Potatoes (O.S.)

FEBRUARY 1957 ECONOMIC REPORT No. 41

POTATO HARVESTING

by

C. J. BLACK, B.Sc., B.Litt., N.D.A.

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CONTENTS

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F O R E W O R D

The harvesting of the potato crop presents a problem of organisation which has to be solved annually by farmers working under very variable conditions of soil, type of crop, acreage grown, etc. In the main, the solution of this problem has been to supplement the regular workers on the farm by the employment of gangs of casual workers - men, women and children, either separately or as mixed gangs - to pick the potatoes in the field. In recent years it has become increasingly difficult to find enough casual labour at ordinary day rates to harvest the crop in the limited time available. There is no likelihood but that this difficulty will become greater in the future. The production of a machine capable of doing this work under all conditions and thus offering a solution on these lines has still to come. It is important and timely, therefore, to consider any other possibility which may alleviate the present situation.

This report on "POTATO HARVESTING" prepared by Mr. C. J. Black, is the result of a long period of intensive and detailed study of potato harvesting under field conditions. The process of harvesting is reviewed under headings in line with practical conditions and suggestions are made for improvements in organisation based on incentive payments or piece-work. It is not claimed that the procedures outlined in the report can be applied indiscriminately; on the other hand, it does bring to the fore methods of organising the harvesting work which could make the maximum use of the restricted supplies of labour likely to be available in the future. Piece-work has been tried out and has been found to be successful - successful for the farmer and satisfactory to the workers.

A briefer report dealing with the principal suggestions has been prepared for general circulation, but it was thought that this full discussion of the problem and the suggestions arising from the study would be of interest to other centres and individual workers actively engaged on work studies.

The sincere thanks of this Department are due to all those farmers, farm workers, merchants and College advisers whose co-operation made this study possible.

J. D. NUTT.

Senior Agricultural Economist

POTATO HARVESTING

2. INTRODUCTION

The Problem

To most farmers in the East of Scotland, potato harvesting represents the major upheaval in the ordered cycle of farm work. Yearly, the problem of where and how to get lifters who will do a satisfactory job of work becomes more acute. Indeed, in recent years, the worry to some farmers has become one of where to get any sort of casual labour at all at this time of the year. Mr. J. A. Stodart of Kingston, North Berwick echoed the thoughts of many when he wrote that "farmers and farm workers alike consider that when and if the introduction of a potato-harvester is an accomplished fact, they will have reached the Promised Land".[1] Mechanical potato harvesting is coming but it will be many years yet before hand picking is a thing of the past in Scotland as a whole.

Because the problem was not likely to be resolved quickly an investigation into potato lifting was started in 1952 with the object of seeing what improvements could be made in the organisation of potato harvesting, making use of the equipment and labour force already available to most farmers. The existing pattern of organisation had been built up from years of practical experience and was generally accepted by farmers and workers alike. The first year's work confirmed that the basic organisation was of the high standard that could be expected from a progressive farming district. But there were variations in the efficiency with which the work was done and, therefore, scope for improvement if only the means could be suggested.

Scope for Improvements

Merely to improve the less efficient to the standard of the best would in itself be a considerable step forward for the range of variation was surprisingly large. For example, 15 cases have been chosen from the records obtained by this College for its 1954 Potato Costs, the choice being restricted to those farms for which precise information was available on the type of casual labour used for the gathering. The cost per acre for harvesting labour, both regular and casual, varied from £9:4:5 to as high as £17:3s., almost twice as much (see Table I.). The bad weather of that year was undoubtedly responsible for increasing costs in some cases but data collected from 11 of these farms which were visited whilst the lifting was in progress indicated that many important factors affecting costs were subject to human control and that these alone could lead to differences of cost as wide as that stated above. There was no obvious connection between the harvesting cost and the type of casual labour; that is, the final cost was not directly affected by whether the gang was composed of adults or children, or came from the country or the town. (see Table I.)

The importance of the organisation and control of the labour force had been made clear already by work studies taken in the two previous years. Twenty-four studies in all were made, each study being started about 10 o'clock in the morning and continued until "lousing" time. There were some variations from one study to the next in the duration of observation and in the time worked by the gatherers and considerable variation in /

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[1] "Farming News and N.B.A.", January 2, 1953.

in the number of the gatherers. For the purpose of comparison adjustment had to be made to a standard.

The standard taken was a day of $7\frac{1}{2}$ working hours, exclusive of "piece-time", and 20 pickers, or full stents, to each gang. On this basis of comparison performances varied from $1\frac{1}{4}$ to $3\frac{3}{4}$ acres per day (see Table III.). Once again the difference could not be attributed to the fact that some gangs had children doing the gathering and some had adults. Children formed gangs that had high outputs and also gangs that had low outputs and the same applied for gangs composed of adults. Nor could the differences in output be attributed to the size of the crop. Indeed, the conclusion from these studies seemed to be that yield played only a minor role in increasing or decreasing the time required to harvest an acre.

This conclusion accords well with those made public by Mr. J. A. Stodart who found that the acreage picked on his farm varied over a period of years from $2\frac{3}{4}$ to $3\frac{3}{4}$ acres per day despite and not in step with great differences of yields from 5 tons to 13 tons per acre (see Table II.). The number of pickers remained fairly constant but the weight of potatoes that each gatherer picked in a day varied considerably from 22 to 32 cwts. This is a point that must be returned to later.

The truth is that there were a large number of reasons why one gang was cheaper than another or had a better performance than its neighbour. Indeed, two gangs with very similar results quite probably varied enormously in the manner by which those results were achieved. It is, therefore, worthwhile to examine some of the main reasons why results did not tally with expectations. The order of precedence will be first to discuss the causes of stoppages and delays and then to focus attention in turn on the digging, the picking, the transporting and the pitting or storing of the potatoes.

TABLE I.

1954

LABOUR COST OF POTATO HARVESTING

Rank	Type of Casual Labour*	Cost per Acre		
		Regular Labour	Casual Labour	Total Labour
		£ s. d.	£ s. d.	£ s. d.
1	Sc	1: 9: 5	7:15: -	9: 4: 5
2	Sc	2: 4: 6	7: 4: 6	9: 9: -
3	A	3: 2:10	6: 9: 2	9:12: -
4	A	1: 5: 4	8:15: 4	10: -: 8
5	A	2:17: 3	7:10: -	10: 7: 3
6	A/Sc	3: 1: 8	7:10: -	10:11: 8
7	A	2:12: 1	9: -:10	11:12:11
8	Sc	4: -: 2	7:13: -	11:13: 2
9	A	4:15: 6	7: 8: 4	12: 3:10
10	A	3: 7:11	9: 3: 4	12:11: 3
11	Sc	3:12: 4	9: 3: 8	12:16: -
12	Sc	2:10: 6	10:10: -	13: -: 6
13	A	4:16: 2	10:15: 1	15:11: 3
14	A	8: 2: 4	8:11: 5	16:13: 9
15	A	6: 9: 7	10:13: 5	17: 3: -

* A = Mainly adult pickers.
Sc = Mainly schoolchildren.

TABLE II.

OUTPUT FROM LIFTING SQUADS ON AN EAST LOTHIAN FARM, 1947-52*

	1952	1951	1950	1949	1948	1947
Acres	54	54	50	59	50	64
Tons per Acre	13+	$8\frac{3}{4}$	10	11	$9\frac{1}{4}$	5
Average Number of Gatherers ..	26	25	26	28	26	25
Number of Days Gathering	17	17	$18\frac{1}{2}$	17	15	17
Acres per Day	$3\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{2}$	$3\frac{1}{3}$	$3\frac{3}{4}$
Total Man-Hours	3515	3504	3888	3744	3120	3400
Man-Hours per Acre	65	65	78	64	62	53
Cwts. per Gatherer per Day ..	32	22	22	28	25	23

* J. A. Stodart, Farming News and N.B.A., January 2, 1953.

+ Estimate.

TABLE III.

1952 and 1953

COMPARISON OF PERFORMANCE OF GANGS PICKING POTATOES

(1) Rank	(2) Output in Day[ⁿ] (Acres[ǂ])	(3) Pickers in Gang (Full Stents) (No.)	(4) Comparative Output[+] (Gang of 20 Pickers) (Acres per Day[ǂ])
1	3	16	$3\frac{3}{4}$
2	2	11	$3\frac{3}{4}$
3	$4\frac{1}{4}$	24	$3\frac{1}{2}$
4	$3\frac{3}{4}$	21	$3\frac{1}{2}$
5	$3\frac{3}{4}$	22	$3\frac{1}{2}$
6	$2\frac{1}{2}$	15	$3\frac{1}{2}$
7	$3\frac{3}{4}$	24	$3\frac{1}{4}$
8	$3\frac{1}{2}$	21	$3\frac{1}{4}$
9	$3\frac{1}{2}$	22	$3\frac{1}{4}$
10	$3\frac{1}{4}$	20	$3\frac{1}{4}$
11	$3\frac{1}{2}$	23	3
12	$3\frac{1}{2}$	26	$2\frac{3}{4}$
13	$3\frac{1}{4}$	24	$2\frac{3}{4}$
14	$2\frac{3}{4}$	20	$2\frac{3}{4}$
15	5	38	$2\frac{1}{2}$
16	5	39	$2\frac{1}{2}$
17	$4\frac{1}{2}$	34	$2\frac{1}{2}$
18	3	30	$2\frac{1}{2}$
19	$4\frac{1}{2}$	38	$2\frac{1}{4}$
20	$3\frac{1}{2}$	34	2
21	3	31	2
22	$2\frac{1}{2}$	24	2
23	$2\frac{3}{4}$	30	$1\frac{3}{4}$
24	$4\frac{3}{4}$	70	$1\frac{1}{4}$

[ⁿ] Working day of $7\frac{1}{2}$ hrs. (450 minutes) exclusive of breaks. This has been taken as equivalent to an 8-hour working day.

[+] Col. (2) ÷ Col. (3) x 20. Output expressed in terms of gang of 20 with $7\frac{1}{2}$ hrs. working day.

[ǂ] To nearest quarter of an acre.

3. TOWARDS A FULL WORKING DAY

Working Time

Gatherers in most cases are paid on the basis of an eight-hour day, this time excluding an hour for lunch but including two ten-minute breaks, one in the forenoon and one in the afternoon. Yet, for a variety of reasons, farmers are fortunate if they obtain seven and a half hours of full working time during a day. Some of the losses are inevitable, being due to the distance the gatherers have to travel to reach the farm, others are caused by the weather and still others are due to the fact that some of the casual workers employed prove to be completely unsatisfactory for the task. Other losses of time are due to failures of the digger. It becomes choked by shaws and rubbish or encounters a hidden boulder and sometimes breakdowns result which cannot be avoided entirely by taking care and forethought.

Complete stoppages or breakdowns are by no means the only cause of lost time on the potato field and some of the waste is subject to control. Every care must be taken to prevent those delays that can be avoided so that costs may be kept to reasonable levels. For example, if 30 gatherers are hired to pick the potatoes 5 minutes loss out of an effective working time of seven and a half hours is equivalent to the wasting of one worker's time for $2\frac{1}{2}$ hours! Put another way, at 18s. a day for a gatherer it means paying 6s. with nothing to show in return. The loss may seem small when considered against the total cost of potato harvesting, but shillings and 5 minutes soon mount up in the course of a few days.

Evidence soon accumulated during the investigation to suggest that many gangs were being treated too leniently. It was comparatively rare to find that the direct cause of a stoppage was a stent that had not been picked. Indeed, it seemed that many tractor drivers in charge of the diggers were unduly sensitive to the needs of the pickers. Take the studies made in 1952 (see Table IV.). Only in four cases out of twelve studied were the gatherers working half, or more, of the time the digger was at work. In four cases they were working less than 40 per cent. of the time. The best gang was working 66 per cent. of the time the digger was at work.

Surely the minimum standard which should be expected is that the gatherers work half the time the digger is at work. They are already getting breaks and delays in starting work sufficient to turn an 8-hour day into one of 450 minutes and even if there are no other stoppages, working half time required only 225 minutes of work in a day. The remaining $4\frac{1}{4}$ hours are available to recover from fatigue and would seem more than adequate; and this is assuming that there are no breakdowns or checks to the digger!

Forewarned is Forearmed

The task of maintaining output at a satisfactory level is the joint responsibility of the foreman and the driver of the digger. They have to strike a reasonable balance between underworking and overworking the gatherers. The tendency at present is to be too sensitive to the calls of the gatherers in cases where adult pickers, or those over school age, are employed. To help the supervisors in their task they should be given a firm idea of how many drills ought to be dug in a day. The art of pressing without making it too obvious is also required. A slightly quicker speed down the drill cannot easily be detected but it will allow that very visible but small pause at the end-rigg which helps to keep everyone /

everyone happy. It must be added that an underworked gang soon becomes a bored gang and the latter is the hardest team to keep under proper control.

Two other somewhat frequent causes of loss of working time are under the control of the foreman and the driver of the digger. Some gatherers are naturally easier to look after than others, but in most cases it is possible, with a little foresight, to prevent the ten minutes piece-time extending to a quarter of an hour. A similar period of delay in the harvesting can occur when the gatherers are changing over to a new break. Slackness of oversight and of the general working of the whole organisation will be reflected in the slow time taken by the gatherers to move - a largely subconscious reaction on their part in most cases.

The foreman will find his task made easier if the gang is kept to the minimum number of gatherers. This point was emphasised by a visit to a field where there was the unusual sight of a gang of 70 working with two diggers. Inspection of the work and supervision of individual workers was made very difficult and there was a noticeable tendency for any rest period to be lengthened out because it was impossible to get all hands back to work at the same time. Moreover, every time one of the diggers had to halt in the middle of a drill, 70 gatherers were held up - at the cost of over 2s.9d. per minute.

It is customary for the end-riggs or any break in the length of the drills to be dug before the main gang of gatherers arrive. This is sound policy because the gatherers would have frequent periods of idle time whilst picking the end-riggs and this tends to make the regular working less acceptable later on. What is more, a small number of workers do this particular job far more economically than a gang of 20 to 30. The cost of digging the end-riggs with a gang can be shown by the following example. Twenty-one gatherers out of a gang of twenty-four spent half a day picking end-riggs and completed the equivalent of 1.6 acres in a full day. At 18s. a day for each gatherer the cost would be over £10 per acre for the gatherers alone. Later on the same gang under normal working conditions picked twice this acreage in a day at a cost of less than £7 per acre.

Some stoppages of the digger during normal working are almost inevitable under the conditions usually obtaining in the East of Scotland. Yet that is no excuse for slackness. The higher outputs were usually associated with those cases where the digger was kept at work with the minimum of halts. It is obviously worthwhile then taking what precautions are possible. Such are, for example, overhauling of the digger before harvesting begins both for the year and for the day and checking to make sure that the gatherers are never short of baskets or skulls.

One or two other points come to mind. In two or three cases there were awkward patches in the fields, wet or rocky sections or parts of the drills badly overgrown with grass. These held up the diggers for a matter of minutes every time they came to them, even in some cases causing a mechanical breakdown. How much output was lost from these causes it is difficult to say, but the obvious conclusion is that the gatherers would have picked more potatoes if they had been given the opportunity. In all such cases it would be better if the awkward spots were either dug out beforehand or done after the squad has departed. The crux of the matter is to keep the digger at work as constantly as possible and make sure that the gatherers alone are the limiting factor.

Blockage of the mechanism of the digger by shaws must be avoided. With the elevator digger it has often helped to have an extra man riding on the rear of the tractor with a fork to push away the impeding shaws but this practice will most probably offend against the new and necessary safety regulations. If the tractor driver can release the shaws himself from /

from the tractor seat there should not be the same objection. But in cases where shaws are going to be troublesome the latest and best answer would seem to be to pulverize them beforehand with rotary flails.

Unless the shaws are likely to be strong enough to hinder the digger, there is little incentive under present conditions of organisation to pulverize as well as to spray the crop to kill the shaws. If the digger leaves the potatoes covered by dead shaws it will take the gatherers a little longer to pick the potatoes because they have first to move the shaws out of the way. This additional time requirement is, however, negligible compared to the time that is available for gathering before the digger's return. With bulky shaws the case is different because they may stop the digger working. Assuming that pulverizing could be done by contract at £6 a day and that 10 acres could be covered in that day, the cost would be 12s. per acre. In such circumstances it would require only a saving of 10 minutes of wasted time an acre with a gang of 30 gatherers to repay the charge.

In this argument the possibility of cleaner picking after the use of a shaw pulverizer has been ignored. No data is available, but with the recent prices of potatoes not more than an extra cwt. per acre increase in the tonnage gathered would be required to repay the additional cost.

Co-ordination of the Jobs

To the question "Can the organisation be too good?", the obvious answer is, "No, but -." The hazard with the present system of harvesting is that all the various components fit together like a well-knit jig-saw puzzle. The digger places the potatoes ready for the gatherers, who pick them into skulls which are emptied by the loaders ready for the next round of the digger. The full cart is taken off to the pits, unloaded and returned empty in time to receive its next load of potatoes. The jobs are rigidly, indeed, too rigidly, linked together. A hitch, a delay, in one part of the work automatically stops the whole organisation.

The usual answer is to have a surplus of labour, more gatherers than are strictly necessary, more loaders, more carts or trailers, all of which makes the harvesting a costlier business. Nor does it provide even then a complete answer. When the digger stops owing to a blockage or because a gatherer has failed to pick the allotted stent, everything else stops, despite the excess capacity.

Driving the trailers down the undug drills to load potatoes from the skulls can also waste time. Loading can not begin until sufficient of the drill has been picked and then the trailer may not be far enough ahead of the digger as it comes round again. The loaders travel slower than the digger which has eventually to reduce speed accordingly.

The true answer is to keep the various operations co-ordinated but remove the interlocking. In other words, instead of having an organisation comparable to a machine constructed with the drive linked through a series of cogwheels, have the drive delivered independently at each wheel. If the cogs are interlocked, one piece of grit or a stone will jam all the wheels but with independent drives it could only cause momentary delay to one part. For example, this could be done by providing a suitable elevator digger with a deflector at the rear so that it could start a second drill without the wheels running over unpicked potatoes. Then when time has been lost by a hitch or delay, the pace of working could be increased for a little while to restore the balance. Again, if the loading is done from behind the gatherers and they are provided with spare skulls, then small delays to the loaders, or a pace of actual loading slower than the speed of the digger, cannot interfere with the /

the gathering. Similarly, when unloading at the pit the tractor driver should not need to be present whilst the potatoes are built up into shape. The job should be organised for a quick turn-round of the trailer independent of the pitters.

