical data required the results cannot be taken as conclusive, but it is probable that the fuller examination of the farms would confirm these results. If so, they summarize the whole case both for and against the large farm as opposed to the small holding, for whereas the former makes possible a bigger reward to the workers in the industry, the latter provides a larger volume of employment and produces a greater value in products. Obviously no such generalization can be made from this example, which is introduced only to show a method by which to apply agricultural costings to the study of an important problem in agricultural economics.

3. The Relation of Labour Cost to Earnings and to the Cost of Living

The data which only accounts can furnish would throw much light upon labour problems, and much controversy would have been obviated during the past few years if farmers could have brought evidence of this nature to bear upon their discussions with the representatives of labour. The question here is less one of method than of the utiliza-

tion of the results of ordinary book-keeping processes, and the accounts of a large farm in the east midlands have been taken to test the effect of the rise in wages on the efficiency

GRAPH IV. The Relation of Wages and Earnings to the Cost of Living, 1913/14 to 1919/20.



of the worker and of the management. It is contended by many that a low standard of remuneration results in a low standard of output, and it was the *dictum* of a great contractor that 'all labour costs the same'. On the other

hand, a half-stoked engine cannot run at full speed, and low wage-rates do nothing to stimulate the management to make the most effective use of labour.

In the graph (opposite) a comparison is made between the rise in total wages and the rise in earnings per man during the years 1913–14 to 1919–20. If higher wages induce better work, or more efficient management of labour, the curve for 'total wages' should rise less sharply than the curve for 'earnings per man', but in this respect the results on the farm in question are negative, for the two curves follow each other very closely throughout the seven-year period. Perhaps the chief interest in the graph lies in the fact that the rise in the labour bill and the rise in the earnings per man were identical during the period that wage-rates were fixed by the play of the market, and that the influence of the Orders of the Agricultural Wages Board on the farm in question was to reduce the efficiency either of labour or of the direction of labour. This effect as measured by figures is, however, so slight as to be negligible, and it is common knowledge that there were other factors in the labour situation during the years 1916–19 which would more than account for the slight differences indicated in the graph. The curve introduced to show the rise in the cost of living indicates a very close correspondence between the changes in wages and in the cost of living.[1]

4. The Distribution of the Net Returns of Farming

In the *Final Report on the First Census of Production of the United Kingdom* (1907)[2] a calculation is made of the value of the net output per head of persons employed in the industries reviewed. This net output is ascertained by deducting the cost of materials at the works from the value of the output at the works, and the difference constitutes for any industry the fund from which wages, salaries, rent, royalties, rates, taxes, depreciation, advertisement, and sales expenses, and all other similar charges have to be defrayed

[1] The curve for the cost of living is plotted from the figures published in the *Labour Gazette*

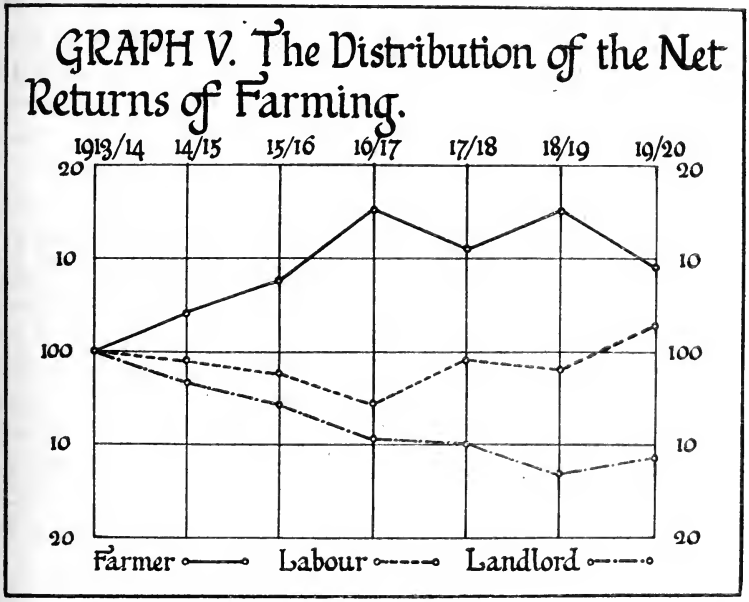
[2] Cd. 6320.

as well as profits. The same basis of calculation was adopted in the *Report of the Board of Agriculture and Fisheries* on the *Agricultural Output of Great Britain* [1] made in connexion with the Census of Production Act, 1906. In applying this measure of net output to the agricultural industry the method is to value the farmer's capital at the beginning of the year and to add to this figure all live and dead stock bought during the year, foods, manures, tradesmen's bills, on-cost and establishment charges, &c., and to deduct the total from the sales during the year added to the valuation of the farmer's capital at the end of the year. Figures collected in this way from a sufficient number of farm accounts would not only afford valuable evidence of the comparative productivity of the industry, but also would assist in the regulation of wages by an examination of the distribution of the net output between the three interests concerned—namely, the return received by the landlord on his capital, that received by the farmer as a return on his capital and for his own remuneration, and that received by the workers as a reward for their labour. Only in the case of the workers is this share of the net output available as net income. The landlord has to incur a considerable expenditure upon the farm in the way of repairs and maintenance, and this must come out of his share of the net output. From an inquiry conducted by the Land Agents' Society in the year 1909, it appeared that about 30 per cent. of the rent received by the landlord is expended by him in repairs, insurance, management, and similar payments necessary to maintain the property in a condition to produce the rent.[2] The farmer, too, may have certain expenses to meet not covered by those deducted in arriving at the net output, and his share of this figure has also to cover some rate of interest on his working capital besides the reward due to him for the exercise of his managerial functions. Thus, in considering the distribution of the profits of agri-

[1] Cd. 6277.

