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T H E P R O B L E M

O F L A B O U R

T U R N O V E R.

(with four case studies of firms
in the North East.)

by

E. EDWARDS.

SUBMITTED FOR THE DEGREE OF
MASTER OF LETTERS

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C O N T E N T S.

	Page.
CHAPTER ONE	Introduction. 1.
CHAPTER TWO	The Measurement of Labour Turnover (1) Simple indices of Labour Turnover. 8.
CHAPTER THREE	The Measurement of Labour Turnover (2) Relating Labour Turnover to Length of Service. 34.
CHAPTER FOUR	Indices based on Specific Leaving Rates. 80.
CHAPTER FIVE.	Exclusions. 91.
CHAPTER SIX.	The Cost of Labour Turnover. 117.
CHAPTER SEVEN.	Economic Labour Wastage and its Measurement. 159.
CHAPTER EIGHT	Case Study A. - Labour wastage in seven units of a firm in the first year of service. 181.
CHAPTER NINE	Case Study B. - Labour Turnover in a Passenger Transport Organisation. 226.
CHAPTER TEN	Case Study C. - Labour Wastage amongst entrants to three production units in the Fuel and Power Sector. 290
CHAPTER ELEVEN	Case Study D. - Labour Turnover in the distribution section of a Large Public Utility. 323.
CHAPTER TWELVE	The Characteristics of Labour wastage- - a Summary. 342.
	Bibliography. 361.

CHAPTER ONE

Introduction

In any growing economy the mobility of the factors of production is of primary importance. An economy grows through changes in techniques and in the goods that are produced. Such changes frequently mean changes in the types of jobs which are available, in the resources which are required and in the areas in which a particular type of production is undertaken. If labour is reluctant to move to newly developed areas where its services are likely to be at a premium, and prefers to stay in an area where there are far more men than jobs, there is not only a measurable loss to the individual worker in terms of low pay and unemployment but also a loss to the community by reason of the uneconomic distribution of the factors of production. It is true, that we can, in some measure, substitute for such geographical mobility of labour a movement of capital resources. The whole idea behind the Development Areas is to attract capital in diversified forms to the labour which prefers to stay put. Whatever long term changes may be brought about in such cases however, there is little doubt that in the short run the attraction of capital to labour by Government intervention, where in

a completely free market labour would have moved to capital, is nevertheless relatively uneconomic. This is not to deny that socially the movement of capital might in such cases be the only feasible thing, because, in practice the alternative to capital mobility might not be the mobility of labour, but unemployment and political unrest consequent upon labour's refusal to move. Nevertheless it is one thing to attract capital to a relatively immobile labour force but quite another to place obstacles in the way of labour which would otherwise be prepared to move. If we conceive one of the aims of Government to be to increase economic welfare, no Government is likely, except in ignorance, to initiate a policy calculated to render labour more immobile than it naturally is, in areas where greater mobility is economically desirable.

The same argument does not unfortunately apply to an individual industry or firm where steps to restrict the mobility of labour may bring economic benefits to the firm in question, whilst being economically disadvantageous to the community as a whole.

Such partial advantages, to the general disadvantage, are not confined to restrictions on the geographical mobility of labour; indeed, as will be seen, the individual firm is likely to be more concerned with restricting inter-firm, and to a lesser extent inter-industry mobility, whilst the activities

of Trade Union and Professional Associations are to a very large extent concerned with limiting occupational mobility. We shall not, in what follows, be concerned with the latter, taking the present restrictions upon entry into a particular type of occupation as given, though it should not be assumed from this that restrictions on occupational mobility are always, or even frequently, economically desirable.

Reverting to the position of the individual firm, it is pertinent to consider some of the ways in which its interests may be opposed to those of the community in the matter under discussion. The management of a firm will wish to maintain its labour force at a level sufficient to produce what it conceives to be capable of selling. It will also wish to minimise the amount of movement into and out of this labour force, because such movements give rise to increased costs. In addition it may desire to retain an option on the full time services of the workers even when there is, temporarily, insufficient work to keep them occupied. It would do this if the cost to the firm of having to recruit a new labour force when required was likely to be greater than the cost of maintaining a force temporarily in excess of requirements. All this may be in opposition to the interests of the community as a whole. The firm may be using its workers inefficiently, it may be seeking to retain workers who could be employed more productively elsewhere and it may actually be imposing a further cost upon the community if it keeps

workers on short-time in such a manner as to allow them to draw unemployment pay.

Of course not all attempts by a firm to retain its workers are uneconomic by any means. Indeed a firm where labour productivity is high will be doing a disservice to the community as well as to itself if it does not take steps to prevent the movement of labour elsewhere, to firms where productivity is likely to be lower. The individual interests of each firm determine its own actions however, and in an imperfect market these interests are not necessarily those of the community of which it forms a part.

When the economist is looking at the production sector as a whole he refers to Labour Mobility, stressing its benefits in a dynamic economy, whilst when the manager is looking at the movement taking place in his own firm's Labour force he speaks of Labour Wastage or Labour Turnover, stressing its costs and other disadvantages. The term Labour Mobility has, therefore, acquired emotionally favourable overtones, whilst Labour Wastage (particularly) and Labour Turnover have unpleasant connotations. Yet Labour Turnover is merely one special aspect of Labour Mobility.

It is particularly important to make the above point in this introduction to an inquiry into some of the problems

involved in measuring Labour Turnover as it is only too easy to accept that what is in the interests of an individual firm is necessarily in the interests of all. This tendency is strengthened by the fact that in a situation of high-employment (such as has been experienced in this country since the war) much Labour movement is aimless and uneconomic. Workers will move from one firm to another not attracted by higher productivity resulting in higher wages but merely for a change. Working conditions which might be tolerated when the labour market was less buoyant will lead to much wastage when many employers are seeking workers. If this type of wastage predominates successful steps taken by a firm to reduce its Labour Turnover do not conflict with the broader advantage of the community. Nevertheless, we should always bear in mind that the possibilities of such a conflict exist and that whilst the problems involved in the measurement of Labour Turnover are of interest from the firm's point of view, these problems are of equal importance viewed from a different angle to those who are interested in the overall growth of the economy.

The purpose of this book is to consider three aspects of Labour Turnover. Firstly, the problem of measurement is considered. The methods which are commonly in use by firms to record and measure their Labour Turnover are examined and

the reliability of such methods in providing a basis for sound decisions on policy is assessed. There follows a comprehensive discussion of an approach which has been suggested by a number of earlier writers, but which has received very little publicity and consequently, despite its essential simplicity, has not been widely used. Whilst the writer claims no originality for the basic approach adopted, he hopes that in his detailed justification of the method and in the suggestions offered for its use he has made some slight contribution of practical value as well as of theoretical interest. Case studies of Labour Wastage in four large public utilities in the North East serve to illustrate the scope and practicability of the method.