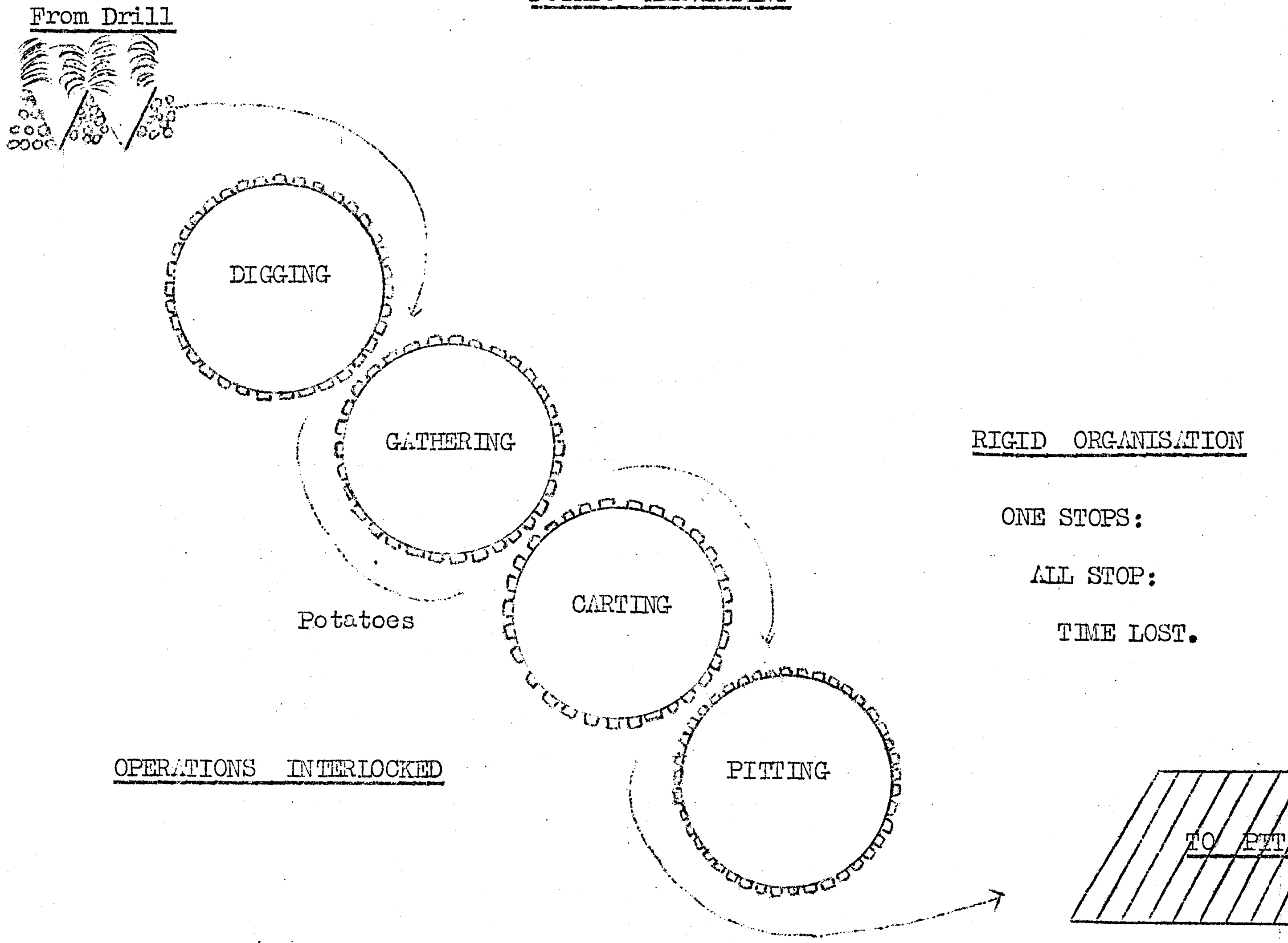
Three purposes are served by this approach to organisation :-

1) Delays are not "passed down the line".

2) The minimum number of people can be used for each part of the work.

3) The working capacity of the gatherers is made, as far as humanly possible, the sole factor that is placing a limit on the output.

POTATO HARVESTING



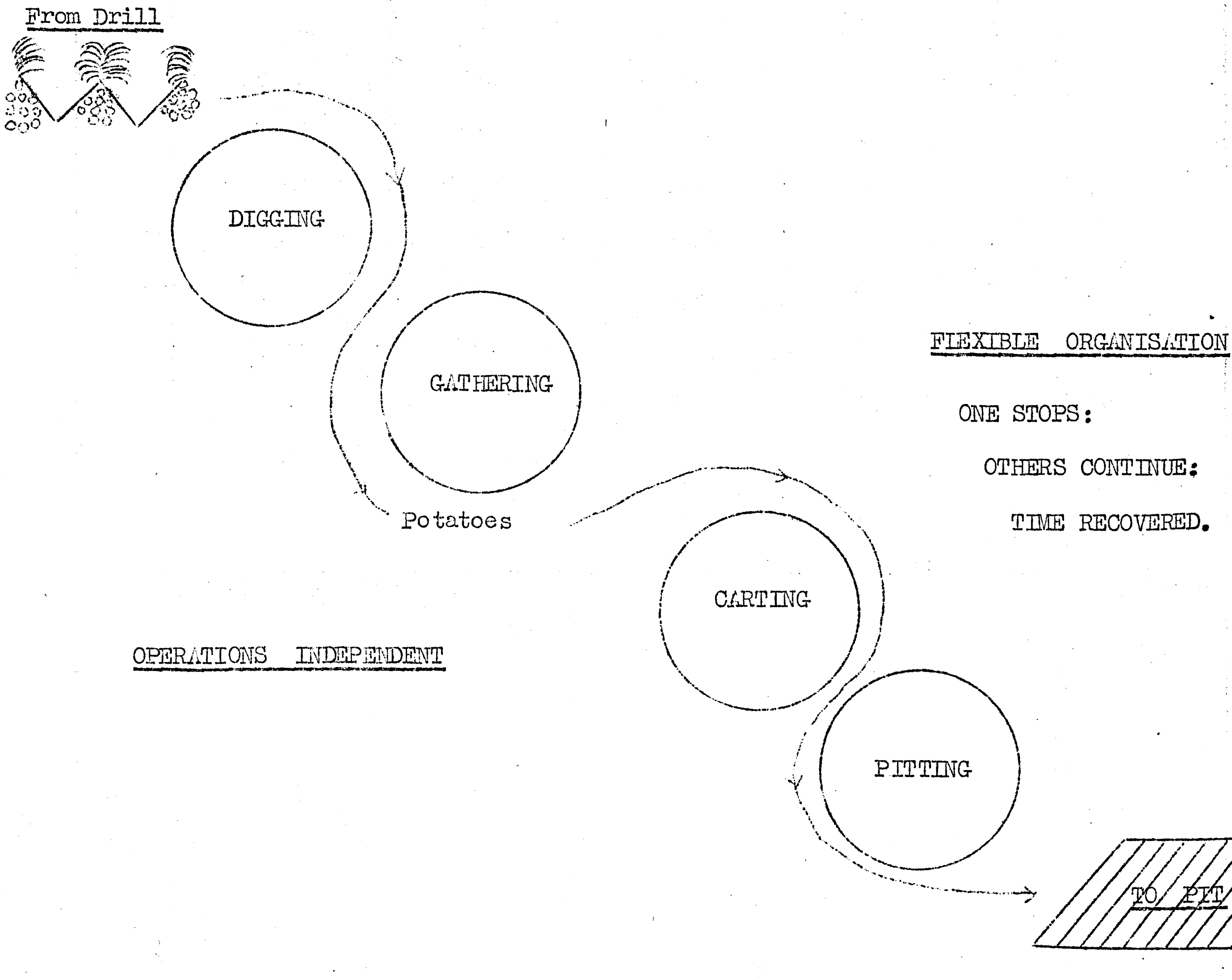
RIGID ORGANISATION

ONE STOPS:

ALL STOP:

TIME LOST.

OPERATIONS INTERLOCKED



FLEXIBLE ORGANISATION

ONE STOPS:

OTHERS CONTINUE:

TIME RECOVERED.

OPERATIONS INDEPENDENT

TABLE IV.

1952

THE GATHERERS

PROPORTION OF WORKING TIME SPENT IN PICKING

(1) Rank	(2) Yards of Stent	(3) Picking Time (mins.)	(4) Total Time (circulating time of digger) (mins.)	(5) Proportion of Time Spent Picking (%)
1	10½	2.70	4.08	66.0
2	23	5.46	9.39	58.0
3	10½	2.30	4.25	54.0
4	16	4.00	7.78	51.5
5	5	1.38	2.93	47.0
6	17	4.09	9.36	43.5
7	11	2.63	6.50	40.5
8	26	5.30	13.86	38.5
9	14½	3.62	9.87	36.5
10	11	2.79	7.76	36.0
11	9	2.10	6.59	32.0
12	8	2.01	8.64	23.0

4. THE DIGGER

Acres per Day

The organisation of the potato harvesting should centre round the gatherers and be so arranged that the acreage lifted in a day depends on the willingness and ability of the gatherers to do the picking. This desirable position cannot be reached unless it is remembered that the number of acres that can be harvested in a day depends in the last resort not on the gatherers but on the acreage that a digger can lift in a day. This is not an academic point. Some instances were seen where the poor performance of the gatherers could be attributed directly to the fact that the stents were picked long before the digger could return. It will help to have a look at the reason for this.

The range in working speed of the diggers down the drill was from 2 to 3 m.p.h. for both spinner and elevator diggers according to the observations taken in 1952 and 1953. The commonest speed recorded for the elevator digger was $2\frac{1}{2}$ m.p.h. and for the spinner digger slightly more, $2\frac{3}{4}$ m.p.h. It had clearly been fouhd that somewhere around these speeds was best for the potatoes, the machine and the gatherers. Faster speeds with the spinner diggers would tend to cause more damage to the potatoes or make gathering more difficult by burying the potatoes again or scattering them too far, whilst there was some evidence that faster speeds with the elevator diggers would cause undue wear and tear to the machines.

If these working speeds are taken as useful standards it is possible to give estimates for the number of acres that can be lifted in a day. Taking 28-inch drills, 200 yards in length and a spinner digger working round a "break" of 55 drills at $2\frac{3}{4}$ m.p.h., the greatest area that is likely to be dug in a day is $4\frac{1}{2}$ acres, exclusive of end-rigg.

However, this figure makes only slight allowance for hitches or breakdowns in the working and ignores the fact that most gatherers like to see a definite halt by the digger at the end-rigg. Giving a larger allowance for such items the common expectation becomes 4 acres a day for the spinner digger. The elevator digger usually travels slightly slower at $2\frac{1}{2}$ m.p.h. and could be expected to dig $3\frac{1}{2}$ acres under similar conditions. In both cases the expectation is a figure that can be exceeded if breakdowns are avoided and the will to work is present.

The length of the drill quite naturally has an important influence on the acreage dug in a day. The longer the length of the drill the fewer the number of times the digger has to travel round an end-rigg whilst completing an acre. The less the time spent going round the end of the drills the greater the time spent actually digging the potatoes. In the above examples the length of drill was taken as 200 yards, double this to 400 yards and output would potentially be half an acre more in a day. In the other direction to decrease the length of drill by a half to 100 yards would lower output by about three-quarters of an acre (see Table V.).

Digger and Gatherers

Here, then, are useful targets for the amount of work that can readily be attained in a working day of $7\frac{1}{2}$ hours ("piece-time" being excluded). Once the target has been decided it becomes possible to adjust the number of gatherers to this requirement. This depends on two factors; the proportion of time the gatherers are willing to work and the speed with which they can do the actual gathering. Regarding the first it has been suggested already that the minimum demand should be that the gatherers work 50 per cent of the time. If working conditions are favourable there is then always the possibility of a slightly better performance /

performance and the harvesting of an extra quarter of an acre or so in the day.

The second factor is the speed of gathering from the dug drill. The years 1952 and 1953 produced good crops of potatoes and under these conditions an extremely useful standard was discovered. Each adult (or near - adult) gatherer could be expected to pick 4 yards of stent in a minute. At this pace and working 50 per cent of the time it requires 7 gatherers for every acre lifted in a day. This means that if $3\frac{1}{2}$ acres was the target for the day, 25 gatherers would be sufficient and supposing the drills were 200 yards in length they would have stents of 16 yards (see Table V for further details). To have more gatherers would be a complete waste of money but fewer would not necessarily be detrimental.

Seven gatherers for each acre dug in a day is a maximum figure. If the above gatherers were willing to work nearer 60 per cent of the time it would require only 6 gatherers for each acre dug in a day; that is, with a target of $3\frac{1}{2}$ acres 21 gatherers would be sufficient and with 200-yard drills they would have stents of 19 yards.

Layout of Work

The number of drills per break varied greatly according to the inclination of the driver of the digger or the custom of the farm. A useful compromise between the extremes was a break of 55 drills, giving an average of 30 drills to turn round at the end-rigg. Narrow breaks caused the gatherers to move position too frequently and so time was lost, whilst wide breaks lowered the proportion of time the digger was actually digging. No rigid law need be made on the matter, however, for it depends on circumstances to some extent. On the whole it is better to err on the side of having too wide a break on the grounds that it is easier to speed up the digger than to persuade the gatherers to move positions with the minimum waste of time.

The custom of the area is to work towards the centre from both sides of a break. When five drills are left one party of gatherers are moved over to the near side of the new break. The five drills are dug with the digger alternating between the new and the old break and then the remainder of the gatherers move over to the far side of the new break.

A small change in procedure could be helpful. Instead of a break of 55 drills take one of 30 and then work both sides in the same direction thereby keeping constant at 30 the number of drills the tractor has to turn round. When 30 drills have been dug from each side of the break, one party of gatherers will have reached the point where the others began and will then move to the far side of a new break. The advantages of this new method are that the digger will have a constant proportion of its time available for digging instead of a varying amount, and a move will still be made by the gatherers only every 60 drills. Even more important, instead of the move being a "double-shuffle" only half the gatherers will change positions, and will move a shorter distance. (see Fig.3) This offers the possibility of reducing by a half the time taken to move from break to break and such a saving is well worthwhile both for itself and because it simplifies the task of supervision.

One Way Digging

Controversy has often arisen on the point of the circumstances favourable to one way digging. The first thing that must be ascertained is the effect of one way digging on the daily output of a digger. Under conditions such as those given previously for normal working the expectation would be that a trailed elevator digger digging one way along drills of 200 yards would lift $2\frac{1}{2}$ acres in a day. A trailed spinner digger's output/

output would be slightly greater at $2\frac{3}{4}$ acres per day. Different lengths of drill will make no great difference except that shorter drills will tend to slow up most elevator diggers which require a certain amount of adjusting when drawing in and out of the drills.

The daily output of the digger fixes the maximum number of gatherers that can be used with profit. Taking the requirement of 7 gatherers for each acre lifted in a day, at $2\frac{1}{2}$ acres a day 18 are required and for $2\frac{3}{4}$ acres 19. The effect of the length of drill becomes important here for upon it depends the length of stent given to each gatherer. When the drills are 200 yards in length each of 18 gatherers will take a stent of 11 yards. If the drills are 500 yards in length stents will be 28 yards. The one tends to be short and the other long but neither to an alarming degree.

However, the hydraulically mounted diggers that are now appearing on farms are better suited to one way digging than the trailed types just discussed. Their speed of working will be no greater but the whole machine can be lifted at the end-rigg and transported at a fairly rapid speed to the other end of the drill. Supposing this return speed is 8 miles an hour, then the output of a mounted elevator digger working 200 yard drills will be 3 acres in a day and that of a mounted spinner digger $3\frac{1}{2}$ acres a day. Double the length of drill and the potential output rises by a $\frac{1}{4}$ of an acre, reduce the length by 50 yards and it falls by a similar amount.

Under some circumstances one way digging is attractive; it becomes almost essential when the number of gatherers is fairly small. When the drills are long and the gatherers relatively few it can avoid the need for making an artificial end-rigg to cut the drills in half. Digging costs will be greater through the additional consumption of tractor fuel but the increase will be comparatively slight. One way digging can, therefore, be recommended when, for example, school children are employed to do the gathering. Twenty children are quite enough to supervise and yet at the same time they need shorter stents than adults. With one way digging it is possible to have drills of 200 to 300 yards and yet to give twenty children stents of 10 to 15 yards. The children's speed of gathering will be slightly slower than that of adults and they will require an equivalent lengthening of the resting period. Making such allowances twenty children on one way digging can be expected to gather 2 to $2\frac{1}{2}$ acres in a day, according to age and experience.

The small gang of gatherers must not be despised for the work studies showed that the smaller the gang the more likely was its output per gatherer to be high. In other words two gangs of 15 gatherers were likely to do more work than one gang of 30 (see Table II.). For this reason one way digging showed more favourably than two way in a comparison based on output per gatherer. However, care must be taken with one way digging to see that some of the advantage is not lost through an undue amount of labour being used in the ancillary tasks of carting and pitting.

Two-Row Digger

Two-row elevator diggers have attracted a certain amount of attention particularly since they have been used with piece-working. They can do a useful job of work and the evidence discussed in the next chapter shows that they give a small but definite increase in the rate of gathering. This advantage may be further increased by the psycho-:logical effect on the gatherers who will not feel themselves pushed by a machine that travels more slowly up the drill and takes longer to turn than the ordinary single-row machines. Unfortunately, these two-row diggers /

diggers are more sensitive to field conditions than the ordinary machines. For example, work done by the University of Maine (U.S.A.) showed that a slope that did not reduce the working speed of a single-row digger caused a 15 per cent reduction with the two-row machine. The two-row digger requires light soil, fairly free from stones and level ground to give the best results.

The few studies of two-row diggers taken in Scotland give working speeds down the drills within the range of 1-2 m.p.h., though under English conditions the speed is slightly greater. Considering that few fields in Scotland are without slopes or a proportion of stones which can jamb the mechanism, $1\frac{1}{3}$ to $1\frac{1}{2}$ m.p.h. can be considered satisfactory rates. With drills 300 yards in length this would give an average expectation of $3\frac{3}{4}$-4 acres in an 8-hour day. This is much the same output as that obtained with a single-row digger, digging both sides of the break.

There are two reasons for this comparatively low output. First, the slow working speed under most Scottish conditions and, second, the time taken to turn at the end-rigg. The Maine studies gave turning time for an ordinary elevator digger as 5.2 per cent of working time and the two-row digger at 15.7 per cent. The two-row digger, therefore, needs long drills and as few turns at an end-rigg as possible to each acre.