[2] The figure is the average expenditure on 224 estates extending to some 2,000,000 acres. See *Journal of the Land Agents' Society*, viii. 214 (1909).

culture between the three interests concerned, it is necessary to distinguish between *net output* as defined in the Census of Production and what may be termed the *net returns*. The net returns are ascertained by deducting from the net output any additional expenses of the business not already allowed for; a sum representing about 7 per cent. interest on the farmer's capital (this figure being based on current rates for money), and one-third of the amount of the rent.



Figures collected prior to the War go to show that about 40 per cent. of the net returns went to the farmer, the same proportion to the workers, and about 20 per cent. to the landlord, and the variations from these average figures in individual cases were comparatively slight, even under widely diversified conditions as to localities and types of farming. It may not be without interest to examine the effect which changes in wages and prices have had on the distribution of net returns since 1914. The figures used for the construction of the graph shown here are those of the east midlands farm already referred to, and the starting

point (100) represents the proportion of the total net returns received by each interest in the year 1913–14.

If the rise in the value of the total net returns during the years 1914–15 to 1919–20 had been shared in the same proportion as previously by all three interests, the graph would consist of a straight 'curve' following the 100 line, whilst if there had been any changes in the relative shares received these would be indicated by variations above or below this line. It is of interest to note that the increase in the value of the net returns went almost entirely to the farmer until the setting up of the Agricultural Wages Board, and that the effect of the Orders of the Board was to restore the workers' share in the distribution practically to its pre-War proportion of the total net returns. Thus, the position at the close of the year 1919–20 was that the landlord had received no share of the increased prosperity of agriculture, the worker had received a share about the same as that previously received from the industry, and the farmer had received an increase proportionate to his former share *plus* the amount which would have gone to the landlord had the same rate of distribution continued. The figures show that wages and rents, particularly the latter, adjust themselves but slowly to changing conditions in the results of farming business, and incidentally they may afford some consolation to the Appointed Members of the Agricultural Wages Board.

The four examples given above are included for the purpose of indicating the value of farm accounts and records of every kind in the study of the economic problems of the agricultural industry, and to suggest methods for their use. More data of this kind are urgently needed ; in fact, it may be asserted that the divergencies of opinion on many matters of importance in the organization of agriculture, as well as the difficulty of arriving at a reasoned national policy, are due almost entirely to the lack of statistical information, particularly such as can best be obtained by scientific book-keeping.

APPENDIX I

AN ALTERNATIVE BASIS FOR COST DETERMINATION

One of the obstacles in the way of the general adoption of costing as an aid to farm management is the amount of clerical labour involved, and as it is true that any system of departmental accounting is bound to entail a good deal of detail work, it is the more necessary to explore every possible short cut through the present methods, and to consider changes of method which may lead to useful results at less effort and expense. Brief reference to one suggestion to this end has already been made (see p. 52, *ante*).

It is not suggested, at this stage, that any appreciable amount of labour can be saved in the actual recording of labour, &c., at the farmers' end; indeed there are strong arguments in favour of a system of still greater detail in the collection of data, particularly as to the time of the stockmen, but certain alternative methods are here put forward which, if found satisfactory after a test in practice, should result in the saving of a great deal of labour without sacrificing any part of the measure of accuracy achieved under the present methods.

Under the system described in this volume, which is the one in general use, the cost of any crop is got by allocating manual labour, horse labour, manures applied, &c., in the first instance, to the various fields under the crop, together with such details as would enable the responsible accountant to arrive at a net cost after deducting any beneficial cultivations, manurial residues, &c., not strictly chargeable against the particular crop. This method is usually followed, in the case of corn crops, as far as the harvest, after which such additional costs as thatching, threshing, and delivering

are more easily recorded in the crop account—to which the net costs on the various fields up to harvesting have been transferred. Taking the case of a farm of 500 acres divided, say, into forty fields, the multiplicity of accounts involved under this system is easily imagined.

It is fairly obvious that apart from the actual recording of time, materials, &c., the main part of the clerical labour necessitated under such a costing scheme is employed in allocating the manual and horse labour to the various fields, for the apportionment of labour on live-stock is a much simpler matter, and it is now suggested that if the time spent by men and horses on the land were allocated in the first instance to the various farming operations, such as ploughing, cultivating, rolling, harrowing, &c., instead of to the fields, the saving in clerical work would be enormous. In addition, a new and more accurate basis would be afforded for the distribution of implement depreciation and repairs, and the total cost of each of the various operations performed on the farm arrived at in this way could then be spread over the various crops according to a record of cultivations carried out on each. Such a record is not uncommonly kept, and it would, of course, be absolutely necessary, and care would need to be exercised in the case of double cultivations for cleaning purposes, or of re-sowing after the failure of a crop, but these safeguards are needed equally under present methods of costing.

The method might possibly lead to slight inaccuracies in particular cases, but a survey of the position suggests that even if the cost of ploughing or harvesting two equal areas on any farm varied to any appreciable extent, such variation would be due largely to temporary conditions—such as a break in the weather—and that to average the costs of cultivations over the whole farm would not upset conclusions in the long run. It might be desirable in certain cases to be able to compare the costs of similar cultivations, manurings, &c., as between one field and another, but remembering that it is impossible to distribute Rent, or Cleaning Costs, or Manurial Residues except on an arbitrary

basis, it may be argued that greater accuracy than would be afforded by averaging the various cultivations and labour costs is unnecessary.

This method of costing by operations instead of by direct apportionment of manual and horse labour has not yet been tested in practice, but the points in its favour seem to be sufficient, *prima facie*, to justify a trial.

APPENDIX II

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PRINTED IN ENGLAND
AT THE OXFORD UNIVERSITY PRESS