The primary aim of a firm is to increase its profits. This it may do by increasing its revenue, or by reducing its costs. In seeking to measure its Labour Turnover a firm will be looking for indications which enable it to reduce its costs. Though the numbers leaving the firm and the measurements based thereupon provide some indication of changes in costs, it is an indication only. Therefore in recent years some attention has been given to the direct measurement of the costs arising out of Labour Wastage, with in the main, unfortunately, only indifferent success. This second aspect, the Costing of Labour Turnover is commented upon in Chapter VI. and the author offers what he

conceives to be a new method and he hopes a more fruitful approach to the problem than has previously been adopted.

Finally the author presents the outline of a scheme for assessing the limits within which a given transfer of Labour would be an economic proposition. To the extent that this is concerned with the measurement of the economic benefit accruing to the community when a worker moves from one firm to another the interest is, in the absence of direction of labour, largely theoretical. Few firms, if any, would be prepared to adapt their policies voluntarily so as to benefit the community as a whole, if by so doing their own interests were threatened. Fundamentally there is, however, no difference between estimating if a transfer from firm to firm is economically worthwhile to the community, and, if a transfer from department to department is beneficial to the firm. Therefore at this level the scheme has practical possibilities for use in assessing the economic value of a transfer of labour within a unit firm, and also of a movement from branch to branch in a large organisation.

CHAPTER TWO

THE MEASUREMENT OF LABOUR TURNOVER. 1.

Simple Indices of Labour Turnover.

Figures of labour wastage are of little value unless we can use them to make meaningful comparisons, either from group to group at a given time, or at group level over a period of time.

It is obvious that comparison of the mere numbers of leavers from group to group is not fruitful because such comparison ignores the size of the population from which the leavers have been drawn. A firm with twice as many workers as another might, it is argued have twice as many leavers in a given period as the latter, even though both firms were subject to exactly the same forces of separation. It is not so well understood that comparison of numbers of leavers from the same sized group at different intervals of time is also unsatisfactory because size of group is not the only factor which may hinder comparison. This latter point is of considerable importance because the great majority of the indices hitherto suggested for use involve the implicit assumption that if the size effect can be eliminated direct comparisons are significant. In other words it is assumed that all the differences in population

characteristics, other than size, are strictly relevant to the comparison that it is desired to make. For example if we use the British Institute of Management's Index of Labour Turnover (1943.1.) ; of which more will be said later, viz:-

Labour Turnover Rate equals $\frac{\text{No. of leavers in period} \times 100}{\text{Average size of working force}}$

we might find that firm A had an annual Labour turnover rate of 25 and Firm B had one of 40. Hence we might conclude that factors of a relatively favourable nature were influencing workers at firm A in comparison with firm B. If, therefore, these factors could be isolated, Firm B could, in theory, take action to lower its Labour wastage to the same level as that of Firm A. To the extent, however, that the index includes factors that could not, even in theory, be altered purposively by the firm in question, the comparison is misleading.

It will be useful to examine some of those characteristics of the respective populations which can be taken as given, both over the long and the short period; i.e., those which within a certain period of time could not be altered by the firm seeking to reduce its labour turnover.

The differences in Labour turnover from Firm A. to Firm B. may be influenced by any of the following factors:-

- A. The personnel policies of the firm e.g.,
 - i. Selection methods employed
 - ii. Welfare facilities.
 - iii. Attitude to collective bargaining and joint consultation.
 - iv. Policies favourable to long service workers.
 - v. Pension and similar schemes.
 - vi. Educational facilities.
 - vii. Promotion opportunities.
- B. The wages paid for comparable levels of skill, age or sex.
- C. The attitude of management and supervisors to the workers.
- D. The sex distribution of the workers concerned (and of the supervisors.
- E. The age distribution of workers and supervisors.
- F. The areas from which employees are drawn, either in respect of characteristics of those areas, or of the distance which employees have to travel to work, etc.
- G. The personal occupations and skill of the workers.
- H. The intensiveness of effort which the worker has to employ at his or her work.
- I. The morbidity, mortality and accident rates of the workers in the firm.
- J. The working conditions
- K. Geographical differences in location.
- L. Type of area differences (i.e. rural or urban)
- M. Proximity to other firms of a competitive or complementary

type so far as labour is concerned.

- N. The size of the firm, as distinct from the expected effect of the number of workers as mentioned in the second paragraph. It is conceivable, for example, that larger firms, because of some characteristic due to mere size, e.g. the existence of indivisibility may have a different rate of labour wastage than a smaller firm otherwise similar in characteristics.
- O. The industry to which the firm belongs.
- P. The economic situation external to the firm.
- Q. The length of service distribution of the workers at the firm.

The foregoing list is not, of course, exhaustive, but is useful for illustrative purposes in what follows.

Of the above mentioned difference factors A B. and C. are the only ones which are capable of being remedied at short notice, should it prove economic to do so. Over a somewhat longer period of time considerable changes can be made in the factors D E and F but the extent of these changes will depend to some degree at least on influences outside the control of the firm. Factors G H I and J may be closely inter-related. Improvements may be possible in some cases, but only technical developments over a long period of time will produce a change. Any change in factors K L M and N are also likely to take place only in the long period, if at all, whilst factor O. must be taken

as given. If we can assume that the influence of the general economic situation is constant from firm to firm provided we take into account the other variables in the situation, factor P can be neglected. However, this seems unlikely as factors which may not normally have any significant effect upon Labour Turnover under Full or Over-full Employment may cause significant differences in turnover rates from firm to firm under less than full employment. We have only to consider the position of employees of a firm working upon commission. Where there is no considerable unemployment such a firm may be able to retain its workers to much the same degree as a firm working for itself, but if the economic situation becomes less favourable and unemployment grows the latter firm will probably experience less redundancy in the early stages than the commission firm, whilst workers whom the commission firm desires to retain may seek to leave in increasing numbers because they fear eventual redundancy. This latter phenomena will be evident in the non-commission firm also, but because of the greater instability of the situation at the commission firm, not to the same degree.

The conclusion which one must draw from the above is that comparison from firm to firm using any crude index such as the one employed in the B.I.M. (1951.8) surveys (and used in most other investigations to some extent) must

always be treated with great reservations.- As Joyce Long states (1951.4) comparisons between firms should be restricted to firms which are as similar as possible to one another in such characteristics as we have enumerated. However, she nowhere indicates how one firm desirous of making a comparison is to be even reasonably certain which is the most suitable of the other firms to use for comparative purposes. Moreover the method suggested is a most unwieldy one and in practice would probably preclude any comparisons being made at all. In addition the fact should be stressed that the same precautions should be observed when comparing labour turnover rates for one firm from one period to another. Unless the populations at the two periods have remained the same in all relevant respects our comparison will be inaccurate to a greater or lesser degree.