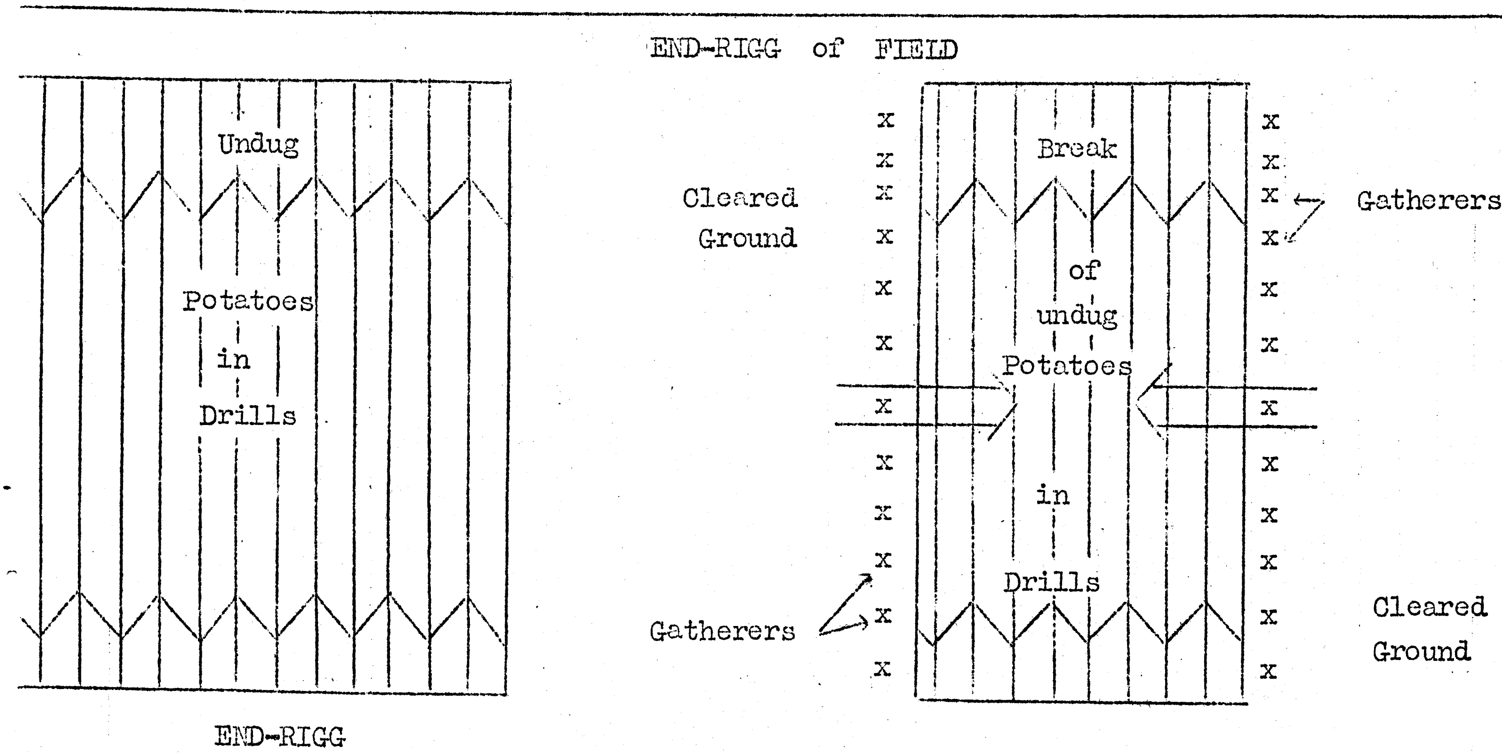
Because the two-row digger has been associated with piece-work, it has been used to dig one side only of the break or field, its great advantage being that it can dig both up and down the field. Since the digging can be done well in advance of the gatherers, it is possible to turn round a minimum of 6 to 8 drills every time making small breaks of this width and working outwards and parallel to keep the width constant. This practice will save a small but useful amount of time every turn as against continuous working across the field which causes considerable backing at the end-rigg.

It might be useful to say here that piece-work gathering is not dependent upon the use of the two-row digger. There are other means of tackling the job and these will be discussed in the course of the next chapter. Whether it is piece-work or day-work that is being organised the burden of this chapter remains relevant: the digger and the gatherers must form a balanced combination. It is a pure waste of time and money to have more gatherers than the machine can provide for. The digger should always be able to dig a slightly greater acreage than the gatherers can lift.

Fig. 2

METHODS OF WORKING A BREAK

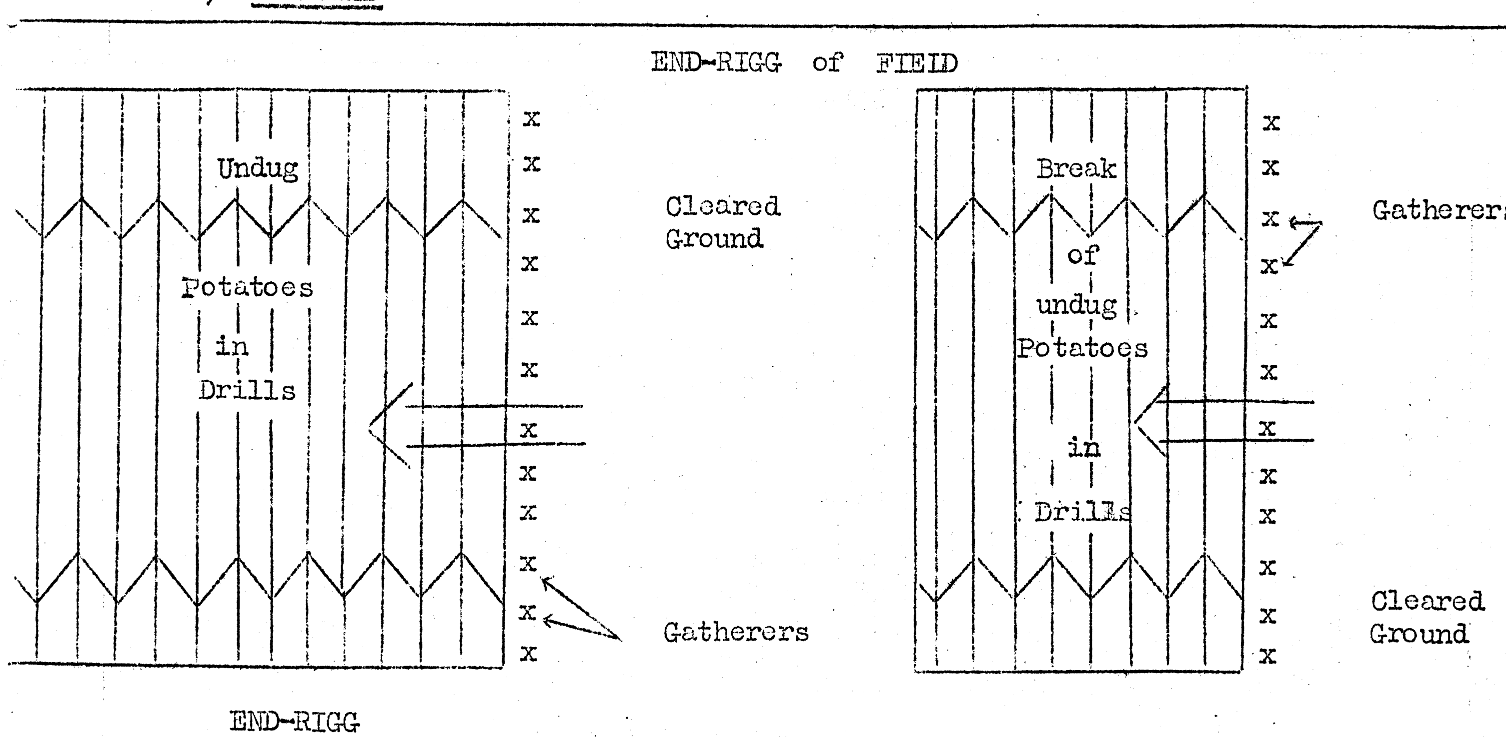
A) PRESENT



Gatherers picking two sides of break

Gatherers approaching nearer with every drill picked

B) PROPOSED



Gatherers picking one side of two breaks

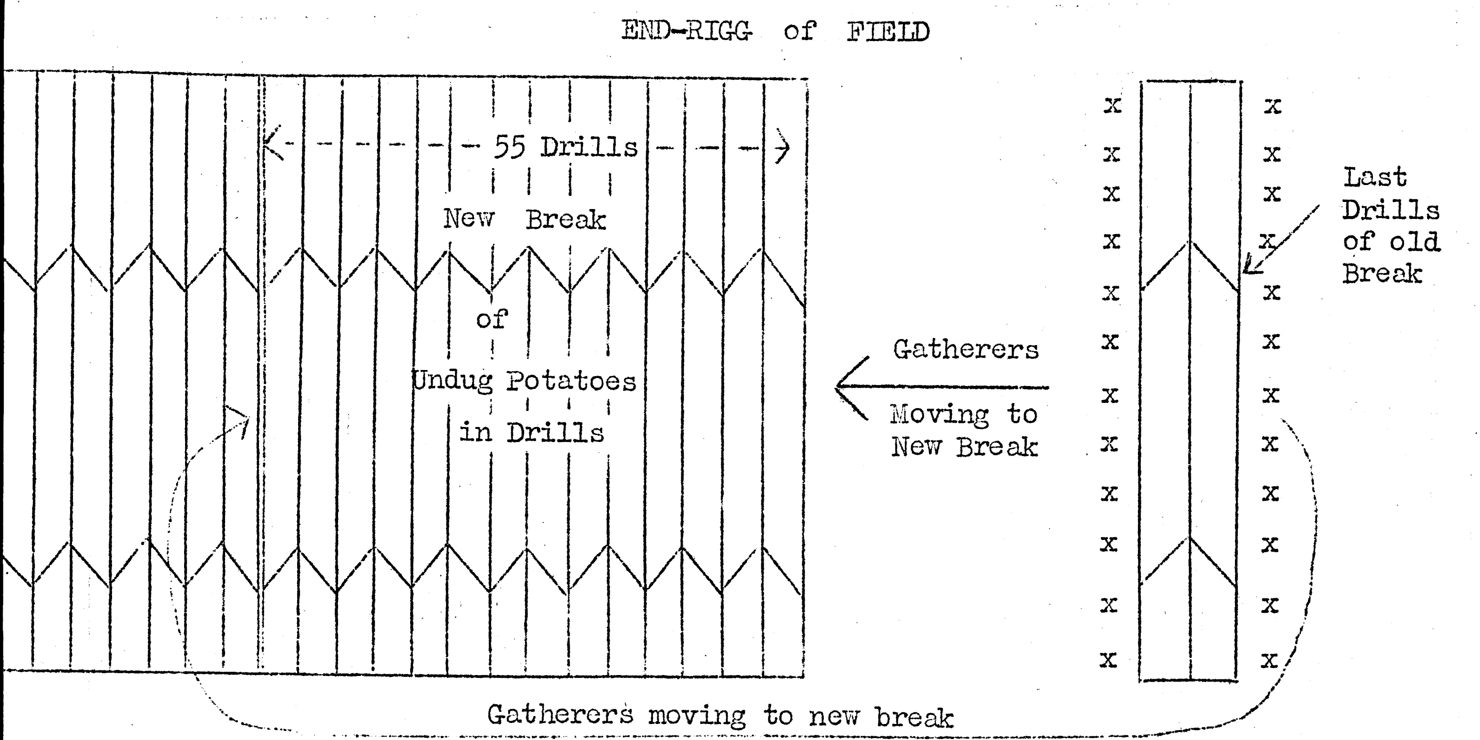
Gatherers working in same direction keeping same distance apart

Fig. 3

METHODS OF WORKING BREAK

THE CHANGE-OVER

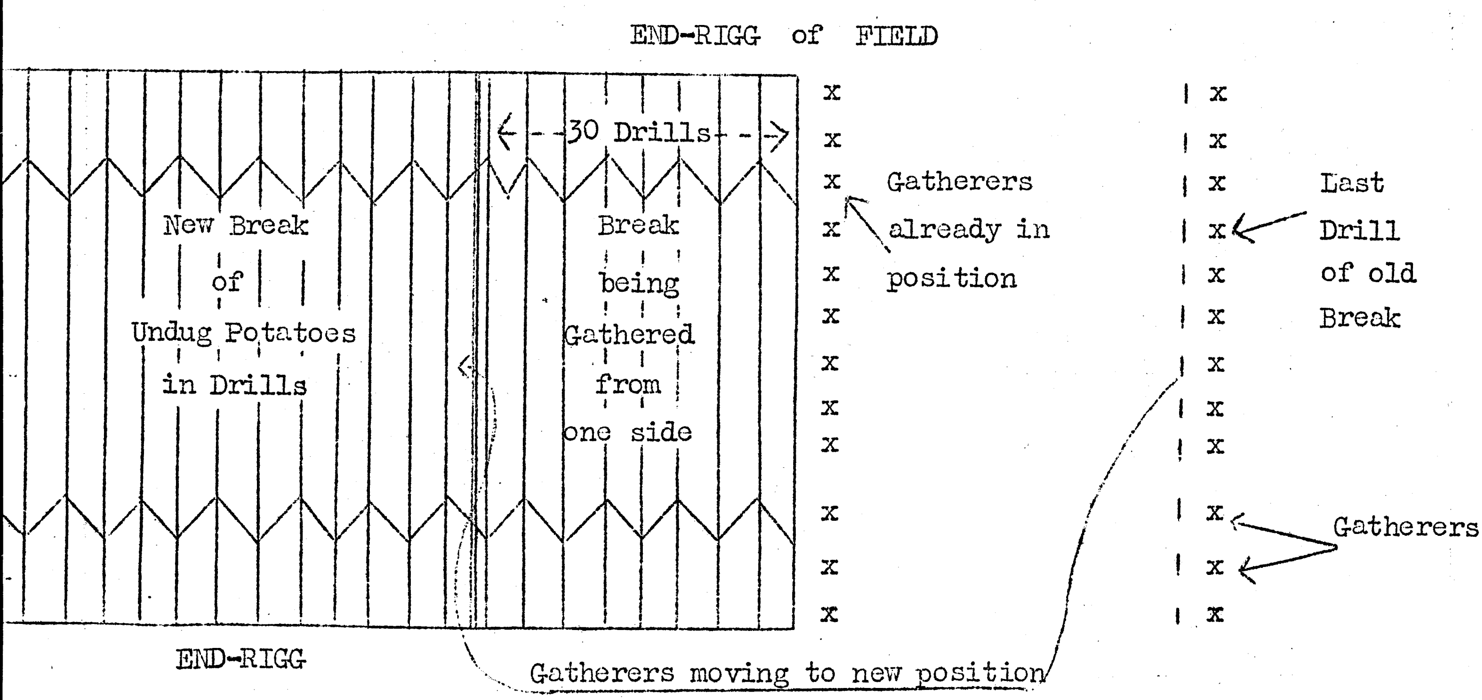
A) PRESENT (cf. Fig. 2)



BOTH GROUPS of gatherers have to move

			Distance
1)	One group to near side of new break	=	25 Drills
2)	Other group to far side of new break	=	85 "
	Total	=	110 "

B) PROPOSED (cf. Fig. 2)



ONE GROUP ONLY of gatherers has to move
to edge of new break

		Distance
This movement is shorter than in A) above	=	60 Drills
Total	=	60 "

TABLE V

(A) ELEVATOR DIGGER

Working Speed $2\frac{1}{2}$ m. p. h. (73 yards per minute)

Length of Drill (yards)	Drills per Acre ‡	Acres per Day Common Expectation †	Maximum No. of Gatherers ∓	Length of Stents (yards)
50	125	2	14	7
100	62	$2\frac{3}{4}$	19	$10\frac{1}{2}$
150	$41\frac{1}{2}$	$3\frac{1}{4}$	23	13
200	31	$3\frac{1}{2}$	25	16
250	25	$3\frac{3}{4}$	26	19
300	21	$3\frac{3}{4}$	26	23
400	$15\frac{1}{2}$	4	28	$28\frac{1}{2}$
500	$12\frac{1}{2}$	4	28	$35\frac{1}{2}$
600	$10\frac{1}{2}$	$4\frac{1}{4}$	30	40

(B) SPINNER DIGGER

Working Speed $2\frac{3}{4}$ m. p. h. (81 yards per minute).

Length of Drill (yards)	Drills per Acre ‡	Acres per Day Common Expectation †	Maximum No. of Gatherers ∓	Length of Stents (yards)
50	125	$2\frac{1}{4}$	16	6
100	62	$3\frac{1}{4}$	23	$8\frac{1}{2}$
150	$41\frac{1}{2}$	$3\frac{3}{4}$	26	$11\frac{1}{2}$
200	31	4	28	$14\frac{1}{2}$
250	25	$4\frac{1}{4}$	30	$16\frac{1}{2}$
300	21	$4\frac{1}{4}$	30	20
400	$15\frac{1}{2}$	$4\frac{1}{2}$	32	25
500	$12\frac{1}{2}$	$4\frac{1}{2}$	32	31
600	$10\frac{1}{2}$	$4\frac{3}{4}$	33	$36\frac{1}{2}$

‡ In compiling this Table the width of drills was taken as 28 inches. 27 inch drills will give slightly lower performances but the difference is not sufficient to alter materially the above figures except for the number of drills in an acre. Acreage excludes area of end-rigg.

† Taking an 8 hour day with 450 working minutes. The common expectation is a figure that can be exceeded under good conditions.

∓ Using 7 gatherers per acre dug in a day.

5. THE GATHERERS

Towards Fewer Gatherers

Whilst the suggestions made in the previous chapter will help to reduce the seemingly insatiable demand for gatherers, the possible savings so far suggested will not be sufficient on their own to reduce this harvesting problem to manageable proportions. More drastic changes are required. It is a question of either mechanising to remove the need for gatherers altogether or changing the organisation to get more work from those employed to do the gathering. This latter alternative will be dealt with here.

There is a considerable amount of evidence which suggests that the output of the gatherers can be increased to a marked extent provided the right means are found for accomplishing the change. For example, as was stated in the introduction, differences in the daily output of the gangs studied could not be attributed to the fact that some gangs had children doing the gathering and some had adults. Indeed, the adults did no better than the children. The implication is that the adults, given the opportunity, could have done more work. One of the several reasons why it was impossible for them to do this was uncovered in the last chapter, where it was pointed out that in some cases there were more workers than the digger could use effectively.

Another important reason is that the acute shortage of labour has produced in many areas a situation whereby both children and adults are paid at adult rates with the result that the level of output of all workers tends to fall to that of the children. Many children, not in organised school parties are, therefore, overpaid and many adults are underemployed. This applies particularly in cases where the labour shortage has resulted in mixed gangs being used, these comprising all the available labour both young and old. It is imperative in such cases to give the adults longer stents and to pay the children less for their shorter ones. It is better still to separate adults and children into separate gangs. But neither of these alternatives is practicable until the demand for gatherers has been reduced.

Tools and Methods

The first step must be a detailed examination of the work involved in the crucial task of collecting the potatoes together and separating them from soil and stones.

Several alternative receptacles are available for gathering. From the point of view of the gatherers the most suitable is, in the first instance, the one that requires the smallest movement of the hands in transferring a potato from the ground into the container. On this point the brat* scores because its mouth is near to ground level and a flick of the hand is sufficient movement for transferring the potato. The brat has two defects: only one hand is available for picking and the brat has to be emptied into another container. An attempt to overcome these objections has been made by hanging a sack between the gatherer's legs from a special picking belt round the waist. It leaves both hands free but there is the disadvantage that the method is too burdensome for women. Moreover, a trial at the University /

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* A sack tied round the waist and wrapped round one fore-arm.

University of Nottingham showed that when using this method men doing the gathering took longer to pick their stents than when they were gathering into baskets which they were not required to empty.

The best compromise is the wire skull. It is low to the ground and a limited movement of the hands is sufficient for transferring the potato from the soil. More than a flick is needed because there is no "back-screen" to stop the flight of the potato as is the case with the brat. Wire is better than wicker because the wire skull retains less soil and does not absorb the damp. The bucket is inferior to the skull because the distance of the lift is greater and the movement of the hands farther and more deliberate. The potato basket, a foot in height, obviously demands even more effort from the gatherer.

The best picking position, and the one usually used in the East of Scotland, is where the gatherer straddles the skull and reaches for:ward with both hands to pass the potatoes back into the container. The gatherer can then bring the skull up to the edge of the ungathered potatoes and clear the ground within easy reach in front. The spread of the potatoes as left by the digger needs to be within this reach but the swath must not be too narrow, otherwise the stones are so mixed up with the potatoes that it is difficult to distinguish between them and the process of separation becomes painful to the fingers.