It would appear, therefore, that only in a very limited number of instances can we expect to obtain meaningful results from the use of crude indices of Labour turnover. As Silcock (1954.1.) says:- "The wide variation in computed rates of 'Labour Turnover' has already been seen to be a likely result of a variety of different influences which affect this crude indicator. It follows that comparisons of the rate between different firms may be very misleading and it seems scarcely necessary to add that executive

action based upon such comparisons may entirely fail to achieve the intended results". Also from the same article we have:- "It is difficult to see what valid inferences may be drawn from the tabulation of the crude rates for a number of different establishments, yet such a table is a common feature of some recent surveys".

The present writer cannot stress too strongly his opinion that the use of an index which is apt to be so misleading in the majority of cases and the accuracy of which in apparently favourable situations is always a matter of doubt, ought to be avoided except, perhaps, for comparisons over short periods of time within the same firm.

It might be argued that however inefficient might be the present type of index it is better than nothing, in much the same way as Ely Devons (1954.3) recently argued in favour of economic forecasting even though the forecasts might be wrong as often as they were right. What is important, it might be said, is that firms should be spurred to take some action to reduce their labour turnover. Whether the particular measure that they are using is reliable or not is of little importance. Firms are taking some action as a result of the comparison of their labour turnover rates within the national average or the average for their industry or for the area in which they are established, and some good may come out of the action,

whilst inaction will certainly benefit no one. This argument seems to me to be completely misconceived. Action resulting from false premises is likely to worsen rather than to improve an existing situation. One can imagine the employer who has recently opened a new factory going out of his way to develop welfare schemes, joint consultation, incentive schemes, etc., until he finds that a firm just across the way producing similar products has a labour turnover rate about half that of his new factory, offers its employees no welfare facilities, brooks no interference with management by its hands, and has poor working conditions. What is the new firm to do? Follow the apparently successful example of the firm across the way relying upon that particular piece of witchcraft, the crude Labour Turnover rate? I very much doubt it. Yet this is the logical result of using the index. It would seem that no action at all, or purely empirical action without comparison of Labour Turnover rates might result in far more satisfactory results. So long as crude indices are used at all they are barring the way to the development of more refined measures and methods which could be of real significance.

A useful method of approach which has been adopted by a number of writers, originating with Greenwood (1919.3) has been to take into consideration the length of service distribution of the population from which the leavers come,

when constructing a measure of labour wastage. It is not difficult to see why this factor rather than any of the others enumerated (A to V pages 10 and 11) should have been selected as the basis of the index. Whatever other factors the firm may be capable of influencing at will, it cannot alter its length of service structure in any desired manner that it may choose. A firm can, it is true always reduce the length of service structure by discharging all its old workers and replacing them with new ones, but it is impossible for it to increase the lengths of service of its staff merely by altering policy or wages or any other factor. Length of service only grows with the passage of time. Hence it would seem that a first approach to the measurement of labour wastage should take into account the lengths of service of existing workers, if there is any evidence at all that variations in wastage are related to the period of time which workers have been with the firm. There is ample evidence that such a very close relationship exists (see refs. to next chapter), wastage being very great during the early period of service and declining rapidly as length of service grows. Long's suggestion that the more refined measures employed by Greenwood (1936.1) to eliminate the effects of differences in length of service structure for purposes of comparison are only necessary if we are directly concerned with measuring such differences appears to be based upon a

misconception. The fact is, that unless we strive to take into consideration differences in length of service in the populations from which the leavers come, any comparisons which we make are likely to be invalid, unless the number of firms which we are considering is sufficiently great to eliminate bias. It is doubtful if this was the case even in Long's investigation - one of the most comprehensive to date.

Despite this general criticism of crude Labour Turnover rates it is useful to look at those which have been suggested for use in the past, to examine their validity on grounds other than the consideration already mentioned and to provide a justification of methods to be developed in later chapters.

Even without the considerations discussed above, the determination of the relevant population is far from straightforward.

Perhaps the earliest of the indices which received considerable publicity is the so-called Separation Rate introduced at the Rochester meeting of the American Employment Managers Conference in 1918. (1918.1) This Separation rate is calculated using the following formula:-

1) T equals $\frac{S}{W} \times 100$

where S is the Total number of separations in the period and W equals the average number of men actually working each day in the period at the establishment in question.

The population at risk is here conceived to be the average number of persons in the labour force actually working. It is difficult to see why this particular population was selected. It may have been intended to exclude persons still recorded on the firm's books who had actually left during the period. Where insurance cards are not used as they are in this country at the present time, it is obviously likely that employees will in some circumstances take up other employment without informing their original employers. If this was the main reason for using W it would appear logical to deduct W from the average numbers on the books adding the remainder to the separations which appear on the numerator, because this difference by our previous reasoning would represent the unknown leavers. In subsequent periods even this adjustment would not be sufficient as some of the unknown leavers might remain on the books of the firm for a number of periods and hence the value $N - W$ could grow steadily from one period to the next because it had become increasingly weighted with unknown leavers during earlier periods who had not been eliminated from the records. It would seem that a more satisfactory picture could be obtained by

eliminating all workers who had been absent without reason for (say) one month, from the recorded labour force and treating them as separations. In such a case the formula would read:-

ii) $T \text{ equals } \frac{S + E}{N} \times 100$ where S is defined as above (i) E equals the eliminated workers and N equals the average numbers on the books of the firm. *

This formula is similar to a number of others which will be discussed later in this chapter. In this country the number of unknown or unrecorded leavers is likely to be very small in any case and therefore the adjustment is probably unnecessary.

The denominator N , does not however, exclude only the unknown leavers. Those who may be absent due to illness

* The yearly average number of workers employed should be calculated by obtaining the number of workers employed at the beginning and end of each month, dividing by two to obtain the monthly averages totalling the averages for each month and dividing by twelve. This method is superior to the more commonly used method in which a half of the sum of the workers at the beginning and end of the year is taken.

or for any other reason will also be eliminated from the denominator of the formula, for the period in which they are not working. They will, however, be included in the numerator when they leave. Hence a firm which has a high rate of absenteeism or sickness, or is generous with absence permission, will tend to have a separation rate which has an upward bias. This will be accentuated if the absentees or the sick have a higher rate of labour wastage amongst themselves than exists amongst the other employees. It might be suggested, of course, that, to the extent that absenteeism and labour wastage give rise to similar costs, or arise from similar causes, the index is empirically justified. In this connexion it might be noted that several writers (Mice, 1950.5; Behrend 1953.2; Baldamus 1951.7; 1951.9;) indicate that labour turnover is only one form of withdrawal from the work situation, others being absenteeism, sickness absence, accident rates, restrictive work practices and so on. However this may be, it is surely desirable not to confuse the various factors if it can be avoided. Ideally an index might be derived which includes the influences of the forces for withdrawal from the work situation, but apart from the general index number criticisms which could then be made, a suitable weighting system would be very difficult to devise.

A number of writers have suggested a Labour turnover

index based upon entrants to the Labour Force. Such an index might be:-

$$T \text{ equals } \frac{A}{N} \times 100.$$

where A equals the number of entrants to the firm in a given period.

N equals the average number of workers employed.

The idea behind this type of index is that, as many separations may be at the wish of the employer, e.g., on account of redundancy, the use of a separations figure in the numerator will tend to give an upward bias when the labour force is contracting. If accessions are used, only those leavers who are replaced will influence the index. Should the labour force be expanding however it would seem that such an index would be very misleading - the increased number of entrants, who are not replacements would go to swell the Labour Turnover rate when no corresponding increase in labour wastage was taking place. A further difficulty is that a firm may be losing workers and be unable to replace them. In such a case a labour turnover rate based on accessions would under-estimate the actual wastage.

One writer (B. Emmett 1919.5) has suggested that both formulae for accessions and for separations should be used. He quotes:-

$$T_1 = \frac{S}{W} \times 100. \quad \text{and} \quad T_2 = \frac{A}{W} \times 100.$$

using the denominator which has already been criticised in the earlier section of this chapter. The Separations formula T_1 is to be used when the Labour force is expanding, and T_2 , the Accessions formula is to be employed when the labour force is contracting. It is true that this avoids the disadvantages noted above. On the other hand one is left in some doubt as to which index to use if the labour force is neither contracting nor expanding. There is also bound to be a discontinuity when a firm that has hitherto been expanding its labour force experiences a period of contraction. In addition the valid comparison from firm to firm, when some firms are expanding and some contracting the labour force, will be impossible. A further criticism is that the index makes no allowance for any new posts that may be created during a period of contraction, nor for positions which are eliminated during an expansionary period. As expansion and contraction are seldom simple processes it would appear that the whole basis for the use of such indices as these is suspect and very strong advantages would have to be present to offset such obvious faults.

Professor Douglas (1919.1) suggested a similar formula to T_1 and T_2 , using N (as previously defined, instead of W)

as the denominator. As this change leaves the majority of our arguments intact further comment would appear to be unnecessary.

A Labour Flux Rate suggested by Brissenden and Frankel (1922.1) suffers from the twin disadvantages of complexity and of being difficult to understand. They advocate:-

$$R \text{ equals } \frac{A \text{ plus } S}{E}$$

Where A and S have the connotations previously mentioned and E stands for the number of fully employed workers Labour time units of 3000 hours put in by the labour force.

The authors suggest that the index takes into account the variation in the amount of time and of piecework, but it confuses absence with labour wastage and is difficult to apply because of the denominator. The authors appear to think that an index based upon 'working time' rather than 'number of workers' is more satisfactory. As there seems to be little reason to suppose that differences in length of working hours, working weeks, etc., are proportionately related to Labour wastage the authors argument can hardly be said to be firmly based. A fundamental problem is also raised by the question as to what is meant by 'fully employed'. When will men be eliminated from the index because they are not fully employed? Is a worker who is waiting between jobs fully employed, or a labourer who is usually employed

as a Blacksmith's assistant if he spends half an hour sweeping up whilst the Blacksmith is doing single handed work? Moreover it is likely that the number of fully employed, by any criterion, would tend to decline as the separation rate increased - as attempts were made to spread the work, if the separations arose as a result of redundancies; or as the number of new entrants needing training grew, as replacements were made. Both denominator and numerator of the index would tend to be affected by such changes, and consequently comparisons over a period of time rendered difficult. Little excuse can be found for the use of the sum of the total accessions and total separations in the numerator. If separations and accessions were simply mirror images of one another either could be used alone, but because they are not, it does not suffice to put them both in the index. A firm, for example, which had twenty separations and twenty accessions out of an average labour force of 100 would be given an index number of 40 per cent (we are here ignoring the complications of the denominator recommended by the authors of the index, and using N. instead. This does not affect our conclusions). Another firm which had twenty separations and thirty accessions, evenly spaced throughout the period would have an index of -

$$\frac{20 + 30}{(100 + 110) / 2} = \text{i.e. } 47.6\%$$

yet the labour wastage is identical in each case; the ten additional accessions occurring in the second instance solely because of the firm's expansion.

It is now convenient to deal with a group of indices which are very commonly employed at the present time, of which the B.I.M., Labour Turnover Index (1948.1; 1948.2.)

$$T = \frac{S}{N} \times 100 \quad \text{is an example.}$$

This index has been criticised in earlier pages on the grounds that it makes no allowance for the length of service structure of the labour force and that will not be commented upon any further. It has been criticised by Joyce Long (1951.4) on the additional grounds that it includes all separations from the labour force, without taking into account the fact that some separations may be to the advantage of the management, rather than to their disadvantage. She quotes Sargent Florence (1949.7) with approval in his statement that Redundancies should be eliminated from the numerator of the index on the grounds that such separations are cost saving rather than cost inducing. On the face of it this would seem to be a valid argument, but both Long and Sargent Florence appear to overlook the fact that some redundancies, at least, are the result of incorrect expectations on the part of management, and therefore, though the firm may be cutting its losses if

the redundant members of the working force are discharged, their original entrance was due to a wrong, or at least a cost inducing, decision by management. This will be argued at greater length in a succeeding chapter. As far as this writer is aware Long nowhere in her book gives a specific formula on which she bases her calculations of the Labour Turnover Rate. It is presumed that she used the following:--

$$T = \frac{S - R}{N} \quad \text{Where R stands for the number of redundancies.}$$

Whether a suitable adjustment was made to the population at risk (N) as is suggested in the next chapter is doubtful.

One firm supplying information to Long in her Birmingham survey did, however use an adjusted Labour Turnover Rate of the following type:--

$$T = \frac{S - U}{N} \quad \text{S and N having the usual meanings and U being the number of individuals leaving for unavoidable reasons.}$$

Such an index has something to recommend it. A deliberate attempt is made to exclude those causes of departure from the firm which no action of the firm could remedy. The real difficulty lies in determining just what is Unavoidable loss. The firm in question excluded separations due to sickness, death, pregnancy, marriage of female, transfer of husband to another area and redundancy. Can such

separations always be classed as unavoidable? A full analysis of the difficulties in the way of the straightforward use of the concept Unavoidable loss will be given later.

In the same class of indices comes Bloomfield's Adjusted Turnover Rate (1919.6)

$$T = \frac{S - (M+U)}{S} \times 100$$

M represents transfers from the ordinary working force to the staff whilst the other letters have their usual significance.