If the gatherers are expected to empty their skulls into sacks or barrels the amount of work they have to do is, naturally, increased beyond what has been considered so far. In situations where they are picking for fifty per cent or less of the available time there is no reason why they should not undertake this additional work. On the other hand, if it is hoped that the gatherers will work harder than this proportion of their time it is better to retain the usual system where the skulls are emptied directly into the carts by the loaders themselves. The whole of the gatherers' attention and working capacity is thereby concentrated on the urgent task of sorting and collecting the potatoes.

Yield and Output

Crops of potatoes vary in yield, distance between plants and size of potatoes. It might, therefore, be expected that the acreage harvested in a day by the same gang of gatherers would vary considerably. This variation is not marked in practice (see Introduction) and one of the reasons has been discovered already. The pace of harvesting is too often set by the digger almost irrespective of the yield of the crop. There was also an interesting suggestion that the anticipated differences do not materialise because the picking time depends on the number of tubers, irrespective of their size, and also that the number of tubers does not vary greatly with yield. It was felt that this possibility was worth investigating and the work studies taken during the 1955 harvest, which fortunately provided a wide range of yields and sizes of potatoes, were designed to prove or disprove it.

A small group of gangs were studied as they worked in different fields with varying crops under the same basic organisation. This reduced the number of possible causes of variations in the picking rate and left the crops themselves as the main variable. The results were extremely interesting although the major part of the suggested relationship was disproved.

The number of potatoes increased with the yield though the relationship was not close. After eliminating differences due to planting distance and variety of potato, it could be seen that there was /

was a positive increase in the number of potatoes to be picked per plant as the yield per plant increased. However, even for any one variety there was quite a wide range of possible yields for any given number of potatoes per plant. In addition, in that year at least, King Edwards averaged several more (and smaller) potatoes than Majestic for a given yield. Yield was not, therefore, a satisfactory basis for gauging the work that could be expected from the gatherers in a day although gathering time was certainly greater for the higher yields.

Fortunately there was a very close relationship between the number of potatoes gathered and the time taken by the gatherer, and this can be accepted as a valid foundation for devising improved methods of organising the gathering. It is almost as easy to count the number of potatoes in a small stretch of drill as to weigh them to get an estimate of yield. The relationship between the number of potatoes and the gathering time held irrespective of the size of the potatoes, a given number of small potatoes taking as long to pick as the same number of large potatoes. It also held over the extensive range of yields encountered in 1955.

More surprisingly, the relationship was not affected by the type of digger. Gatherers prefer an elevator digger but took no longer to pick the same number of potatoes after a spinner digger - provided the width of its swath was kept to reasonable proportions. It is probable that the spinner demands a fraction more concentration from the gatherers but that this comes automatically from the skilled worker; there is also the possibility that the narrower swath leaves the potatoes too close together for the eye to separate them quite quickly enough in advance of the hands. This, however, must be largely speculation; the major point is that for practical purposes the effects of both types upon speed of gathering are indistinguishable.

Using potato counts as a basis it was established that for a full seed crop of 85 potatoes in 3 yards[x] a gatherer needed .25 minutes for each yard gathered (or a working pace of 4 yards per minute) (see Graph I). This is very close to the approximation found during the earlier investigations of the time required for picking a full crop. For each 10 potatoes less in the 3 yards the picking time would fall by .023 minutes, which means that an average crop for 1955 (a poor year) of 55 potatoes per 3 yards should have taken the gatherers only .18 minutes per yard (or just over 5 yards per minute).

The probability is, therefore, that in 1955, with its low counts (and yields), a considerable proportion of the potato gangs were working less than 50 per cent of their time, seeing that there was a tendency for this to happen in previous years when there were much fuller crops. Indeed, if in the earlier years 25 gatherers were required to gather $3\frac{1}{2}$ acres in a day (see Table V), in the latter year possibly only 18 working at the same pace would have been required to gather the same $3\frac{1}{2}$ acres in a day.

This illustrates the difficulty of adapting the present methods of harvesting to differences in the amount of work required from the gatherers. The system is too inflexible. Some improvement could be obtained by reducing the normal size of gangs to 18-20. Then, when there /

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[x] In the first instance 3 yards were used as the unit of distance along a drill because the number of pounds in this distance is readily con-:verted to tons per acre. The distance has been retained because the number of potatoes in 3 yards is not too many or too few to count.

there is a small number of potatoes to be picked the gatherers can work for 4 minutes and rest for 4 minutes and produce the target $3\frac{1}{2}$ acres in a day; when, because of yield or variety, there are considerably more potatoes to be gathered there is every possibility that a fairly high acreage, around 3 acres a day, will be maintained because 5 minutes rest will seem too long even after 5 minutes work. The improvement depends upon the willingness of the gatherers to accept "long" stents of 20 to 25 yards. Such stents are not really long and should soon become an accepted length, particularly if the potato foreman has a long stride and makes twenty yards look like seventeen.

Incentives Payments

This reduced size of gang offers some possibility of a gradual improvement in the harvesting work but the problem is so great that more drastic action is required. A more effective answer is to have even smaller gangs and pay directly according to output. This is an extremely attractive proposition for with sufficient incentive, gatherers would work a far higher proportion of their time and pick a correspondingly greater number of potatoes. The gangs need to be small in order to ensure that the limits to output are set by the gatherers and not by the diggers. Incentive payment would increase the earning power of those women who form the backbone of the harvesting force and should attract more of the right kind of labour. It must also be noted that this class of labour is available for more weeks than the three during which children are available.

The next question to be answered is: what could offer an adequate incentive to potato gatherers? Incentive schemes are common in industry where it is usually assumed that piece-rate workers would on the average both earn and produce one-third more than on day rates. Every unit of work done is worth an equal amount to the worker. In agriculture the weather can stop work and so lower the earnings of casual workers. A fairer basis, therefore, might be to expect an average incentive wage to amount to a half more than day rate, so making allowance for this factor. But it must be noted that in agriculture, as in industry, it should be assumed that the labour concerned is skilled and accustomed to the work.

The adult labour that is, or might be, attracted to potato harvesting is of very mixed composition and only a limited proportion of it is engaged in agricultural work for any considerable proportion of the year. The standard previously suggested for day work on potato harvesting was this: that gatherers should pick for 50 per cent of the $7\frac{1}{2}$ hours that the digger is at work. This has always seemed a low proportion. Is it too low? An estimate of the maximum work time that could be expected may be made by taking the $7\frac{1}{2}$ hours digger time and then making due allowance for the ancilliary work done by the gatherer in putting the skulls into position during picking and their rest require-:ments in addition to the half-hour already allowed. This gives an estimate that those accustomed to farm work could gather for 85 per cent of the time the digger is at work. The majority of gatherers not so conditioned might be expected to manage 75 per cent, at least after the first few days; that is, they would gather half as much again as on day work.

The whole objective of an incentive scheme is to solve the problem of labour shortage by encouraging the available labour to make the utmost use of its time. The farmer should, therefore, be willing to pay more money, in direct proportion, for more work even if some gatherers earn twice as much as on day work. Since it is necessary to attract labour that is not fully accustomed to farm work the standard for /

for day working already proposed should be retained for working out an incentive scheme. In other words a fair basis for an incentive scheme for potato gathering is that on day work a gatherer should work 50 per cent of the time the digger is at work. For reaching this level of output on piece work a gatherer should be paid a current day's wage and for doing more work than this should be paid a proportionately greater amount. The ordinary competent gatherer on incentive rates should average the 75 per cent level and earn a day's wage and a half (150 per cent) whilst an equally skilled gatherer fully accustomed to farm work should average 170 per cent of a day's wage. In other words the ordinary gatherer should earn 3 days' pay in 2 days and the gatherer accustomed to farm work almost $3\frac{1}{2}$ days' pay in the same time. Some gatherers with above average skill and speed in picking will get through the work quicker than this and could accordingly expect to earn more and should be paid more. As already stated, the farmer should have no objections to paying more, even double, per day for he has the assurance that he is getting a proportionate increase in the work done.

Before proceeding further one point must be made. Present methods of fixing incentive rates are open to criticism on the grounds that there is no known relationship between the work done on piece-work and the work done on day work, nor is there any direct relationship between piece-work earning and day-work wages. The fixing of the incentive rate is, therefore, apt to be a hit-or-miss affair. If the gatherers earn enough and pick enough, it is a success, but if the correct balance is not chanced upon, the rate is a failure and there is need for adjustment. Such a situation is not satisfactory for incentive working should be demonstrably fair to both sides.

Further, if several farmers in the same area are setting piece-work rates on an arbitrary basis, the earnings on the various farms will be compared by the gatherers without them making any allowance for differences of conditions and, more important, differences of the gangs' working abilities. Such a situation can easily develop into a compe-:tition to increase earnings without compensating the farmers by increases in productivity. Bad labour relations will follow, one side saying that they are grossly underpaid and the other that the workers could work harder if they wanted.

The incentive systems being developed here seek to avoid these pitfalls. They are firmly based on the day wage rate which can be readily compared from one farm to another. The piece rates can be adjusted automatically to meet increases in the day rate. The appropriate variation in rate to suit the individual field is then linked from this base with the work requirement which depends on the number of potatoes to be gathered. The plan is to have incentive schemes which enable both sides to see clearly the reason for any adjustment that has to be made.

Incentive Payment to the Gang

There are two ways in which incentive payment can be made to potato gatherers. The one depends on the payment of a small gang on the basis of their output as a unit and the second upon the payment of individual gatherers according to the quantity picked into a barrel or some similar measuring container. The former requires the least new equipment and change of organisation and will be dealt with first.

The basis is the employment of 8 to 10 workers to do the gathering for ware crops, possibly 10-12 gatherers for seed crops. The task is limited to picking the potatoes into skulls and payment is made to the gang as a unit. The allocation of the stents is, therefore, /

therefore, the business of the gang, for the individual members will benefit if the more capable workers do slightly more of the work. Payment should be on the basis settled above, that is for the same amount of work that would be expected on day work the gang would receive a day's wages. The work that is done in excess of this should be paid for at the equivalent rate.

As stated already the rate of payment depends on the work content as measured by the number of potatoes and the daily wage rate. With a gang of 10 and potatoes at 85 per 3 yards of drill the gang would be paid a day's wage for $1\frac{1}{2}$ acres and a sixth of that sum for every additional quarter of an acre. They would expect to harvest $2\frac{1}{4}$ to $2\frac{1}{2}$ acres in a day. With 60 potatoes per 3 yards, payment would be on the basis of an eighth of a day's wage for each quarter of an acre, the gang gaining a day's wage for 2 acres and expecting to harvest from 3 to $3\frac{1}{2}$ acres in an 8-hour day (see Table VI). Putting these last figures into terms of cash, if day rates are 18 shillings per day, two acres would earn the whole gang 18 x 10 shillings i.e. 180s. and $3\frac{1}{4}$ acres would earn them $\frac{180}{2} \times 3\frac{1}{4}$ shillings $= \frac{180 \times 13}{8} = 292\frac{1}{2}$ shillings.

This method of payment could be used without making any changes in the organisation from that usual for day working - except for making the improvements suggested in the previous chapters. There are one or two difficulties. Eight to ten people spread out along two sides of a break with 250 yard drills means stents of 50 to 60 yards and this will scarcely be acceptable.

The immediate answer is one-way digging with hydraulic mounted diggers so automatically reducing the length of the stents by half to 25 to 30 yards which is a fair length considering the additional earnings available. The mounted digger can in most circumstances dig a sufficient acreage to keep the gatherers at work but the common trailed types, both spinner and elevator, are more limited in performance. Their capacity of $2\frac{1}{2}$-$2\frac{3}{4}$ acres in a day with one-way working may be insufficient where 10 gatherers are lifting a crop with an average to low count of potatoes. In such a case two trailed diggers would be needed.

The disadvantages of using mounted or trailed single-row diggers of ordinary design for piece-work are slight when compared to the benefits of having the gatherers on incentive earnings. True that the machines cannot work ahead of the gatherers but this can be overcome by setting a target at the start of the day and allowing the individual stents to be adjusted to keep the digger working to the desired pace. If the ability of the gang is not known it will be best to set the first target at the readily obtainable one of doing half as much again as on ordinary day work - then it can be stepped up once the gatherers show their capacity to exceed it. The method will work like this: if there are 30 drills to the acre and the target is 3 acres in $7\frac{1}{2}$ hours, the digger driver will be told to dig one drill every 5 minutes; if there are only 25 drills to the acre he will be told one drill every 6 minutes, and so on.

Until a suitable one-row elevator digger with a side-swathing arrangement is available, the only alternative to the mounted digger is a two-row elevator digger, wherever ground conditions are suitable. This has proved itself for incentive working since it can work one swath in front of the gatherers and dig in both directions taking successive drills along one side of the break. The small amount of evidence obtained about the use of this machine suggests the same relationship holds between picking rate and numbers of potatoes as for the single-row digger. Since two drills are put into one swath the machine also has the advantage of increasing slightly the rate of picking. It will, therefore, /

therefore, call for a corresponding adjustment to the incentive payment (Table VII) which will be to the benefit of the farmer and of no detrement to the gatherers. In this case the rate of payment depends on the number of potatoes in two adjacent three yards of drill. Again 8 to 10 (or 10 to 12) gatherers seems to provide the most satisfactory size of gang.

Details of the rates of payment required per $\frac{1}{4}$ acre according to the operative day wage rate and the number of potatoes in the drills are set out in Appendix II, Tables B for both one and two-row diggers*. As with previous tables, calculations are based on 28-inch drills. When drills are of a different width it can be assumed for payment purposes that an acre consists of 6223 yards of drill as is the case with 28-inch wide drills (see Appendix II, Table A). Any adjustment in rate of pay is, therefore, made only through variations in the number of tubers in the drills. After all, the gatherers should be paid by the number of potatoes and the length of drill they have to gather. The actual acreage of the field is of secondary concern.

Responsibility for supervision of the quality of the work done remains, as at present, with the farmer or his potato foreman. Full payment should depend on the usual standard of clean gathering of the potatoes exposed by the digger. It would be wise in most cases to demand a minimum number of gatherers in the gang, say 8, to make sure the work is done expeditiously and to fix a maximum number of gatherers for whom payment will be made, say 10, so that only the gatherers will suffer if they increase their own numbers beyond the capacity of the digger.

The estimation of the number of potatoes per 3 yards can be made by dividing the field into six approximately equal areas and taking a random sample of 3 yards of drill within each area. If the crop appears very variable or the yield low, it would be perhaps preferable to divide into 9 approximately equal areas. Sections of a field that are obviously different in yield and which can be worked separately should be sampled and paid for separately. The random sample within each area should be made by throwing a suitable object and measuring from the point of rest. The 3 yards should be dug by hand and the number of potatoes counted. An average of all the results with 4 or 5 potatoes deducted from it to allow for loss in harvesting gives the required answer.

One or two points of difference between ordinary working and incentive working must be noted. More attention must be paid to making sure that the potatoes are left by the digger in a suitable swath and in a position clearly visible to the gatherers. This means that care must be taken to remove beforehand any weeds or shaws that are going to hinder the gatherers. Further, there must always be skulls ready at hand for the gatherers to fill. This means that more thought must be given to the loading of the potatoes, and this task should be done from behind the gatherers to avoid the slightest chance of delaying the digger. Full attention must be given to precautions against delays so that any hold-up in the digging is so short as not to affect the gatherers.

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* T. S. Wilson, College Machinery Adviser of Perth, suggests a third possibility of paying for gathering according to the length of drill lifted by each gatherer. This would allow gatherers to be paid individually yet without the necessity of using barrels. For those who would like to experiment with this method Table E is included in the Appendix.

For any job at the mercy of the weather and machinery break-:downs some adjustment must be practicable to the incentive rates to allow for situations out of the ordinary. It is possible to compensate the gatherers for breakdowns that prove an obvious hindrance to their chances of gaining the target by allowing them additional drills. The number of drills gathered are counted at the end of the day, counting from whatever mark has been set up, and to these are added the extra drills allowed, so arriving at the acreage to be paid for. When conditions become unsuitable for gathering, work and payment should cease. Of course, if gangs are travelling from a distance it may be necessary to guarantee them at least half a day's wage (not piece-work earnings) for making the journey.

More difficult is the position in bad harvest weather when the potatoes are difficult to dig and not easy to see on the ground. This requires a judgment taken on each specific instance with a knowledge of the capacity of gangs working on incentive rates and an appreciation of the effect of the conditions on the picking speed of the actual gang. It is a decision to be taken on the spot and constitutes a temporary arrangement for the particular unfavourable conditions at the time. The simplest way is again to allow additional drills on the basis, to give an example, of one drill extra for each 9 drills gathered. It is important to notice that this avoids making any change in the basic rate. Naturally it pays to be conservative in giving such allowances, otherwise too much incentive is removed particularly when the number of potatoes per yard of drill is low. An increase of the order of 1 for 9 is equivalent to assuming that if the gang of gatherers were expected to pick all-told 2 acres in a day, their output for the day would, through no fault of their own, have been less by a fifth of an acre.

The rates of pay suggested are based on the use of the skull. Some areas use the brat which needs emptying into a skull or basket and this takes up part of the gatherers' time. No additional allowance should be given for this. The decision on whether or not to use the brat is the gatherers'. If they are accustomed to the method and feel they can compensate by quicker picking for the need to empty it, they should be allowed to use the brat but should not be granted extra pay because of their preference.

The incentive method of harvesting should be no dearer per acre than the usual method; in many instances, because of the indifferent labour now available, it will be cheaper. The real point is that payment should fit the performance and full use should be made of the available adult labour force. When provided with an incentive a small number of efficient workers can do the gathering in the same time as a gang of very much larger numbers, and this change should remove most of the annual worry of discovering sufficient gatherers and keeping them at work.

<u>Payment by the Barrel</u>

So far, all incentive payment has been based on the gang as a unit. The alternative is paying the individual gatherer on the basis of the quantity of potatoes picked and placed in suitable containers, usually barrels. This method is mostly employed in conjunction with a two-row elevator digger, but a single-row mounted machine would do almost as well. Under Scottish conditions there may be definite advantage in this barrel method which requires the hiring of individuals and not a unified gang.

As previously, the digger works only one side of the field and uncovers the potatoes so that no one is ever without potatoes to pick. Each gatherer has a stent allocated and this may be as long as forty yards. The /

The size of the stent is varied by the foreman according to the ability and performance of the gatherer so that by the end of the day no exposed potatoes are left. When the barrels are collected the foreman gives a ticket to the gatherer for each barrel that has been filled, and payment is made at the end of the day on the evidence of the tickets.

This method of working is inferior to the previous method in one particular respect. More work is demanded from the gatherers in harvesting an acre of potatoes. Not only have the potatoes to be gathered, they have also to be emptied into the barrel and from time to time a barrel has to be moved into a convenient position for filling. In all, this adds around 10 per cent to the work compared with normal gathering into skulls and allowance has to be made for it in fixing a price per barrel. As with the previous system, the rate is based on the work done on ordinary day work when the gatherers are picking 50 per cent of the time the digger is operating(Table VII). The incentive payment varies automatically with the day wage rates and is determined by the number of potatoes to be gathered.