As with the concept of unavoidable loss a transfer to staff may hide an ambiguity. It is conceivable that such a transfer might arise either because the individual concerned moved to another post which had been designated as a staff post for some time previously, or it might merely mean that a post hitherto paid at day rates (e.g. assistant foreman) had now become a staff post. In the latter case it could be argued that no effective transfer had really taken place, and hence no adjustment need be made. The problem however merges into the wider one of whether the population of the whole factory is suitable for use as the denominator.

A. K. Rice (1951.2; 1952.1; 1952.2) has suggested that more significant comparisons are obtained by using departmental figures. If this approach is adopted, the problem of transfers, not only to staff, but from department to department, becomes of significance.

A partial recognition of the importance of length of service can be seen in the use of indices of the following type:- (1951.4; 1958.1)

$$T_x = \frac{S_x}{S} \times 100$$

S_x being equal to the number of separations in a given period amongst those having up to length of service x

S equals total separations in a given period.

Thus it will be possible to say, thirty per cent of the total separations occurred in the first month of service, forty per cent within the first two months and so on.

This method effects a good comparison if there is no pronounced change in the length of service structure of the firm (such a change may itself be the result of previous fluctuations in Labour Turnover, to contraction, or expansion, or to intentional change of structure, of the labour force) but if such change takes place the ratios will be scarcely less misleading than the crude indices previously mentioned. Obviously, a firm with only a small proportion of short service workers is unlikely to show a very large percentage of wastage of such workers amongst the total leavers, but this does not imply that the wastage rate for short service workers is not large.

In an article in the Manager (1955.3) David C Duncan

reintroduces two indices of a type different from any yet considered. One of them which he calls a Skill wastage index is given as:-

Index i.
$$\frac{n_1}{N_{x-1}} \times 100$$
 where n_1 equals the number of individuals remaining in the labour force with a length of service necessary to reach full skill and experience, and N_{x-1} equals the total employees one year previous to the time of calculation.

Brissenden and Frankel (1922.1) who introduced the Labour Flux Rate, also mention this index, and Long comments upon it briefly in her monograph. (1951.4)

An alternative index, also mentioned by Duncan is the following:-

Index ii.
$$\frac{n_1}{N_x} \times 100$$
 where N_x being the total number of employees now, whilst n_1 has the meaning given above.

This was originally suggested in a Report of the U. S. Coal Commission. (1923.1)

The latter is referred to by Duncan as a Skill dilution index.

Duncan suggests that these indices are of value in answering the following questions, which are not necessarily answered by the crude indices aforementioned:-

- i. To what extent is the pool of skill, represented by all my fully experienced workers being drained

by wastage?

- ii. To what extent am I having to dilute my experienced force with learner workers not fully skilled.

In Duncan's hands the indices are used on the basis of a length of service of one year necessary to reach full skill and experience.

As a first, and minor criticism it seems to the writer that the numerator should not record those workers who have merely stayed sufficiently long enough to achieve efficiency but should include only those who have been employed for a substantially longer period. As will be suggested in the next chapter it is probably undesirable for workers to be encouraged to stay at one job for a very long time but, on the other hand, a worker who leaves shortly after he has attained full skill and efficiency will not have given a reasonable return to his employers to offset the costs incurred in his training period. Probably where the period to attain full skill and efficiency is one year the numerator of the index should include only those workers who have stayed at least twice as long, i.e., two years, in order to allow for this. The actual period selected would, of course, depend upon the costs of training as well as the length of period of training and the relationship between wages paid and the profits earned.

A more fundamental difficulty is the fact that the index measures only the stability of one section of the population concerned. The index would not vary in a given year, assuming for the sake of simplicity, no entrants during the year, in any of the following very different cases:-

100 employees at the beginning of the year.

- a. thirty stay eleven months and then leave
no replacements remainder stay.

$$\text{Index i.} = \frac{70}{100} = 70\%$$

- b. thirty stay one week only remainder stay.
no replacements.

$$\text{Index i.} = \frac{70}{100} = 70\%$$

- c. thirty leave at evenly spaced intervals
throughout the year, remainder stay.

$$\text{Index i.} = \frac{70}{100} = 70\%$$

and so on.

In each of the cases noted above it might be desirable for the firm to adopt very different policies to counteract the wastage. Case (a) would call for an immediate investigation to see what event or events might have occurred at the eleven month period to cause the sudden departure, and doubts would be felt about the stability of the remaining

seventy individuals. A review of selection and induction procedure would be desirable in case (b), whilst case (c) would reveal the possibility of some cause operating more or less consistently over a long period.

Index ii is even less reliable. Obviously if we are considering a batch of entrants at the beginning of a year, as indicated above, the index (ii) would give an answer 100% however many left during the year. Hence a firm which engaged 100 employees at the beginning of a year could proudly point to a skill dilution index of 100%, (i.e. no dilution) even if ninety nine workers had left during the year.

It is true that if replacements are being made during the period under review, and if workers of all lengths of service are already represented in the population, such obvious effects are unlikely to occur. Nevertheless the underlying fault remains. We are told nothing about the structure of the population beyond or before the selected point. Moreover the complications introduced by any contraction or expansion of the force are not allowed for in any way. In this sense the criticism made of previous indices on similar grounds can be applied here also. *

* An index of a type similar to those suggested by Duncan is given in Recording and Analysing Labour Turnover in Industry (1947.1) Department of Labour & National Service **

It must not be thought that these latter indices serve no purpose whatsoever. A series of such indices with numerators giving different lengths of service, say from one month up to five or ten years would give a picture of the Survival pattern of the labour force, of much more value than a single index. It is to the consideration of such measures that we must now turn.

** of the Commonwealth of Australia. The authors of this booklet suggest using:-

$$100 \times \frac{\text{Number of employees with one year's service or more}}{\text{Average number employed in the previous year.}}$$

This index seems to be rather less satisfactory than Duncan's

CHAPTER THREE

MEASUREMENT OF LABOUR TURNOVER (2)

Relating labour turnover to length of service.

Introduction.

A number of investigators have recognised that the probability of an employee's leaving is very strongly related to his length of service. Greenwood in his lecture to the Royal Statistical Society (1919.3) was the first writer in this country to recognise the problem specifically. Very shortly after the publication of this article, interest in Labour Turnover declined, largely because of the state of the labour market - the level of unemployment in the United Kingdom never fell below 1,000,000.

from 1920 to 1939. A further article under the direction of Greenwood in 1936.1, appears to be the only other contribution to the literature on Labour Turnover in which the problem of length of service is dealt with, prior to the recent war. The overfull employment of the wartime and post war years has stimulated a considerable amount of investigation into Labour Turnover, as mentioned previously, and amongst the work are a number of articles relevant to

the subject under discussion.