It has been noted already that variations in the time requirement for gathering depend on the number of potatoes in the picking swath. To convert this into variations in time per barrel requires the additional knowledge of the capacity of the barrels and the yield by weight of the crop. (This latter can be obtained at the same time as the estimate of numbers by simply weighing with a spring balance the 3 yard stretches that have been lifted by hand, again making an allowance for loss in harvesting.) With this knowledge the relationship between numbers of potatoes and picking time can be converted into variations in payment for gathering a given volume of potatoes.

Tables for arriving at the required payment per barrel are provided in the Appendix II (Tables C and D). The capacity of the barrel and the weight of the crop gives the number of barrels that have to be filled by a gatherer in order to harvest, in this case for pure convenience, 1/40th of an acre. The number of potatoes in 3 yards of drill and the day wage rate give the payment required for the same 1/40th of an acre and the two sets of facts taken together give the required payment per barrel. For example, take two cases where $1\frac{1}{2}$ cwt. barrels and a single-row digger are in use. A seed crop of 78 potatoes to the 3 yards would call for a payment of 42 pence for each 1/40th acre when the day wage rate is 20 shillings. With a yield of 12 tons to the acre (13 lbs. per 3 yards of drill) 4 barrels would hold this amount giving a payment of $10\frac{1}{2}$ pence per barrel. With a 12-ton ware crop, in contrast, counting out at 54 potatoes to 3 yards of drill, the rate of earning would be 32 pence per 1/40th acre and only 8d. per barrel.

The only other check required is the level to which the barrel has to be filled in order to weigh the required $1\frac{1}{2}$ cwts. The average size of the potatoes varies from crop to crop and so does the weight that can be collected in a given volume of space, i.e. a barrel. If the number of potatoes per pound weight is high, the barrels will require to be filled to a higher level than if the potatoes are large in size and the gatherers need to be told of these differences. Allowances for special conditions will have to be made as before if a delay has lost the gatherers part or the whole of a barrel, or if bad soil conditions have increased the difficulty of gathering enough to warrant paying for an extra barrel for every 9 or so filled.

One other point requires mentioning with regard to this method of harvesting. Rigid containers are a "must". Sacks take too long to fill and are easily knocked over. It will then be no part of the work of a gatherer on piece-rates to pick them up again. The difficulty with the rigid container is that for handling with any ease it requires /

requires a special machine. Hoists on the trailers are frequently used for barrels and other arrangements have been made involving the use of an additional tractor and hydraulic loading device for lifting and emptying the containers.

Restricted Numbers

The shortage of gatherers is the over-riding problem of potato harvesting and it is a problem that might become extremely acute if the school children were withdrawn. There is considerable scope for improving the output from adult gatherers, the first step being to restrict the number employed. Ten adults are not too few and twenty should be considered the maximum for the usual arrangements. Yet the present organisation of harvesting still would not make full use of a scarce resource. The answer must be incentive payment, paying more money for more work. The size of the gang has then to be reduced to 8 or 10, or possibly 10 to 12 with seed crops, in order to meet the limitations imposed by the diggers. If the lifting machinery is available two small gangs can be used instead of one larger one and it will be found that they can harvest between one and a half to twice as much again in the same time.

The choice between the two methods of incentive payment depends on local circumstances. Payment to the gang as a unit requires least change in the organisation of the lifting but requires some organisation by the gatherers to form themselves into gangs. The barrel method requires the purchase of containers and changes in the loading and transporting of the potatoes but the gatherers are employed as individuals. On the other hand, where the gatherers are willing to organise themselves and work as a unit, there might be more guarantee of having a sufficient complement of labour available every day. Whatever the method of organisation, the incentive payment should be related to the number of potatoes that have to be gathered because this has proved to be the major factor determining the work to be done. Unless there is this firm basis for the incentive scheme there is always the danger of mutual recrimination between farmer and worker on the level of payment fixed and the output obtained. Underpayment will not attract sufficient labour but overpayment will reduce the incentive to achieve maximum output and it is that which is so urgently required.

RELATIONSHIP BETWEEN GATHERING TIME

AND NUMBER OF POTATOES IN DRILL AS DUG

GRAPH I

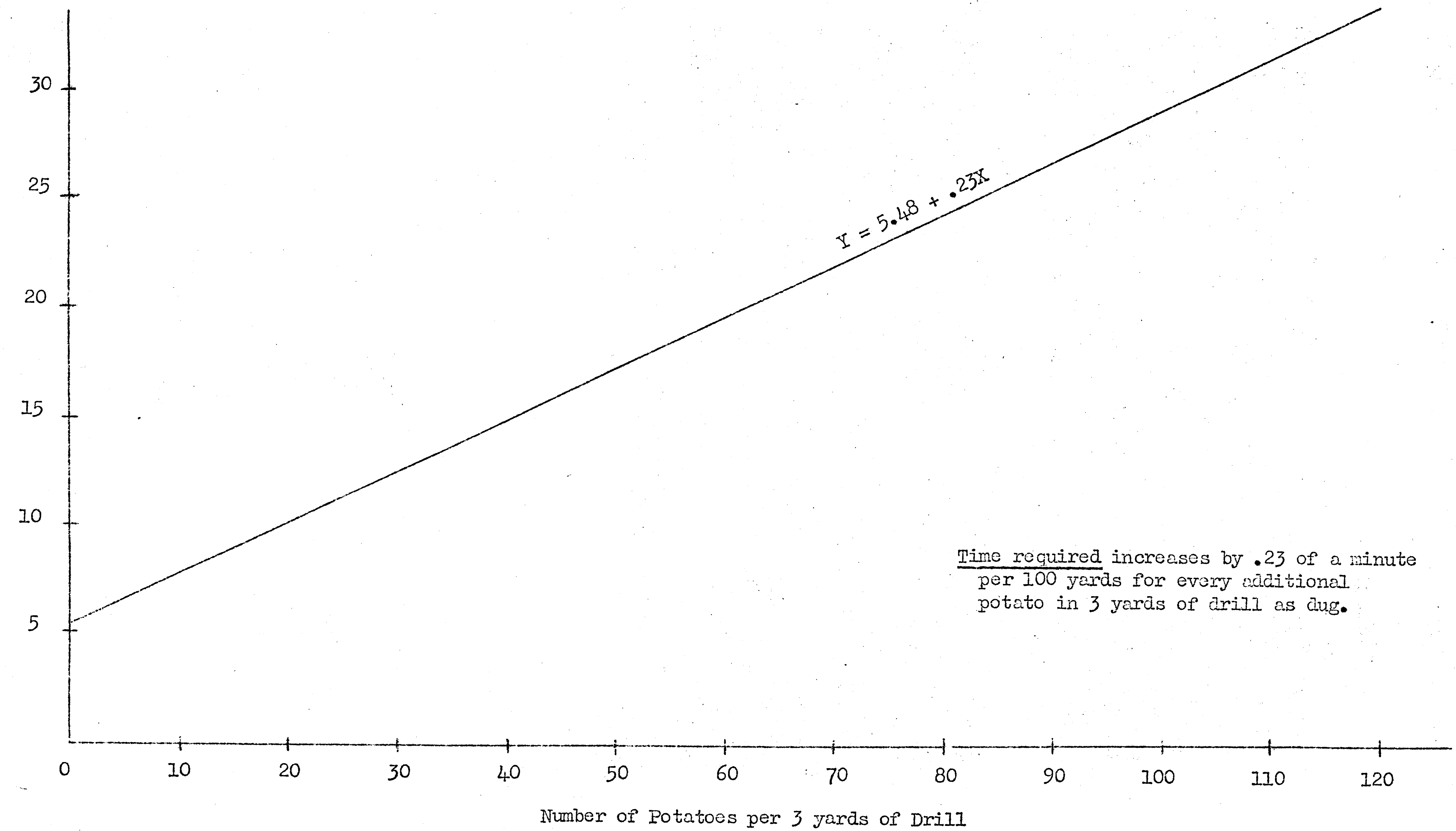

TABLE VI.

INCENTIVE PAYMENTS TO GANG AS UNIT

PAYMENT TO GANG OF 10 GATHERERS FOR EACH $\frac{1}{4}$ ACRE

A) ONE ROW DIGGER

8 Hour Day

	Number of Potatoes in 3 Yards of Drill							
	120 - 116	115 - 91	90 - 73	72 - 61	60 - 51	50 - 43	42 - 36	35 - 30
Acres to be Gathered to Earn Day's Wages	1	1$\frac{1}{4}$	1$\frac{1}{2}$	1$\frac{3}{4}$	2	2$\frac{1}{4}$	2$\frac{1}{2}$	2$\frac{3}{4}$
Fraction of Day's Wages Paid per $\frac{1}{4}$ Acre	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11
Acres Expected in Day with Incentive Working (to nearest 1/8 Acre) at 150% to at 170%	1$\frac{1}{2}$ to 1$\frac{3}{4}$	1$\frac{7}{8}$ to 2$\frac{1}{8}$	2$\frac{1}{4}$ to 2$\frac{1}{2}$	2$\frac{5}{8}$ to 3	3 to 3$\frac{3}{8}$	3$\frac{3}{8}$ to 3$\frac{7}{8}$	3$\frac{3}{4}$ to 4$\frac{1}{4}$	4$\frac{1}{8}$ to 4$\frac{5}{8}$

B) TWO ROW DIGGER

8 Hour Day

	Number of Potatoes in 3 Yards of Swath*										
	240 -214	213 -170	169 -144	143 -125	124 -109	108 - 96	95 -86	85 -77	76 -70	69 -64	63 -58
Acres to be Gathered to Earn Day's Wages	1$\frac{1}{4}$	1$\frac{1}{2}$	1$\frac{3}{4}$	2	2$\frac{1}{4}$	2$\frac{1}{2}$	2$\frac{3}{4}$	3	3$\frac{1}{4}$	3$\frac{1}{2}$	3$\frac{3}{4}$
Fraction of Day's Wages Paid per $\frac{1}{4}$ Acre	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15
Acres Expected in Day with Incentive Working (to nearest 1/8 Acre) at 150% to at 170%	1$\frac{7}{8}$ to 2$\frac{1}{8}$	2$\frac{1}{4}$ to 2$\frac{1}{2}$	2$\frac{5}{8}$ to 3	3 to 3$\frac{3}{8}$	3$\frac{3}{8}$ to 3$\frac{7}{8}$	3$\frac{3}{4}$ to 4$\frac{1}{4}$	4$\frac{1}{8}$ to 4$\frac{5}{8}$	4$\frac{1}{2}$ to 5	4$\frac{7}{8}$ to 5$\frac{1}{2}$	5$\frac{1}{4}$ to 6	5$\frac{5}{8}$ to 6$\frac{3}{8}$

* One swath equals 2 adjacent drills.

TABLE VII.

BARREL SYSTEM

INCENTIVE PAYMENT TO INDIVIDUAL

ACRES EXPECTED IN DAY FROM GANG OF 10 GATHERERS

A) SINGLE ROW DIGGER

8 Hour Day

		Number of Potatoes in 3 Yards of Drill						
		120 - 104	103 - 81	80 - 65	64 - 53	52 - 44	43 - 37	36 - 30
Acres to be Gathered to Earn Day's Wage		1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$
Acres Expected in Day with Incentive Working (to Nearest $\frac{1}{8}$ Acre)	at 150% at 170%	$1\frac{1}{2}$ to $1\frac{3}{4}$	$1\frac{7}{8}$ to $2\frac{1}{8}$	$2\frac{1}{4}$ to $2\frac{1}{2}$	$2\frac{5}{8}$ to 3	3 to $3\frac{3}{8}$	$3\frac{3}{8}$ to $3\frac{7}{8}$	$3\frac{3}{4}$ to $4\frac{1}{4}$

B) TWO ROW DIGGER

8 Hour Day

		Number of Potatoes in 3 Yards of Swath*										
		240 -232	231 -186	185 -153	152 -130	129 -112	111 -97	96 -86	85 -76	75 -68	67 -62	61 -56
Acres to be Gathered to Earn Day's Wage		1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$	$3\frac{1}{2}$
Acres Expected in Day with Incentive Working (to Nearest $\frac{1}{8}$ Acre)	at 150% at 170%	$1\frac{1}{2}$ to $1\frac{3}{4}$	$1\frac{7}{8}$ to $2\frac{1}{8}$	$2\frac{1}{4}$ to $2\frac{1}{2}$	$2\frac{5}{8}$ to 3	3 to $3\frac{3}{8}$	$3\frac{3}{8}$ to $3\frac{7}{8}$	$3\frac{3}{4}$ to $4\frac{1}{4}$	$4\frac{1}{8}$ to $4\frac{5}{8}$	$4\frac{1}{2}$ to 5	$4\frac{7}{8}$ to $5\frac{1}{2}$	$5\frac{1}{4}$ to 6

* One Swath equals 2 adjacent drills.

6. LOADING THE POTATOES

One important point has already been made in connection with the loading, carting and storing of potatoes - that these final operations should in no way interfere with the primary tasks of lifting and gathering. Yet this consideration must not result in an excessive use of workers. The crux of the matter is to produce a balance between too few and too many hands. The final choice necessarily remains with the farmer or foreman on the spot because of the large number of factors that can determine the needs of the moment. This makes it undesirable if not impossible to attempt to reduce the selection of numbers of persons and vehicles for loading and carting to a mathematical formula.

Loading

First of all the loading. This is usually done straight from the skulls by workers who empty them into carts or trailers which are travelling alongside. It is no light task since it demands continual bending down-:wards and stretching upwards. The most suitable vehicle is, therefore, the one that demands the minimum of stretching by the loaders as they empty the skulls. The smaller the lift the less the resulting fatigue. The old horse box-cart with its high sides is certainly the most unsatisfactory type of vehicle at present in use. The modern trailers with their low floor levels are a considerable improvement.

Sometimes a man or youth is seen standing in the trailer, his job being to empty and throw back the skulls as they are thrown up to him by the loaders. It is a practice difficult to justify and timing shows no advantage in speed of loading. The mere fact that the full skulls have to be thrown to a much higher level than the top of the trailer's side-board suggests that it calls for a greater expenditure of energy from the loaders. In addition to this, potatoes should not be trampled as they lie in the cart. There are already more than enough occasions for bruising and damaging the tubers.

Time-studies have shown that the number of minutes required to load a ton of potatoes by this common manual method depended on the distance that had to be travelled to obtain that quantity of potatoes. For example, on one farm one man loading into a horse cart took 8½ minutes to pick up a load of approximately 9 cwts. whilst in another instance, again with one man loading, 15½ cwts. were loaded in the same time. The cause of the difference was that whilst on both farms the carts were collecting the potatoes as soon as they were gathered, the first man was loading the equivalent of 4 tons to the acre and the second a 10 ton crop; as a result the first man was having to walk twice as far as the second to collect one cwt. In other words the loading time depends greatly on the walking time, the actual emptying of the skulls taking place without markedly interrupting the speed of forward travel.

There must be some limit of course to the number of skulls that a man can pick up without having to reduce his normal pace down the drills. However, on one farm where only one loader was being used (not the same man for every load) it was taking only 7 minutes to load a ton of potatoes into the trailers. This was because with a heavy crop of 18 tons per acre 376 yards of drill* were sufficient to yield a ton. The walking distance was, therefore, low for each ton. (It must be emphasised at this point that the tonnage carted off the field must of necessity be greater than the tonnage dressed out later when a considerable weight of water has been lost).

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* 27-inch drills in this instance.

The present studies gave no indication of the length of drill that can be loaded by one man before he needs assistance in order to avoid undue fatigue. The general practice possibly forms as useful a guide as can be given. One loader was considered sufficient for a load over a distance of up to 500 yards; that is for two sides of a break with 250 yard drills. Two loaders were used for greater distances and these distances were sometimes twice as much as the above.

Because of the importance of distance, loading time can be cut by almost a half if two adjacent drills are collected at the same time. This is because the loading distance, or walking time, is halved. Two men taking alternate skulls should be sufficient for any weight of crop and it is a worthwhile practice with one way working. However, when working two sides of a break the practice of collecting two rows at once is generally restricted to low yields because with high ones the gatherers would need far more skulls than are usually available and it could be expected that correspondingly more skulls would be lost or damaged. But with low yields (10 tons and under per acre) and with small loads of 20 to 30 cwts. it would be possible to have only one loader instead of two as otherwise required.

In a previous chapter the benefits of loading behind the gatherers was noted, the alternative practice being to drive the tractor down the undug drills. Loading behind avoids all possible chance of the loading delaying the digger. When a tractor and trailer is being used it is imperative to have someone on the tractor seat. This is not necessarily a retrograde step although it calls for a greater integration of the loading team than is otherwise needed, the tractor driver taking a share of the loading and allowing one of the other men to rest to act as driver. Some farmers have already adapted their loading organisation to such requirements and some of the alternative arrangements are presented in Appendix I.

According to the suggestions given there, the maximum number of men required for a loading team is five. This maximum could become six only if three trailers are necessary for carting under the conditions of the last of these illustrations in which the position is considered where the loaders are prohibited from driving a tractor. The range proposed, then, is only from three to six men despite the fact that someone must always be driving. It is similar to present requirements although references to time studies show that the number of men employed on loading rose as high as 9: this was observed in two instances where three tractors were driving off! The general practice was a team of 2 loaders and 2 drivers with the work variously divided between them and there seems no reason to exceed this number unless there is a special call for an additional loader or an additional tractor and trailer.

Loading by Machine Power

Lifting skulls and emptying them into the trailers is not light or necessarily attractive work. For that reason it is worth looking at some of the mechanical alternatives which may be substituted for the loaders. The obvious drawback is a very real one in that mechanical loading transfers work to the gatherers since they have to empty the skulls into suitable containers. However, whilst these people are paid on day-rates and work such a low proportion of the day there can be no complaint about this. Indeed, it is a simple way of getting more work out of the gatherers.

As stated before, a sack is not a suitable type of container and will not be considered. That leaves barrels and also stillages on which the National Institute of Agricultural Engineering has been doing some valuable work.

(a) /

(a) Barrels

Wooden barrels of $1\frac{1}{4}$ to $1\frac{1}{2}$ cwt. capacity can be loaded on to trailers by means of a metal grab and an hydraulic hoist worked from the tractor hauling the trailer. The loading team, with ordinary working round a break, would not have to follow directly after the digger but could make its round fit in with the filling of the barrels. The team would be composed of 2 people actually doing the loading; a man arranging the barrels on the trailer and a man placing the grab over the barrels. In addition there would be the tractor drivers.

The method of loading 20 barrels with a hoist is comparable in performance to ordinary loading with small two-wheel trailers, taking 10-11 minutes for the 30 cwts. However, for heavy yields 3 trailers may be required instead of the usual 2 because of the fact that carting and loading time must also allow for the barrels being returned along the drills. The full requirements are a team of two or three tractors and trailers with 2 or 3 drivers plus 2 loaders in the field. Each tractor would require an hydraulic hoist costing in 1956 in the region of £30 each. Assuming three trailers are used, in order to deal with heavy yields, each gatherer would need 4 barrels as a minimum, one being filled, one being loaded and the other two being transported. With a squad of 20 gatherers this would mean 80 barrels plus five as a margin, say 85. At 22s.6d. a barrel (1956) 85 barrels would entail an outlay of £96. The cost is one obvious snag particularly since no saving of manpower is obtained. Even then the loading might become the factor limiting the work of the potato gang. To prevent this happening a larger type of trailer could be fitted with extended sides so that 30 barrels might be loaded and carted together.