Rice, et al, in a series of articles in Human Relations (1950.5; 1951.1.2; 1952.1.2.) reporting upon an investigation into labour turnover at the Glacier Metal Company's factory; H. Silcock (1954.1) commenting upon a particular aspect of this investigation in the Journal of the Royal Statistical Society, and Lane and Andrews (1955.4) in a later contribution to the same journal have publicised the problem and developed methods for tackling it.

The elimination of bias in labour wastage figures caused by differences in length of service structure from group to group.

The annual crude labour turnover rates (calculated according to the B.I.M., formula) for two departments of The United Steel Companies, Ltd., were found to be 8.8% and 17.3% . (1955.4) It appeared from this that the former department was very much more stable than the latter. Further investigation, however, revealed that this was entirely due to the fact that the former department had a much greater proportion of longer service workers than the latter. As under practically all circumstances, newer workers are very much more likely to leave than workers who had been established for some time, any department which is expanding and thus adding to its short service workers can expect to experience an increase in its crude labour turnover. In the example quoted above, Department A. with

8.8% Labour turnover had 26 workers with less than one year's service and 1091 with more, whilst Department B. had 50 workers and 332 workers with corresponding service lengths. When steps were taken to relate the numbers leaving to the population of the departments in different length of service groups it became obvious that the specific turnover rates for each length of service group were, on the whole lower in Department B. than in Department A.

A method of approach to the problem is illustrated in what follows:-

Consider a group of 1000 entrants to a firm in a particular year, let us say, 1950. Classify any leavers from this group according to the length of service on leaving. Suitable class limits might be 1 month, 2 months, 3 months, 6 months, 9 months, 1 year, 2 years, and so on. The reason for the finer division at the beginning is because the changes in the rate of leaving take place much more rapidly in the early months of service. Just as in the construction of mortality rates (to which this method of analysis is analogous) special attention must be paid to changes in mortality in the first few months of life, so here we must pay special regard to changes in service mortality (i.e. leaving) during the early period of service.

The figures available for the 1950 entrants might be as follows:-

TABLE 1.

Year of entrance.	Number of entrants.	Numbers remaining after months/years.									
		1 m.	2 m.	3 m.	6 m.	9 m.	1 y.	2 y.	3 y.	4 y.	5 y.
1950	1000	700	500	400	340	300	270	250	230	220	215

The proportion surviving the first month of service is then -

$p_0 = s_{11}/N$ (which if we assume that group to be homogeneous can be looked upon as an estimate of the probability that a person entering in 1950 will leave after one month's service; and from the first month to the second the probability is -

$p_i = s_{i1}/s_i$ and so on, where s_i, s_{i1} , etc. are the numbers surviving to the end of the first, second months etc., and s_1, s_2 , etc., are the numbers surviving to the end of the first, second years etc.

$$\begin{aligned} \dots \quad p_0 &= 700 / 1000 = .7000 \\ p_i &= 500 / 700 = .7143 \\ p_{ii} &= 400 / 500 = .8000 \\ p_{iii} &= 340 / 400 = .8500 \\ p_{vi} &= 300 / 340 = .8824 \\ p_{ix} &= 270 / 300 = .9000 \\ p_l &= 250 / 270 = .9259 \end{aligned}$$

$$p_2 = 230 / 250 = .9200$$

$$p_3 = 220 / 230 = .9565$$

$$p_4 = 215 / 220 = .9773$$

Hence the estimate of the probability of surviving from period x to period $x + 1$ (where x is greater than or equal to zero) is given by:-

$$p_x = \frac{s_x}{s_{(x-1)}} \quad (i)$$

Similarly the probability of leaving between one period of length of service and the next is -

$$q_x = 1 - p_x \quad (ii)$$

A table can now be constructed as follows:-

TABLE 2

Duration of Service.

x to $x + 1$.	p_x	q_x	t_x	v_x	u_x
0 to one month.	.7000	.3000	.7000	.3000	.3000
1 to 2 months.	.7143	.2857	.5000	.5000	.2000
2 to 3 months.	.8000	.2000	.4000	.6000	.1000
3 to 6 months.	.8500	.1500	.3400	.6600	.0600
6 to 9 months.	.8824	.1176	.3000	.7000	.0400
9 months - 1 year.	.9000	.1000	.2700	.7300	.0300
1 to 2 years.	.9259	.0741	.2500	.7500	.0200
2 to 3 years.	.9200	.0800	.2300	.7700	.0200
3 to 4 years.	.9565	.0435	.2200	.7800	.0100
4 to 5 years.	.9773	.0227	.2150	.7850	.0050

$$t_x = \left[\text{the probability of surviving from entrance up to the end of period } (x + 1) \right] = \prod p_r \quad (r=0 \text{ to } r=x)$$

$$v_x = \left[\text{the probability of leaving from entrance up to the end of the period } (x + 1) \right] = (1 - t_x)$$

$$u_x = \left[\text{proportion of total entrants leaving in each period } \right] = t_{(x-1)} - t_x$$

Where it is considered desirable to exclude certain causes of leaving from the estimates a further refinement is necessary. Redundancies, deaths, withdrawals through sickness, transfers to other departments may, in certain cases be considered unavoidable labour wastage and consequently require to be removed from the calculated probabilities in the manner indicated later on. One may, of course, argue that redundancies, to the extent that they are due to incorrect expectations, or faulty planning on the part of management, should not be excluded from the data. Similar remarks can be applied to wastage, due to ill health and to most causes of departure to at least some extent. Theoretically at least all causes of labour wastage are partly the responsibility of management. This is discussed at length in Chapter 5. Granted, however, that in certain circumstances it may be necessary to make provision for the exclusion of some individuals at a point within the experience, the method which might be adopted is outlined below.

1. Any individual leaving as a result of a risk to be excluded is treated as having been present for half the period when the size of the denominator of q_x is being considered, and is omitted from the denominator of $q_{(x+1)}$ and succeeding probabilities.
2. Such an individual is excluded from the numerator of q_x in the period in question.

Example:- If in our example (Table I) of then 300 leavers in the first month 50 had left for excluded reasons, the value of the probability q_0 would have been:-

$$q_0 = \frac{300 - 50}{1000 - \frac{1}{2}(50)} = .2564$$

$$p_0 = 1 - q_0 = .7436$$

The adjustment in the numerator is made because we only wish to take into consideration the actual leavers for the reasons which we are interested, whilst the denominator is adjusted on the assumption that prior to leaving the excluded leavers were subject to the same risks of leaving for the causes in which we are interested as others in the same length of service group. A further assumption is made that the frequencies of the excluded leavers are distributed symmetrically throughout the length of service period concerned so that we may take it that the average period at risk for these leavers as a whole is one half of

the time covered.