(b) Drums

An alternative receptacle to the wooden barrel is the "oil" drum holding about $2\frac{1}{4}$ cwts. of potatoes. The potatoes are emptied by one method or another from the drum into the trailers and so the number of drums required is reduced to two per gatherer; that is 40 plus a margin, say 45. In one example inspected, the drums were emptied manually into a mechanical shovel fitted to a fore-mounted hydraulic loader and this emptied the potatoes into the trailers. This loader could empty 20 drums (45 cwts.) into a large trailer in 15 to 16 minutes, which is satisfactory compared with ordinary loading round the break.

It is, however, not quick enough for heavy yields of 15 tons and above (as loaded) in cases where 4 acres are being dug in the day. Such a combination would demand either a larger shovel to hold two drum loads at one lift or a second tractor and shovel so that the loading of one trailer could begin before the other was finished. Unpublished information from V. Baker, Aberdeen, would suggest the same problem arising with another device on a fore-mounted loader. This device drops a frame over the drums, lifts them and empties them individually into a trailer. Apart from this small note of caution, the method is entirely satisfactory and saves more manual labour than the shovel. The shovel requires a minimum loading team, for a gang of 20, of two men to empty the drums, one man to drive the tractor and hydraulic shovel and two men to drive the tractors and trailers, a total team of five men and three tractors. The frame reduces the total manpower required to three and therefore sounds promising.

(c) Stillages

Some interesting work on the use of stillages has been done by the Field Investigation Department of the National Institute of Agricultural Engineering /

Engineering and this was the subject of an article in "Farm Mechanization".[x] A stillage consists of a box which is either fitted with lugs for lifting purposes or is seated on a frame into which the loading "fork" fits. As developed by the N.I.A.E. this "fork" is spade shaped and made of tubular steel. It is mounted on the front loading arm of an hydraulic loader in such a way that the stillage can be lifted and emptied sideways into a trailer. The method has two advantages. In the first place the tipping is under the immediate and constant hydraulic control of the man driving the loading tractor and secondly sideways tipping removes much of the manoeuvering time necessary with the hydraulic shovel which empties at right angles to the trailer. With sideways tipping the trailer can be drawn up alongside the container whilst with a forward tipping device the trailer must be drawn up several yards in front of the container preferably half-way between it and the next one to be loaded. In this latter case the barrel has to be lifted, moved forward and emptied, and the tractor then manoevred into position for the next barrel. The side position must necessarily save some seconds on this method each time a container is emptied, the more so if the containers lie close together.

Where, as with ordinary loading, the loader and the trailer are moving down the drill together, the N.I.A.E. reported 1.10 minutes to load a 5 cwt. stillage. In this way a 40 cwt. load could be collected in $9\frac{1}{2}$ to 10 minutes compared with a time for ordinary hand loading of around 14 minutes with a heavy crop, (hand loading a lighter crop would entail more walking and hence more loading time). Part of the success of the method depends on the large container because, with the smaller 2 cwt. stillages, a 40 cwt. load could be expected to require over 20 minutes to load because of the greater number of containers. In that case it would be inferior, as far as speed of loading was concerned, to the methods with either barrels or drums, presumably because controlled hydraulic tipping takes longer than the more abrupt automatic way.

Five cwt. stillages would demand more work from the gatherers but not a great amount more compared with the $1\frac{1}{2}$ cwt. barrels. The latter method was estimated from direct observation to add 10 per cent to the work of gatherers and it is calculated from these observations that 5 cwt. stillages would demand 14 per cent more work than ordinary gathering into skulls. The difficulty is likely to be that, at least at first, the gatherers would be frightened by the size of the container and this might cause them to over-estimate the additional walking and carrying they would have to do. Otherwise there is no reason at all why this method should not be used where gatherers are paid on day rates, except to note that the work then required is near the upper limit for day-workers.

The team, then, for loading with stillages and the specially fitted hydraulic fore-loader is: one man with the tractor and fore-loader and one or two men with tractors and trailers. This gives the satisfactory low level of 2 or 3 workers plus tractors. Broadly speaking two trailers are required for heavy crops and only one for crops ten ton and less, provided there is not a long haul. Additional equipment required beside the "fork" will be 2 stillages per worker or 40 for a gang of 20.

In all the loading just discussed it has been presumed of purpose that each of the gatherers is filling only one container at one time; in other words that the barrel or stillage is placed in the centre of a 20-yard stent. From the gatherers' point of view a container every ten yards would appear more suitable but it must be remembered that two containers would take about twice as long to fill. This would have the effect of increasing the distance the gatherer had to walk at right angles to /

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[x] H.C. Green, N.W. Dilke, F. Cottrell.
"Farm Mechanization", September, 1956, pp. 262-264.

to the drills in order to empty their skulls, that is over the ground they have already cleared. With an 8-ton crop, for example, 3 drills would fill one barrel of $1\frac{1}{2}$ cwts. (with 20 yard stents) but 6 drills would be needed for 2 barrels. The walking involved in emptying skulls into a barrel in the centre of a 20-yard stent can be reduced if the gatherers remember always to pick towards the container. From the farmer's point of view, the fewer the barrels being filled at one time the smaller the number of barrels required by the gatherers and the smaller the number of barrels that are ready for emptying at one time. This practice is, therefore, to be encouraged.

Piece-Work Gathering

The recommendation given in the previous chapter was that piece-work gangs should consist of 10 gatherers working one side of a break. This is half the number of gatherers assumed in the examples of loading requirements already given above. It must not be assumed from this that half the teams suggested previously will prove sufficient. To take obvious instances, an hydraulic loader is, of course, indivisible and a hand loading team cannot be less than two members, a loader and a tractor driver. More to the point, it may be impossible to use only one trailer with hand loading though in some cases this can be done after thoughtful planning.

The crux of the problem when hand loading into one trailer is to ensure that the trailer can be absent from the loading for a sufficient time for it to travel to the pit or shed, empty and return. This depends on how many drills of gathered potatoes can be allowed to accumulate before the tractor and trailer are back at the drills. With heavy yields, as already mentioned, this is best limited to two drills. A 16-ton crop, for example, would fill 4 skulls to every 20-yard stent and each gatherer would require 10 skulls, 8 for picking 2 drills and 2 for a margin to meet any delay in the loading. Even then such a crop would call for two loaders so that the trailer could be filled at a satisfactory speed. With smaller yields the problem would not necessarily be so acute.

With a heavy ware crop, then, the necessary adjustments are to collect two drills at a time, load with two loaders, and load always towards the pit end of the field to reduce travelling time over the newly dug land. Further, in order to fit the loading in with the one-way working of the field, the digger must work in the same direction as the loading. Yet all this would still leave the trailer with only five or six minutes to do the carting and emptying. This means in effect that the pit would have to be in the same field or very close at hand.*

Increasing the size of the load would not increase the time available for travelling to the pit; that interval could only be increased by allowing three drills to accumulate instead of two. Doing this can only be considered satisfactory where the yields are low.

For longer hauls two trailers would be essential even for the small gang, and the one trailer should preferably begin loading at the opposite end /

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* A quick check on this fact is provided by assuming, what is quite possible, a 16 tons ware crop averaging 60 potatoes to the 3 yards of drill. Ten gatherers would pick 3 acres or more after a single-row digger. Three acres of 200-yard drills comes to 90 drills a day or 5 minutes per drill. Loading once down the drill to collect just over a ton of potatoes (from two adjacent drills) would take $4\frac{1}{2}$ minutes and during that time the gatherers would be well on the way to completing another drill. That would leave only a further $5\frac{1}{2}$ minutes before another load was ready for moving.

end of the drill to that where the previous trailer has finished. To have two trailers at work with a small gang may be necessary, for such a gang on piece-work, particularly with ware crops, can do far more than on ordinary day-work.

When $2\frac{1}{4}$ cwt. "oil" drums are being used for piece-work it would be satisfactory to centre them at around twenty-yard intervals, as already suggested for the larger gangs. Each gatherer would take 10-11 minutes to fill one drum from two drills with the heavy ware crop mentioned above and the loading team would take 7-8 minutes to empty the ten drums into a trailer by means of the hydraulically operated shovel or the frame. Twenty drums would, therefore, be sufficient for the gatherers. Generally two trailers are necessary, although one trailer may prove sufficient when the output of the gang is in the region of only two acres in a day - which can occur with a seed crop having a high count of potatoes. Occasionally the saving of a couple of minutes on the loading would make all the difference between using one instead of two trailers. This can only be done by having a large trailer and three drums to each gatherer. Twenty drums could then be collected on one journey in order to make the small but possibly useful saving.

With $1\frac{1}{2}$ cwt. barrels it would be almost essential to have 5 barrels to every gatherer for the heavy crops. The barrels can, therefore, be set out at 10, 15 or 20 yard intervals according to the length of the drill. Twenty barrels can be collected on one journey down the field and this should take about $7\frac{1}{2}$ minutes. For each gatherer to fill 2 barrels would take, according to the count of potatoes, 15 to 18 minutes with a heavy crop. As already mentioned, the time available for haulage and emptying is not quite so great as it looks because, for one thing, the barrels have to be returned into position along the drill. Two trailers, to hold twenty barrels each, must therefore be considered the requirement for heavy crops until the actual situation in the field proves otherwise. Should the barrels be found to hold only $1\frac{1}{4}$ cwts. instead of $1\frac{1}{2}$ cwts., as may be the case, two trailers are even more essential. Four barrels to each gatherer are, therefore, the minimum requirement and five, giving a total of fifty, barrels provide a necessary margin of safety. The cost of equipment, including hoists, for this manner of organising gathering on piece-work comes to around £120.

All things considered, a well-organised team of men emptying the skulls directly into the trailers still provides the most satisfactory method of loading potatoes. For this method a low trailer is always to be recommended so that the work can be done with the minimum of effort. It must, however, be noted again that there is no excuse of anyone trampling on the potatoes in the trailer. Mechanisation of the loading has begun but it is not at a very advanced stage, is not necessarily cheaper, and does demand more work from the gatherers. Those devices that empty containers into the trailers have perhaps the most promise because they require fewer drums etc. in the field. Yet carting direct to the pit or steading in the barrel must not be despised because it does reduce the number of opportunities for damaging the potatoes between the drills and the store.

TABLE VIII.

LOADING INTO TRAILERS

NORMAL METHOD:

Loading each drill from skulls as gathered

Yield Tons per Acre ⌗	Yards ∓ of Drill to Yield ONE TON	200 YARD DRILLS Number of Drills per Ton	Loading Time for 20 cwts.	30 cwts.	40 cwts.
			Mins.		
18	347	2	$7\frac{1}{2}$	$10\frac{1}{2}$	$13\frac{1}{2}$
17	366				
16	389				
15	415				
14	445	$2\frac{1}{2}$	9	$13\frac{1}{2}$+	$16\frac{1}{2}$
13	479				
12	519				
11	566	3	$10\frac{1}{2}$	$15\frac{1}{2}$	$19\frac{3}{4}$
10	623				
9	692	$3\frac{1}{2}$	$12\frac{1}{2}$	$18\frac{1}{2}$+	$22\frac{3}{4}$
8	778	4	$13\frac{1}{2}$	$19\frac{3}{4}$	$25\frac{3}{4}$
7	889	$4\frac{1}{2}$	$15\frac{1}{4}$	$22\frac{3}{4}$+	29
6	1037	5	$16\frac{1}{2}$	$24\frac{1}{2}$	32

\+ Taking for these 30 cwt. loads a loading distance of 4, $5\frac{1}{2}$ and 7 drills respectively.

⌗ Tonnage as carted, not as dressed.

∓ 28 inch drills.

7. STORING THE POTATOES

Three separate operations are combined in the work usually designated the "carting of potatoes". These are the loading after the gatherers, which was considered in the last chapter, the transport from the drills to the place of storage, and the unloading of the potatoes at the pit or shed. A greater number of workers are concerned with the work at the beginning and end of the carting - with the loading and the emptying of the trailers - rather than with the carting itself. This makes it most convenient to consider next the work at the pit or shed.

Work at the Pit

Unloading at the pit

For the most part, unloading was done quicker at the pit than at the shed. Horses and box carts had the quickest turn-round of all, taking from two to three minutes from arriving at to departing from the pit. Undoubtedly, one factor was the small loads which they carried, sometimes less than 10 cwts. Possibly more important was the method of tipping: the removal of a catch, a quick heave and the potatoes were jerked out of the cart leaving a minimum of forking to complete the task.

In several cases tractors were drawing the box carts and they required the full three minutes to turn round simply because backing into position took longer. The tractor driver whether he is backing a cart or a trailer needs a guide that is easily visible from the tractor seat. This can be provided in many cases by a six or seven foot pole painted with black and white bands to make it visible and spiked at the end. Thrust into the ground, this marks where one edge of the back of the trailer must come to rest. However, with the combination of high box carts and low tractors any such marker is of little use.

When a marking pole can be used it will reduce the time that one of the men at the pit must otherwise spend guiding back the cart or trailer. This man should continue to be responsible for removing the backboard of the trailer. It allows the tractor driver to concentrate on tipping the trailer and thereby speeds up the unloading.

As a general rule, trailers (in all cases two-wheel trailers) took longer than carts to empty at the pit. The range of times obtained, after making allowances for different working paces, was from just over two minutes to nearly eight minutes per load. These times include manoeuvring the trailer into position at the pit and all subsequent work until the trailer left with its backboard in place. Forking the potatoes out of the trailers occupied the bulk of the unloading time but it is important to note that there was no direct relationship between forking time and the weight of the load. Much more important was the method of tipping, the least forking and the quickest turn-round being achieved with trailers which tipped abruptly by some automatic device (similar in principle to the tipping of the box carts). Hydraulic tipping devices and manually operated "winch" systems were fairly comparable in performance although the results with the manual systems, as might be expected, were more variable in respect of the time taken.

One man was usually considered sufficient for the forking although two men were used in some instances studied. It was impossible, however, to assess the improvement in performance due to the use of the second man. He is hardly likely to secure an improvement of more than half as much again compared with one man's output because there is obviously insufficient elbow /

elbow room inside a trailer for both to work to their full capacity. There is one exception to this and that is where side-tipping trailers are used and two men can fork fairly independently.

Forking from the trailer at the pit causes trampling on the potatoes and also delays the return of the trailer to the field. Because of this, forking should be reduced to a minimum and what has to be done should be done by one man. This means suiting the width of the pit to the size of the trailers. It also means using trailers that tip to a satisfactory angle. When these conditions are met it does not appear to matter whether the trailers which empty from the rear do so from a side position, that is at right angles to the line of the pit, or from the end position. The side position is more difficult to organise efficiently and sometimes gave long times for unloading. However, with one well-conceived arrangement hydraulic tipping trailers were unloading 40 cwt. loads from the side position in under three minutes. This is as good as any performance seen for the end position with comparable equipment. In this instance the pit board was placed at an obtuse angle away from the pit instead of the acute angle usually adopted (in which latter position it forms one side of the pit). The board merely checked the flow of the potatoes and the two sides of the pit were formed by natural flow from the apex formed at the mouth of the trailer. Forking only took one man a little more than a minute.

All the same, from many points of view tipping at the open end of the pit is preferable. It allows more latitude in the size of loads and with skilled tractor drivers offers the opportunity of emptying the whole load without any forking - if the occasion demands. One or two possible aids to this end may be noted. There is obvious benefit from using bunches, or sacks filled with straw, to check the backward flow of potatoes from the trailers as they are tipped. These bunches are placed on the two sides of the pit against the back end of the trailer and held in place by forks or stakes. Then if the tractor is jerked forward the potatoes tend to tip in one heap leaving the minimum of trimming up to be done afterwards. It is also possible to limit the lateral spread of the potatoes as they come out of the trailer by fitting baffles or detachable guides to funnel the flow of potatoes. This device was used most effectively on one farm where no forking at all was done as part of the unloading of 20 cwt. loads.

A reasonable time for the complete unloading operation with a trailer can be set at from 3 to 4½ minutes, supposing that the forking is necessary and is done by one man, possibly the tractor driver. The majority of cases where the higher figure was markedly exceeded were, as already noted, with sideways-on unloading accompanied by an unnecessary devotion to forking.

Pitting

It is extremely difficult to give categorical figures for the number of men required to do the pitting for a given tonnage of potatoes in a day. The work is very variable and the task is often given to the older men who need a light job. As many as four men were seen at the pit though the usual number was two men when the throughput of potatoes was up to 5 tons per hour and three men above this quantity. Even then they were underemployed and it was hard to decide what was essential work and what was merely filling up time. Certainly the impression given is that in general more work should be expected from the men at the pit. To give an example of what can be done: two men on one farm with a heavy yield were pitting, strawing and placing spits on the straw and dealing with almost 10 tons per hour coming to them in large loads.

Two /

Two men can be considered as the standard number of men required at the pit until it is proved that another man is essential. To improve performance the work of these two men should be separated as far as possible. One man can assist with the unloading, do the straightening and shaping of the pit when that is finished and then help with the strawing. The other man can be responsible for strawing and spitting, using the straw stacked beside the site of the pit before the start of the day's lifting. These two jobs are, of course, interchangeable but the division avoids two men standing by whilst the tractor driver forks out of the trailer.

In some circumstances this task of forking out of the trailers can be transferred to the men at the pit. This might happen if the tractor driver is helping with the loading in the field and needs a rest period during the unloading. Alternately the load may be tipped without any forking, and this will leave the man who trims up the pit with more straightening to do. If this additional work for the men at the pit avoids the possibility of delays in carting checking the work of the gatherers, it is to be recommended.

When the work at the pit clearly becomes excessive, the easiest answer but not necessarily the best is to add another man there. The danger is that this man will be absorbed into the system, be considered essential in all circumstances and found work there when lighter crops make him unnecessary.

A better possibility can be to leave the bulk of the spitting and get it done whilst the harrowings are being collected or even later still as overtime. If another man <u>has</u> to be brought onto the field it might be more suitable and less of a precedent to introduce that additional man somewhere in the carting organisation either in the loading team so that the tractor drivers can fork out the loads, or as a tractor driver. In this latter case the tractor drivers can either help in tidying up the pit after unloading or, possibly more suitably in some cases, give a hand with the spitting.

The argument lying behind this section is this: the main aim of the harvesting organisation must be to keep the gatherers at work and to make sure that they really are the limiting factor to the day's output. This object must be achieved with a limited labour force engaged on removing the potatoes to storage. Therefore, on most harvest days the strawing and spitting must be regarded as a residual item, one that is done when and where possible. Usually it can be done as part of normal working but in difficult circumstances some of it at least can be left to the end of the day in order that the carting may not be interrupted.

<u>At the Shed</u>

As has been hinted already, instead of unloading at the shed taking 3 to $4\frac{1}{2}$ minutes it can take up to twelve minutes and possibly even more. This applies whether an elevator is used or the work done manually. The latter method is often used in the initial stages of converting buildings to potato stores. It is possible to tip one or two loads but after that the potatoes have to be forked up to the five or six foot level by hand. Every load will take a different time to empty and it will be heavy work for two men. If the tractor drivers are exempt from this forking, three men will be required for the unloading at the shed in order to provide each one with sufficient opportunity for resting periods.

An elevator provides the answer to the heavy work and will reduce the labour requirements at the shed to one man. Using an elevator does not necessarily reduce the time needed for unloading. The best cases observed required 7 to 8 minutes for the complete unloading operation with

40 /

40-50 cwt. loads; others took half as long again. The N.I.A.E., on the other hand, reporting on their design of elevator-loader,* gave an average time of $4\frac{1}{2}$ minutes for turning round a trailer carrying 37 cwts. According to this standard, five minutes should be sufficient for any size of trailer load. The N.I.A.E. report says, and this may be relevant here, "the linear speed of the (elevating) belt was found to be of particular importance in getting satisfactory results when dealing with tipping trailer loads." This suggests that more attention needs to be given to the choice of suitable elevators and particularly to their rate of working.

The N.I.A.E. elevator-loader has several other points worth noting. The first is the wide hopper, 7 ft. 9 inches wide, specially designed to receive loads from tipping trailers. This hopper has an adjustable feed control. It also has two white markers, sticks fitting into sockets on the hopper which assist the tractor driver to reverse into the correct position. Another point needs stressing. In addition to its other qualities, a potato elevator should be easy to move from one loading position to another. In practice this means that it has to be free to move sideways as well as backwards and forwards. A suitable implement should demand only half a minute of the tractor driver's time whilst he helps the storeman to make any necessary major adjustment of position. Minor adjustments of position or height should be within the capacity of the one man at the shed.

Some elevators carry far too much soil into storage and this, according to technical reports, is undesirable. The N.I.A.E. elevator-loader has a wire-mesh conveyor belt which allows loose soil to fall through and collect under the elevator. It is no great task for the storeman to shovel this into a wheelbarrow for removal out of the store. The N.I.A.E. suggest shallow metal trays to collect the soil. The tractor drivers can then help the storeman to tip their contents, possibly into a spare trailer. The fact that the trailers are already taking a long time to travel and turn round at the shed probably makes the wheel-:barrow preferable. The soil can then be returned to the field first thing in the morning before the lifting starts or even at the end of the harvesting.

One storeman is a full complement at the shed compared with the two or three men needed at the pit. The work of adjusting the elevator, levelling the potatoes (i.e. pushing the heaps downhill from immediately beneath the end of the elevator), and covering them with protective straw is sufficient but not excessive. Storage at the shed instead of the pit does, however, usually demand the use of an additional tractor and trailer, partly because the haulage distance is increased, but also because the unloading can take twice as long or more. It is, of course, possible now and again to empty a load direct on to the floor of the store instead of into the elevator and so effect a quick emergency return to the field or give time for doing an additional task.

Unloading Barrels

Work at the pit can be reduced by use of a mould when barrels are being unloaded. This mould is composed of two boards 9 ft. x 4 ft.6 in., for example, which form the sides of the pit and are clamped apart at the top by extensions of the end-pieces and held in place by latches fitting on to the previous set of boards. Two sets of boards are required, the one being moved and clamped into position whilst the other mould is being filled. The potatoes are poured into the open space between the boards. The /

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* G.R. Chalmers - "An Elevator-Loader for the Bulk Handling of Potatoes into Permanent Stores." N.I.A.E. Report No. 29, 1953. See also "Bulk Storage of Potatoes in Buildings," N.A.A.S. Leaflet No. 24, Fixed Equipment on the Farm, H.M.S.O., 1954.

The mould fashions the side of the pit and no other shaping is required.

It takes longer to empty barrels at the pit than to unload loose potatoes. For expeditious working two men are required, both tipping barrels into the mould from the trailer which is drawn up alongside the pit. This enables the two men to work independently. A load of 20 barrels (25-30 cwts.) will take $4\frac{1}{2}$ to 5 minutes for the complete operation and a larger trailer holding 30 barrels will take 6 minutes with a reasonable speed of working. One man doing the unloading alone is likely to take nearly twice as long. A point worth remembering is that both unloaders will need an empty space on the side of the trailer in which they can stand to start unloading. Those who are loading in the field will need to bear this in mind. Another point is that the man unloading at the back of the trailer can always drop the first few empty barrels off the trailer out of his way and pick them up afterwards. It is not so easy for the man at the front. One possibility is to provide him with a raised platform (like that on a milk lorry) jutting out over the front of the trailer, on which he can place some of the empty barrels.

When unloading in the shed an elevator is used with a simple frame fitted across the mouth of the hopper to hold the barrels in position whilst they are being emptied. This particular method of working was not studied in detail but observation suggested that the position of the trailer relative to the elevator is fairly important. The best position is when the elevator is central to one side of the trailer, since this allows two unloaders to work from one side each without getting too much in each other's way. Even then they cannot both empty a barrel at the same time and, therefore, might be expected to take nearer $6\frac{1}{2}$ to 7 minutes to unload 20 barrels. Unfortunately, even in a large shed it will not always be possible to obtain this desirable position and many loads will have to be emptied from the rear of the trailer. This increases both the distance the barrels are moved along the trailer to the elevator and also the number of barrels that have to be dropped on the floor, out of the way of the unloaders, to be picked up later. Such a situation might be expected to at least double the $4\frac{1}{2}$ to 5 minutes taken for emptying 20 barrels at the pit. However, taking all these things into consideration it will take no longer to unload barrels at the shed than to tip out loose potatoes into an elevator by present methods.

Transport to Storage

The Carting

Turning now to the carting, it is usual to measure the incidence of carting and carrying in terms of distance. This was quite satisfactory when horses were everywhere in use. They had more or less one pace. It is far from useful when considering tractors and trailers because the speed of travel is so variable depending greatly on the load and the nature of the ground or road surface. A fully loaded trailer has to be hauled across a newly dug field at, say, $2\frac{1}{2}$ m.p.h. whilst the same load can be drawn at 8 m.p.h. or more on a metalled road. This is one very obvious reason for arranging so that loading ends at the nearest possible point to a roadway when carting to the shed. Haulage, therefore, is best considered in terms of time. Reference to the studies shows a variation in time requirement from less than two minutes to eight minutes (this could, of course, be more) for the two journeys, loaded to the storage site and unladen from the pit or shed to the digging.

Taking the figures for unloading given earlier in this chapter the conclusion can be drawn that 6 minutes is the minimum time a tractor and trailer must have to empty the potatoes and return to the digging.
Storage /

Storage will in such a case be in a pit. Six minutes allows either two minutes for the total travelling and four for the unloading at the pit, or three minutes for travelling and three for unloading with little or no forking. For most farms a more general assumption will be four minutes for total travelling time to and from the pit and four minutes for unloading; a total of eight minutes per load. Working with shed storage the minimum travelling is likely to be four minutes with eight minutes as a fair allowance for unloading into an elevator; a total of twelve minutes away from the digging. The total could easily, of course, be 16 minutes or more through increased travelling time between the digging and the shed or because of unloading difficulties at the shed.

Now that estimates have been given of the time needed for all the operations involved in carting, that is the loading, hauling and emptying of the potatoes, it is possible to look at the number of trailers required for various set-ups. The tonnage that one trailer can cart in a day is naturally governed by its loaded capacity as well as by the time needed for the various tasks just mentioned. Some of the limits to the use of one trailer have been examined already. Apart from this the number of trailers needed depends on the relationship between the tonnage that one trailer can cart in a day and the tonnage dug and requiring removal to storage. In other words, if two trailers are to do the carting each one of them must be capable of collecting, hauling and emptying one ton and returning to the place of loading whilst the digger (and the gatherers) is lifting two tons. If the two trailers cannot manage by even a small fraction, a third is required.

A standard often declared is for a squad to gather 4 acres in a day. This involves carting from 24 tons of potatoes with a very poor crop to possibly 72 tons with a very heavy one. When the potatoes are being pitted fairly close at hand (up to 8 minutes absence from the loading) two trailers will be sufficient - needing a capacity of 20-25 cwts. for crops up to 12 or 13 tons per acre and a capacity of 30-35 cwts. for heavier ones. When potatoes are stored in a shed trailers holding 40-50 cwts. will be required if two are going to be sufficient and even then a long haul can be beyond their capacity with a very heavy crop. But three trailers of 30-35 cwts. capacity can manage the extreme mentioned above of 16 minutes absence from the loading. Alternatively, four trailers of 20-25 cwts. can be used. The greater number of trailers required with the smaller loaded capacity does point the advantage of large modern trailers for hauling potatoes to sheds.

Carting with Piece-Work Gathering

If piece-work is undertaken (as advocated earlier) with small gangs of ten persons each gang will require its accompanying carting set. This will, in the normal course, be two trailers. As already indicated, one trailer may be a possibility only provided it can complete its journey in sufficient time. If the small gang gathers three acres in a day, one 200-yard drill must be dug every five minutes. Assuming, as before, that only two drills can be allowed to accumulate without any loading being done, then one trailer is sufficient only as long as the time to load the last two drills, travel and empty does not exceed ten minutes - the time taken to dig two drills. To collect these two drills by hand on one trip down the field will take $4\frac{1}{2}$ minutes which only leaves $5\frac{1}{2}$ minutes for the round trip to the store. This means that one trailer can only deal with this rate of working if the storage is very close at hand in the field. For two acres dug in the day there will be more time, namely fifteen minutes to collect the last drills and complete the journey to the pit and back. This is sufficient for one trailer to deal with the carting to most pits but only to a few well-placed sheds.

Two /

Two trailers are then the most likely complement for piece-working. With normal pitting and three acres lifted in the day, two trailers of the smaller size - 20 to 25 cwts. - will be adequate. For storing in the shed 30 to 35 cwt. trailers will be needed. They will be sufficient for all but the longest hauls and heaviest crops. For two acres in a day the smaller size should suffice.

Looking at piece-work gathering into barrels or drums the position is somewhat different. With oil drums of $2\frac{1}{4}$ cwt. capacity it is preferable to have large trailers so that the contents of 20 drums can be loaded at once. Looking first at occasions when three acres are gathered in a day, there is no great margin with high yields for transport and emptying time because of the time taken to collect the loads with the hydraulic loader. One trailer can, therefore, deal only with cases of the shortest hauls and yields of a maximum of 15 tons as carted, that is allowing 15-16 minutes for loading and 5-6 minutes for transporting etc. For higher yields and also for longer hauls, particularly to sheds, two trailers are a necessity even for the small gang. On the other hand, if only two acres are harvested in the day more time will be available for removing the potatoes from the field and usually one trailer will be sufficient.

The position is fairly similar for the use of $1\frac{1}{2}$ and $1\frac{1}{4}$ cwt. wooden barrels. Loading is somewhat quicker but, against this, additional time is needed for unloading at the pit (and sometimes at the shed), and two or three minutes have to be spent on returning to the field in replacing the barrels in position down the drills. The result is that, even with 30 barrel loads and $1\frac{1}{2}$ cwt. barrels, performance is not quite so good as with the drums. Two trailers are, therefore, needed more frequently. With 20 barrel loads two trailers are usually the minimum, and three are generally required for hauling to a shed.

Storing potatoes at the shed saves labour otherwise occupied with strawing and spitting. Against this the time required for unloading is increased, and this frequently means that an additional man is required with tractor and trailer to keep pace with the gatherers and remove the same quantity of potatoes from the field. This need to supplement the carting capacity is not necessarily removed by changing over to piece-work and the use of barrels, disregarding for the moment all its positive advantages, does decrease the tonnage that one trailer can deal with in a day.

TABLE IX

TIME AVAILABLE FOR CARTING

DAY'S OUTPUT+ : 4 ACRES

30 drills per acre.
1 drill every $3\frac{3}{4}$ mins.

YIELD≡ Tons Per Acre	TIME TAKEN TO DIG			
	ONE TON	25 cwts.≡1	30 cwts.≡2	45 cwts.≡3
	Minutes			
18	6.2	7.8	9.4	14.1
17	6.6	8.3	9.9	14.9
16	7.0	8.8	10.6	15.8
15	7.5	9.4	11.3	16.9
14	8.0	10.0	12.1	18.1
13	8.6	10.8	13.0	19.5
12	9.4	11.7	14.1	21.1
11	10.2	12.8	15.3	23.0
10	11.2	14.1	16.8	25.3
9	12.5	15.6	18.8	28.1
8	14.1	17.6	21.1	31.6
7	16.1	20.1	24.1	36.2
6	18.8	23.4	28.1	42.2

2 Acres per Day = Mins. x 2

DAY'S OUTPUT+ : 3 ACRES

30 drills per acre.
1 drill every 5 mins.

YIELD≡ Tons Per Acre	TIME TAKEN TO DIG			
	ONE TON	25 cwts.≡1	30 cwts.≡2	45 cwts.≡3
	Minutes			
18	8.3	10.4	12.5	18.8
17	8.8	11.0	13.2	19.8
16	9.4	11.7	14.1	21.1
15	10.0	12.5	15.0	22.5
14	10.7	13.4	16.1	24.1
13	11.5	14.4	17.3	26.0
12	12.5	15.6	18.8	28.1
11	13.6	17.0	20.5	30.7
10	15.0	18.8	22.5	33.7
9	16.7	20.8	25.0	37.5
8	18.8	23.4	28.1	42.2
7	21.4	26.8	32.1	48.2
6	25.0	31.2	37.5	56.3

+ 450 minutes.

≡ As hauled.

≡1 Load of 20 barrels of $1\frac{1}{4}$ cwts. each.

≡2 " " 20 " " $1\frac{1}{2}$ " "

≡3 " " 20 drums " $2\frac{1}{4}$ " "

8. SUMMARY

This report on potato harvesting is concerned with the improvement of the organisation of the work, making use of the equipment and labour already available to most farmers. Whilst the existing standard of organisation is high in the East of Scotland, considerable variation in efficiency can nevertheless be found. There is, therefore, scope for improvement. (see Introduction)

Evidence accumulated from detailed studies has suggested that many gangs were being treated too leniently. This calls, in the first place, for a tightening of the supervision of the harvesting and for more attention being given to details. It also calls for greater flexibility of organisation so that a delay to the carting (for example) does not cause the whole work of gathering to stop (see Towards a Full Working Day).

In a number of cases low outputs per gatherers were found to be due not to the gatherers' unwillingness to work but to the fact that there were actually more people in the field than the digger could keep working. The work of the diggers is, therefore, examined in order to arrive at the maximum number of gatherers required. To reach this standard the gatherers need pick only for 50 per cent of the time the digger is at work (see The Digger).

Continuing this argument the report suggests that to get a satisfactory performance by gatherers on day work the size of gang should be restricted to 18-20 persons. This still would not ensure full use of the restricted adult labour force available at harvest time. Further improvement depends on even smaller gangs and the provision of adequate incentives to the gatherers. By putting the gatherers on incentive earnings it is estimated that output per gatherer will increase by $1\frac{1}{2}$ to 2 times over the day work standard given previously (see The Gatherers).

Gathering time for any length of drill was found by work studies to depend on the number of potatoes gathered, irrespective of the type of digger or size of tubers. This fact is the basis of the incentive schemes put forward in this report. The other foundation stone is a "Day's Pay for a Day's Work" - and proportionately more for more work. A "Day's Work" is taken as being equal to the number of potatoes picked when the gatherers work for 50 per cent of the digger's time. It therefore varies with the number of potatoes in the drill. The type of performance that can be expected from a gang of ten gatherers on incentive earnings is :-

A typical Seed Crop	Day-work	$1\frac{1}{2}$ acres
	Piece-work	$2\frac{1}{4}$ acres or more
A typical Ware Crop	Day-work	2 acres
	Piece-work	3 acres or more

(see The Gatherers)

Two methods of organising piece-work gathering are explained. Whilst the first depends on the gang being employed and paid as a unit it demands no addition to existing equipment. The second requires the use of rigid containers, such as barrels, and this allows payment to the individual. Tables are provided for the ready calculation of the appropriate levels of payment for both methods. One way digging is necessary in both cases whilst the size of gangs proposed are 8 to 10 gatherers for ware crops and 10 to 12 gatherers for seed crops. (see The Gatherers).

The report proposes that potatoes should always be loaded from behind the gatherers. With hand loading this calls for some adjustment to the organisation of the loading team and suggestions are made.
Mechanisation /

Mechanisation of the loading is only in its early stages, yet is essential where rigid containers are used. Methods already in use are discussed together with the number of containers required. It is also pointed out that because of the high output of small gangs on incentive earnings, two trailers are usually a minimum requirement. (see Loading the Potatoes).

Storage in the shed has many advantages one of which is that when the unloading is well organised only one man is needed at the store. In most cases, however, more attention needs to be given to the choice of elevator and to the speed with which it conveys potatoes. It must also be remembered that whilst labour is saved at the store, shed storage often leads to the use of an additional trailer for the longer haul and slower turn-round. This difficulty can be partly off-set by the use of large modern trailers. (see Storing the Potatoes).

APPENDIX I

LOADING BEHIND THE GATHERERS

The following suggestions present some of the alternative arrangements that are available according to different circumstances for loading behind the gatherers. (It is assumed that each tractor driver has a tractor and trailer.)

1) Team of 3 - 1 loader and 2 tractor drivers.

Short distance to obtain one load. (Heavy crops or small loads.)
Loader - loads 2 loads and then drives tractor for one load.
Drivers - load every third load.
Each Driver - loads 1 load every third time in field (in contrast to at pit or store).

∴ Loader loads 2/3rds of loading time.
Each driver loads 1/6th of loading time.

2) Team of 3 - 1 loader and 2 tractor drivers.

Loader - loads 2 loads and then drives tractor 2 loads.
Drivers - load every alternate pair of loads.
Each Driver - loads 1 load every other time he returns to field.

Loader loads 1/2 of loading time.
Each Driver loads 1/4 of loading time.

3) Team of 3 - 1 loader and 2 tractor drivers.

But long distance to obtain 1 load
e.g. 4 drills lengths (or more).

For each load:

Loader loads 2 drills, then
Driver loads 2 drills.

Each Driver loads 1/2 of each load.

Loader loads 1/2 of loading time.
Each Driver loads 1/4 of loading time.

In both the second and the third example, and in some of those following, the work of the drivers could be eased if they had no forking to do at the pit or shed.

4) Team of 4 /

APPENDIX I (Contd.)

4) Team of 4 - 2 loaders and 2 tractor drivers.

Large number of skulls to 1 load (i.e. large loads requiring long distance to load or loading 2 rows at once with heavy crop).

Loaders - load 1 load together, then take it in turns to drive tractors with next two loads.

Drivers - Load 2 loads out of three.
Each Driver - has rest from loading every third time in field.

Each Loader loads 2/3rds of loading time.
Each Driver loads 1/3rd of loading time.

5) Team of 4 - 2 loaders and 2 tractor drivers.

Loaders - load and rest alternate loads.
Drivers - load every time in field but have no physical work to do at pit or shed.

Each Loader loads 1/2 of loading time.
Each Driver loads 1/2 of loading time.

6) Team of 4 - 1 loader and 3 drivers.

Long haul to pit or shed and one man to load considered sufficient.
Loader - loads every other load.
Drivers- load every other load.
Each Driver - loads every other time in field.

Loader loads 1/2 of loading time.
Each Driver loads 1/6th of loading time.

7) Team of 5 - 2 loaders and 3 drivers.