The probabilities, allowing for exclusions can be expressed generally as:-

$$q_x = \frac{S_x - S(x - 1) - a_x}{S_x - \frac{1}{2} a_x}$$

A N D

$$p_x = 1 - q_x \quad (iii) *$$

The use of these two probabilities involves certain assumption which may not be true. The first of these is that already mentioned, a symmetrical leaving distribution for the excluded leavers. In practice this is most unlikely to be true, e.g., redundancies will tend to occur discontinuously and not at random within the time period. Bunching will occur so that, say, most redundancies are concentrated into a few weeks within a year. If these few weeks occur in the early part of the year, or the latter

* The expression given here for q_x can be shown to be in error to a slight extent (ref 1952.5 page 71 et seq) but as there are more serious errors which will almost certainly arise on account of our assumptions above, a more refined formula is hardly necessary. The theoretical error in the formula is, in any case, small.

part of the year, we obviously cannot say that they are evenly distributed throughout the year as our formula assumes. Yet to obtain a formula which allows for assymetry of this type leads to a very complicated expression which would be difficult and time consuming to use. An alternative approach would be to reduce the length of the time period considered for each value of q_x where the redundancies were most likely to occur. The principle of last in, first out is the one most frequently adopted for determining who shall be declared redundant, and thus the concentration of redundancies is likely to be limited to the early periods of service in most cases. If we use finer groupings for the early months of service we are reducing the extent to which our assumption of symmetrical distribution of redundancies will give rise to error. Our original reason for using the finer groupings during the earlier periods of service stated on page 36 is therefore reinforced by this additional point. Where the reason for exclusion is not redundancy there is no suggestion that the adoption of finer groupings in the early period of service will help matters much, as departures due to transfer, health reasons, etc.. are not likely to be concentrated during the early months of a workers service. We must recognise that our formula is likely to be somewhat imperfect in these cases, and must

be prepared to modify it to meet the situation if this can be done without leading to an excessive amount of work. *

Unfortunately our second assumption for the accuracy of the value of p_x and q_x in formulae (iii), is that the excluded leavers, would, apart from their exclusion have been similar in all other respects to the remainder of the entrants under consideration. One can never know in any particular case whether or not this is true, but there are reasons for suspecting that in many cases it will be very far from the truth. Suppose, for example that a very large number of redundancies occur. We must take into account the probabilities with which the redundant members would have survived if there had been no redundancy. If they would have survived with any probability other than the value p_x then a substitution of some of the workers who have not been declared redundant for some of those who have (within a given length of service group) would affect the value of p_x . In the case of every length of service group we are, in effect considering two non-independent samples from a population, the redundant leavers and those who remain in service. The two samples will not have identical properties unless the method of choice of those to be declared redundant is entirely random (which we have precluded in our earlier paragraph when we assumed redundancy to be influenced by length of service) and

* We give an example of this in Chapter 9, page

if the samples are sufficiently large. One point might be mentioned here. It would appear from what has been said, that the estimate of p_x would be less inaccurate if redundancies, whilst being determined in accordance with length of service, were nevertheless selected at random from within the length of service groups concerned. Substantial inaccuracies might, however, still occur because of the different number of redundants from one length of service group to the next. As an illustration of the foregoing suppose that redundants are to be selected from a group of entrants who have now between 0 and 1 month's service, and also from a group with between 1 and 2 months of service. We select from the first group those who are considered to be the least efficient at their work. These individuals might have a higher probability of leaving than the remainder of the same length of service group quite irrespective of redundancy, because, for example, their consciences trouble them when they cannot do their work properly. Hence the selection for redundancy of these persons would tend to raise for us the value of p_x and lower that of q_x calculated by the method suggested from what they would have been if no redundancies had occurred or if some other method of selection had taken place. In the second length of service group, those with service between 1 month and 2 months, the same procedure for selection of redundant workers might be adopted, but applied

to a smaller proportion of the workers in that group. In this latter case p_x and q_x would be affected but to a different extent. Hence comparison of stability from the one group to the other would be liable to error, the seriousness of which would depend on the effect of this differential factor. In addition, of course, quite apart from any differential effect from one length of service group to the next, any selection of redundants which is not on a random basis will give rise to a consistent biased error in all p_x 's.

From the foregoing it would appear that where exclusions appear to arise in a biased manner considerable errors will occur in our estimations of the probabilities unless the numbers excluded are small in relation to the size of the population concerned. Hence, if a large number of redundancies occur any calculations of labour wastage for the period in question should be used only with the greatest reservation. Moreover, if redundancies have an influence on the future behaviour of employees who remain in the labour force, statistics of labour turnover for some period of time around the redundancy dates will also tend to be biased, probably differentially from one length of service period to another.

Redundancy has been chosen for the examples in the preceding paragraphs but the analysis applies to all classes

of leaving which may call for the adoption of an exclusion practice.

One further point might be added. The omission of the correction for exclusions is only likely to hinder comparisons if the number of workers involved is reasonably large in relation to the size of the population. Hence we would be quite justified in omitting any adjustment if the workers leaving for the reasons which it is desired to exclude formed less than five per cent of all leavers. On the other hand if a case has been made out and accepted for the exclusion of a particular category of leavers from the records of labour wastage and these leavers form a substantial proportion of the population an adjustment on the lines indicated above, even taking into account the errors mentioned, is likely to be more satisfactory than no adjustment at all.

The method outlined in the preceding sections would seem to be suitable for comparing changes in the stability of the labour force of a particular firm or department and of particular grades or types of worker, from one period to another for different lengths of service. Comparison from firm to firm could also be made (more accurately than by the use of the conventional labour turnover rate method) provided it was possible to use data from entrants over the same period of time. Graphical methods, using curves

constructed from p_x , q_x , t_x , v_x , or u_x would probably be more convenient than the figures themselves particularly is a comparison between two or three sets were required.

Rice, Trist and Hill (1950.5) use u_x in their analyses (though they do not specify its relationship to the other probabilities which they do not consider) whilst Lane and Andrews (1955.4) use t_x . In our studies we have used t_x also as this seems to be the most suitable method of approach. However whilst t_x (which may be looked upon either as the probability of surviving to length of service ($x + 1$) or simply the proportion of a given entrant group so surviving) itself can be used as the basis of comparison, and is so used in a series of case studies outlined in later chapters, it is sometimes convenient to employ in addition a more refined measure which summarises the characteristics of the data more closely.

* single figure of this type, to facilitate comparisons can be obtained by the calculation of an expectation of service, analogous to the expectation of life employed in actuarial statistics. An expectation of service is merely the average length of service of a group of entrants either over the whole period in which any of them remain employed

or from entrance to a specific time. The former is usually referred to as a complete expectation of service, whilst the latter may be called a truncated expectation.