Long haul and two men required to load each trailer load.

a) Loaders - alternatively load one load together and then one of them rests on the tractor seat whilst the driver loads.
Each Loader - rests one load in four.
Each Driver - loads one load every other time in field.

Each loader loads 3/4 of loading time.
Each driver loads 1/6th of loading time.

b) Loaders - each man rests and loads alternate loads. Resting man drives tractor.
Drivers - load every time in field.

Each Loader loads 1/2 of loading time.
Each Driver loads 1/3rd of loading time.

These /

APPENDIX I (Contd.)

These suggestions do not cover all possible circumstances. They do not, for instance, provide for the situation where casual workers are employed as loaders and cannot be trusted or allowed to drive the tractors during loading. In such cases the two following suggestions are worth considering, assuming 2 tractors and trailers are in use:

8) Team of 4 - 2 loaders and 2 drivers.

Loaders - one man loads at a time and takes alternate drills (or one loads 2 drills and then the other loads 2 drills).
Drivers - drive all the time.

Each loader loads 1/2 of loading time.

9) Team of 5 - 3 loaders and 2 drivers.

Two men required to load into the trailer (i.e. large number of skulls to load from 2 adjacent drills).

Loaders - two load one load whilst one loader rests in rotation.
Drivers - do no loading.

Each Loader loads 2/3rds of loading time.

The two methods just described have what may be a useful advantage in some circumstances particularly in cases of heavy yields and speedy gathering. The advantage is that a loader is always available to start a second load before the first load has been completed. This introduces a further measure of flexibility into the organisation but against it must be set the disadvantage that an extra man's wages have to be paid for.

APPENDIX II.

TABLE A

DRILLS PER ACRE*

Length of Drill	Drills per Acre	Drills per $\frac{1}{4}$ Acre
(yards)		
622	10	$2\frac{1}{2}$
519	12	3
445	14	$3\frac{1}{2}$
389	16	4
346	18	$4\frac{1}{2}$
311	20	5
283	22	$5\frac{1}{2}$
259	24	6
239	26	$6\frac{1}{2}$
222	28	7
208	30	$7\frac{1}{2}$
195	32	8
183	34	$8\frac{1}{2}$
173	36	9
164	38	$9\frac{1}{2}$
156	40	10
148	42	$10\frac{1}{2}$
141	44	11
135	46	$11\frac{1}{2}$
130	48	12
125	50	$12\frac{1}{2}$
120	52	13
115	54	$13\frac{1}{2}$
111	56	14
107	58	$14\frac{1}{2}$
104	60	15
100	62	$15\frac{1}{2}$

* Taken as 6223 yards of drill equals one acre (i.e. 28 inch drills).

No adjustment is needed to tables for different widths of drill.

APPENDIX II.

TABLE B

CALCULATION OF INCENTIVE PAYMENT TO GANG

This table is prepared in the form of a ready reckoner to enable the appropriate level of payment to be seen at a glance according to the count (or density) of the crop and the level of day wages.

The sums shown represent the appropriate payment to the gang as a unit for each quarter acre of potatoes gathered. The payment is to the gang as a whole and not to the individual.

The acreage that a gang can be expected to gather in a day can be calculated from the table (Table VI, page 30) already given in the main text.

Two headings are given to the table, the one being appropriate where a one-row digger is in use and the other for a two-row machine.

N.B. - The gatherers are required only to gather into skulls and NOT to empty the skulls into other containers.

APPENDIX II

TABLE B

CALCULATION OF INCENTIVE PAYMENT TO GANG

SUM PAID PER $\frac{1}{2}$ ACRE TO GANG AS UNIT

DIGGER	Number of Potatoes in 3 Yards of Swath											
ONE ROW	120 -116	115 -91	90 -73	72 -61	60 -51	50 -43	42 -36	35 -30				
TWO ROW*		240 -214	213 -170	169 -144	143 -125	124 -109	108 -96	95 -86	85 -77	76 -70	69 -64	63 -58
Day Wage Rate	Payment to Gang in Shillings and Pence											
Shillings	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
16	40/ -	32/ -	26/ 8	22/10	20/ -	17/ 9	16/ -	14/ 6	13/ 4	12/ 4	11/ 5	10/ 8
17	42/ 6	34/ -	28/ 4	24/ 4	21/ 3	18/11	17/ -	15/ 5	14/ 2	13/ 1	12/ 2	11/ 4
18	45/ -	36/ -	30/ -	25/ 8	22/ 6	20/ -	18/ -	16/ 4	15/ -	13/10	12/10	12/ -
19	47/ 6	38/ -	31/ 8	27/ 2	23/ 9	21/ 1	19/ -	17/ 3	15/10	14/ 7	13/ 7	12/ 8
20	50/ -	40/ -	33/ 4	28/ 7	25/ -	22/ 3	20/ -	18/ 2	16/ 8	15/ 5	14/ 3	13/ 4
21	52/ 6	42/ -	35/ -	30/ -	26/ 3	23/ 4	21/ -	19/ 1	17/ 6	16/ 2	15/ -	14/ -
22	55/ -	44/ -	36/ 8	31/ 5	27/ 6	24/ 5	22/ -	20/ -	18/ 4	16/11	15/ 9	14/ 8
23	57/ 6	46/ -	38/ 4	32/10	28/ 9	25/ 7	23/ -	20/11	19/ 2	17/ 8	16/ 5	15/ 4
24	60/ -	48/ -	40/ -	34/ 4	30/ -	26/ 8	24/ -	21/10	20/ -	18/ 6	17/ 2	16/ -
25	62/ 6	50/ -	41/ 8	35/ 8	31/ 3	27/ 9	25/ -	22/ 9	20/10	19/ 3	17/10	16/ 8
26	65/ -	52/ -	43/ 4	37/ 2	32/ 6	28/11	26/ -	23/ 8	21/ 8	20/ -	18/ 7	17/ 4
27	67/ 6	54/ -	45/ -	38/ 7	33/ 9	30/ -	27/ -	24/ 6	22/ 6	20/ 9	19/ 3	18/ -
28	70/ -	56/ -	46/ 8	40/ -	35/ -	31/ 1	28/ -	25/ 5	23/ 4	21/ 6	20/ -	18/ 8
29	72/ 6	58/ -	48/ 4	41/ 5	36/ 3	32/ 3	29/ -	26/ 4	24/ 2	22/ 4	20/ 9	19/ 4
30	75/ -	60/ -	50/ -	42/10	37/ 6	33/ 4	30/ -	27/ 3	25/ -	23/ 1	21/ 5	20/ -
31	77/ 6	62/ -	51/ 8	44/ 4	38/ 9	34/ 5	31/ -	28/ 2	25/10	23/10	22/ 2	20/ 8
32	80/ -	64/ -	53/ 4	45/ 8	40/ -	35/ 7	32/ -	29/ 1	26/ 8	24/ 7	22/10	21/ 4
33	82/ 6	66/ -	55/ -	47/ 2	41/ 3	36/ 8	33/ -	30/ -	27/ 6	25/ 5	23/ 7	22/ -
34	85/ -	68/ -	56/ 8	48/ 7	42/ 6	37/ 9	34/ -	30/11	28/ 4	26/ 2	24/ 3	22/ 8
35	87/ 6	70/ -	58/ 4	50/ -	43/ 9	38/11	35/ -	31/10	29/ 2	26/11	25/ -	23/ 4
36	90/ -	72/ -	60/ -	51/ 5	45/ -	40/ -	36/ -	32/ 9	30/ -	27/ 8	25/ 9	24/ -

* The swath left by a two row digger is from two adjacent drills, hence the number of potatoes per 3 yards is greater.

APPENDIX II

TABLES C and D

CALCULATION OF INCENTIVE PAYMENT TO INDIVIDUAL PER BARREL

These tables are devised as simple ready reckoners for calculating the price per barrel (or similar container) to be paid to gatherers according to the count (or density) of the potatoes, the day wage rate, the yield by weight of the crop, and the size of the barrels.

Table C - for single and double-row diggers separately - gives from the count of potatoes in 3 yards of gathering the appropriate payment in pence (per 1/40th acre) according to the day wage rate.

Table D - supplies the number of barrels of a given size that have to be filled to gather 1/40th of an acre of potatoes according to the yield by weight of the crop as gathered.

The information from Tables C and D (the payment in pence and the number of barrels) gives the appropriate payment per barrel in pence.

N.B. - The count for the double-row digger is from the swath made by two adjacent drills.

a) SINGLE ROW DIGGER — APPENDIX II. — TABLE C.1

CALCULATION OF INCENTIVE PAYMENT TO INDIVIDUAL PER BARREL

SUM PAID TO GATHERER PER 1/40th ACRE

Day Wage Rates Shillings	Number of Potatoes in 3 Yards of Drill																		Day Wage Rates Shillings
	120 -116	115 -111	110 -106	105 -101	100 -96	95 -91	90 -86	85 -81	80 -76	75 -71	70 -66	65 -61	60 -56	55 -51	50 -46	45 -41	40 -36	35 -31	
	- - - - - - - - - - - - - - Payment in Pence - - - - - - - - - - - - - -																		
16	47	46	44	42	41	39	37	36	34	32	31	29	27	26	24	23	21	19	16
17	50	48	47	45	43	42	40	38	36	34	33	31	29	27	25	24	22	20	17
18	53	51	50	48	46	44	42	40	38	37	35	33	31	29	27	25	23	21	18
19	56	54	52	50	48	47	45	43	40	39	36	34	32	31	29	26	25	23	19
20	60	57	55	53	51	49	47	45	42	40	38	36	34	32	30	28	26	24	20
21	61	60	58	56	53	51	49	47	45	43	40	38	36	34	32	29	27	25	21
22	65	63	61	58	56	54	52	49	47	45	42	40	38	35	33	31	29	26	22
23	69	66	63	61	58	56	54	51	49	47	44	42	39	37	34	32	30	27	23
24	71	69	66	64	61	59	56	54	51	49	46	43	41	39	36	33	31	29	24
25	74	71	69	66	63	61	58	56	53	51	48	45	43	40	38	35	32	30	25
26	77	74	71	69	66	64	61	59	55	53	50	47	44	42	39	36	34	31	26
27	80	77	74	71	69	66	63	60	57	55	52	49	47	44	41	38	35	32	27
28	83	80	77	74	71	68	66	63	59	57	54	51	48	45	42	39	36	33	28
29	86	83	80	77	74	71	68	65	61	59	56	52	49	47	43	40	38	34	29
30	89	86	82	79	76	73	70	67	64	61	57	54	51	48	45	42	39	36	30
31	92	89	85	82	79	76	72	69	67	63	60	56	53	50	46	43	40	37	31
32	95	91	88	85	81	78	75	71	68	65	61	58	55	51	48	45	41	38	32
33	98	94	91	87	84	81	77	74	70	67	63	60	56	53	50	46	43	39	33
34	101	97	93	90	87	83	80	76	72	69	65	61	59	55	51	47	44	41	34
35	104	100	96	93	89	86	82	78	74	71	67	63	60	56	52	49	46	42	35
36	107	103	99	95	92	88	84	80	77	73	69	65	61	59	54	50	47	43	36

b) DOUBLE ROW DIGGER

APPENDIX II.

TABLE C.2

CALCULATION OF INCENTIVE PAYMENT TO INDIVIDUAL PER BARREL

SUM PAID TO GATHERER PER 1/40th ACRE

Day Wage Rates Shillings	Number of Potatoes in 3 Yards of Swath*																		Day Wage Rates Shillings
	240 -231	230 -221	220 -211	210 -201	200 -191	190 -181	180 -171	170 -161	160 -151	150 -141	140 -131	130 -121	120 -111	110 -101	100 -91	90 -81	80 -71	70 -61	
	Payment in Pence																		
16	43	42	40	38	37	35	33	32	30	28	27	25	23	22	20	18	17	15	16
17	46	44	42	41	39	37	35	34	32	30	28	27	25	23	21	19	18	16	17
18	49	47	45	43	41	39	38	36	34	32	30	28	26	24	22	21	19	17	18
19	52	49	47	46	44	41	40	38	36	34	32	30	28	26	24	22	21	18	19
20	54	52	50	48	46	44	42	40	37	35	33	31	29	27	25	23	22	19	20
21	57	55	52	50	48	46	44	42	39	37	35	33	30	28	26	24	23	20	21
22	60	57	55	53	50	48	46	44	41	39	37	34	32	30	27	25	24	21	22
23	62	60	57	55	53	50	48	46	43	41	38	36	33	31	29	26	25	22	23
24	65	63	60	58	55	52	50	48	45	42	40	37	35	32	30	27	26	22	24
25	68	65	62	60	57	55	52	50	47	44	42	39	36	34	31	29	27	23	25
26	71	68	65	62	60	57	54	51	49	46	43	41	38	35	32	30	28	24	26
27	73	70	67	65	62	60	56	53	51	48	45	42	39	36	34	31	29	25	27
28	76	73	70	67	64	61	58	55	52	49	47	44	41	38	35	32	30	26	28
29	78	76	72	70	67	63	61	58	54	51	48	46	42	39	36	33	31	27	29
30	81	78	75	72	69	66	63	60	56	53	50	47	44	41	38	34	32	28	30
31	84	81	77	74	71	68	65	61	58	55	52	48	45	42	39	35	33	29	31
32	86	84	80	77	73	70	67	63	60	57	53	50	47	43	40	36	34	30	32
33	89	86	82	79	76	72	69	65	62	59	55	52	48	44	41	38	36	31	33
34	92	88	85	82	78	74	71	67	64	60	57	53	49	45	43	39	37	32	34
35	95	91	87	84	80	76	73	69	66	62	58	55	51	47	44	40	38	33	35
36	97	94	90	86	83	79	75	71	67	63	60	56	52	48	45	41	39	34	36

* One swath of the digger is formed by two adjacent drills.

APPENDIX II.

TABLE D

CALCULATION OF INCENTIVE PAYMENT TO INDIVIDUAL

BARREL METHOD

NUMBER OF BARRELS REQUIRED

per 1/40th Acre

Potatoes in 3 yards of Drill* by Weight	Approximate Tonnage of Potatoes to be gathered per Acre	NUMBER OF BARRELS to hold Potatoes from 1/40th Acre		
(lbs.)	(tons)	$1\frac{1}{4}$ cwt. Barrels	$1\frac{1}{2}$ cwt. Barrels	$2\frac{1}{4}$ cwt. Drums
4	4	$1\frac{1}{2}$	$1\frac{1}{2}$	1
5	5	2	$1\frac{1}{2}$	1
6	6	2	2	$1\frac{1}{2}$
7	6	$2\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{1}{2}$
8	7	3	$2\frac{1}{2}$	$1\frac{1}{2}$
9	8	$3\frac{1}{2}$	3	2
10	9	$3\frac{1}{2}$	3	2
11	10	4	$3\frac{1}{2}$	$2\frac{1}{2}$
12	11	$4\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{2}$
13	12	5	4	3
14	13	5	$4\frac{1}{2}$	3
15	14	$5\frac{1}{2}$	$4\frac{1}{2}$	3
16	15	6	5	$3\frac{1}{2}$
17	16	$6\frac{1}{2}$	5	$3\frac{1}{2}$
18	17	$6\frac{1}{2}$	$5\frac{1}{2}$	4
19	18	7	6	4
20	19	$7\frac{1}{2}$	6	4
21	19	8	$6\frac{1}{2}$	$4\frac{1}{2}$
22	20	8	7	$4\frac{1}{2}$
23	21	$8\frac{1}{2}$	7	5
24	22	9	$7\frac{1}{2}$	5

* 3 yards of drill as grown.

APPENDIX II

TABLE E

CALCULATION OF INCENTIVE PAYMENT TO INDIVIDUALS BY LENGTH OF DRILL GATHERED

This table has been drawn up in the form of a ready reckoner according to the suggestion made by Mr. T. S. Wilson, Machinery Adviser in the North Region of the College.

The idea of paying the gatherers by the length of drill gathered is that it will enable payment to be made to the individual WITHOUT the use of barrels or similar containers. The gatherer's job is to pick only into their skulls. This, of course, both saves them work and also saves the farmer expenditure on equipment.

Payment varies according to the count (or density) of the potatoes and to the day wage rate. It is based on the number of yards of drill which the gatherer has to lift in order to earn ONE shilling.

Payment, in shillings, for the day's work therefore depends on the total length of drill gathered in the day divided by the appropriate number of yards of drill needed to earn one shilling.

The table is provided only for a single-row digger.

SINGLE ROW DIGGER — APPENDIX II — TABLE E

CALCULATION OF INCENTIVE PAYMENT TO INDIVIDUALS

BY LENGTH OF DRILL GATHERED

YARDS OF DRILL TO EARN ONE SHILLING

ACCORDING TO DAY WAGE RATE

Day Wage Rates Shillings	Number of Potatoes in 3 Yards of Drill																		Day Wage Rates Shillings
	120 -116	115 -111	110 -106	105 -101	100 -96	95 -91	90 -86	85 -81	80 -76	75 -71	70 -66	65 -61	60 -56	55 -51	50 -46	45 -41	40 -36	35 -31	
16	43	45	46	48	50	52	55	57	60	63	67	71	75	79	85	91	99	107	16
17	41	42	44	45	47	49	52	54	56	59	63	66	70	75	80	86	93	101	17
18	38	40	41	43	44	46	48	51	53	56	59	63	66	71	75	81	88	95	18
19	36	38	39	41	42	44	46	48	51	53	56	59	63	67	71	77	83	90	19
20	34	36	37	38	40	42	44	46	48	51	53	56	60	64	68	73	79	86	20
21	33	34	35	37	38	40	42	44	46	48	51	54	57	61	65	70	75	82	21
22	31	32	34	35	36	38	40	41	43	46	49	51	54	58	62	66	72	78	22
23	30	31	32	34	35	36	38	40	42	44	46	49	52	55	59	64	69	75	23
24	29	30	31	32	34	35	36	38	40	42	44	47	50	53	57	61	66	72	24
25	28	29	30	31	32	34	35	37	38	40	43	45	48	51	55	58	63	69	25
26	26	27	28	30	31	32	34	35	37	39	41	43	46	49	52	56	61	66	26
27	25	26	27	29	30	31	32	34	35	37	40	42	44	47	51	54	59	64	27
28	25	26	26	28	29	30	31	33	34	36	38	40	43	46	49	52	57	61	28
29	24	25	26	27	28	29	30	32	33	35	37	39	41	44	37	51	55	59	29
30	23	24	25	26	27	28	29	31	32	34	36	38	40	43	46	49	53	57	30
31	22	23	24	25	26	27	28	30	31	33	34	36	39	41	44	47	51	56	31
32	22	22	23	24	25	26	27	29	30	32	33	35	37	40	43	46	50	54	32
33	21	22	22	23	24	26	26	28	29	31	32	34	36	39	41	44	48	52	33
34	20	21	22	23	24	25	25	27	28	30	31	33	35	37	40	43	47	50	34
35	20	20	21	22	23	24	25	26	27	29	31	32	34	36	39	42	45	49	35
36	19	20	21	21	22	23	24	25	26	28	30	31	33	35	38	41	44	48	36
Yards of Drill to Earn Day's Wage	689	715	741	772	803	837	875	915	959	1010	1065	1129	1196	1273	1362	1464	1582	1720	