In their paper Lane and Andrews (1955.4) construct a complete expectation of service by fitting a curve to the values of t_x which they derive from their data, and their method is, in the writer's opinion of sufficient conceptual interest to merit study on the part of anyone interested in this subject. A brief outline of their approach is given in Appendix B to this chapter.

The difficulty of the method of curve fitting is that, besides necessitating some mathematical ability, it involves the extrapolation of a curve over a considerable range if it is to be of any use. Such extrapolation may give rise to results which deviate to a considerable extent from those which will actually occur. For example Lane and Andrews extrapolate curves based on a length of service of 18 months, over a period of fifty years, in order to obtain sufficient data to estimate their expectation of service. It is true that the form of the curve they select (the log-normal distribution) has some theoretical validity for data of this type, but nevertheless it seems to be a risky procedure. In fact the fit of the curves they obtain for different sets of data are frequently very poor by their own admission even when compared with the

eighteen month series from which they extrapolate. It would be interesting to learn to what extent their curves fit the actual trend of survival for some of the entrant groups considered now that a number of years have passed since their original investigation took place. Generally it is only after simplifying assumptions have been made that a suitable fit can be obtained, and this coupled with the nature of the data (its high variability from year to year when compared with life table data for example) make such attempts at refinement unwarranted and misleading.

It is true, however, that unless some method of extrapolation is employed one can never calculate a complete expectation of service from entrants data unless it has been collected over a very long period (say forty years), and for obvious reasons much of such data would not be relevant to current conditions. It is nevertheless possible to use data over short periods to provide an index of survival - a truncated expectation of service in fact - on the same lines as that used in medical statistics for comparing mortality and morbidity after a given form of treatment has been applied to patients suffering from some disease. Here the histories of patients are traced subsequent to treatment for a period of years, say five, and an expectation of service calculated on the assumption

that at the end of the period all patients are dead. Any who survive to the end of the period of five years would be taken as succumbing at that time. Where changes in mortality after treatment during the first five years are far more important than subsequent changes the method is very useful and affords good comparison. Bradford Hill, (1952.6) gives an illustration of the method for cancer of the cervix as below:-

<u>Period after treatment.</u>	<u>Deaths.</u>
1st. year	60
2nd. year	94
3rd. year	68
4th. year	39
5th. year	52

Survivors out of 1000 patients at end of fifth year are 687.

If we assume that in each year the deaths are symmetrically distributed throughout the year those who died in the first year will, on average have lived half a year, those who died during the second year will have lived $1\frac{1}{2}$ years and so on. The 687 survivors for whom there is no record of death are assumed to have lived five years.

$$e_{05} = \frac{(60 \times 0.5) + (94 \times 1.5) + (68 \times 2.5) + (39 \times 3.5) + (52 \times 4.5) + (687 \times 5)}{1000}$$

$$= 4.15 \text{ years.}$$

hence an expectation of service to a maximum period of r years is given by:-

$$e_r = \sum_{x=0}^{x=r-w_r} (x + \frac{1}{2} w_x) u_x + r.t_r$$

w_x is the width of the length of service class interval above x (e.g. for an interval from 6 months to 9 months-

$$x = 6 \text{ months} \quad \text{and} \quad w_x = 3 \text{ months.})$$

A detailed illustration of this method as applied to labour wastage data is given in Appendix A to this chapter.

It is possible for such data to use expectations of service to only one year with profit when data for longer periods are not available. Even in firms priding themselves on a low wastage 40% leaving in the first year of service is quite common and 60% or 70% wastage not unusual. In such cases it is not unreasonable to calculate our expectation for such relatively short periods as one year (e_{1yr}^o). After all the medical data just quoted uses an expectation of life to five years (e_{5yr}^p) when the proportion of deaths is only 30%. Of course, if data over five years is available then the comparisons will be all the more accurately based

for the use of a five year expectation of service; but obviously such information will only be available after more than five years have passed and if we are concerned primarily with wastage in the early months of service we may be gaining in accuracy at the expense of postponing remedial action until too late.

It may be suggested that in our concentration on entrants data we are neglecting changes in wastage which may occur in the established labour force. Obviously, however, all workers have been entrants at one time or another and if we have figures relating to entrants in each year over a sufficiently long period we shall have information on the stability of all workers in the labour force. Nevertheless in the long established firm this would involve fifty different sets of survival data at least (ranging from that including new entrants aged 15 at the present time to the one including workers on the point of retirement who entered the firm fifty years previously) and undoubtedly this would be extremely cumbersome. In fact, however, sets of survival data over such a range are not necessary. Though the fact that length of service and stability are closely related has been the main theme of our argument up to now, it has been demonstrated by a number of writers (see Lane and Andrews (1955.4) that this relationship decreased in importance as length of Service increases. Thus, a group

of workers with only one month's service have a much greater probability of leaving within a given time than has a similar group who have had one year's service - a group with one year's service usually has a greater probability of leaving than one with five years service but with a much smaller differential than in the first case. When however we compare the stability of groups in their fifth year and those in their tenth, and those in their tenth with those in their twentieth and so on we find, usually, no consistent differences at all. Amongst the longer service groups (say beyond five years service) it is not necessary to consider differences in length of Service, and hence a simple Labour Turnover index of the B.I.M. type or the compound survival index referred to in Appendix A. could be used.

Whether or not the use of a separate index for long service workers (as indicated above) is worth while, is a debatable point. In the writer's opinion a strong case can be made out for concentrating attention on stability within, say, the first five years. It is true that of what is likely to occur in length of service periods after that date we shall have no information - but does this matter? In the opinion of the writer it is here that the analogy with mortality statistics falls down. Whilst most persons are agreed that an extension of the length

of life of individuals is desirable, certainly beyond any limit that has been attained up to the present time, it is by no means so certain that an extension of length of service (with the provisos that will be made shortly is desirable beyond a certain limit, which will vary in different cases and circumstances. Those who control business may like to see a longer period of service than, say five years after the completion of training but if such service is in a particular job in a particular department it is doubtful if it is of great value. Possibly a longer period of service in progressive posts moving from section to section within a firm is a sounder idea, but in this case will not the transfer have a most of the cost elements of labour turnover. Time will be taken whilst the employee settles down in the new department or the new job in much the same manner if he had moved to a similar new job elsewhere and a person from outside the firm had been appointed to his old post, Possibly there will be elements of cost which will be reduced when the transfer takes place internally e.g., a greater knowledge of the social relations within the firm. On the other hand there are some forcible arguments to be offered against the policy of internal promotion at least, which are to be set on the other side. The argument suggests at any rate that labour turnover measurements on an occupational or departmental basis taking into consideration transfers

within the firm as well as those external to the firm might in some cases be more advantageous than referring such measurements to the firm or the factory as a unit. If such an analysis were adopted a change from one occupation to another, or from one department to another might be considered either as part of the ordinary labour wastage of that occupation or department, or, in certain circumstances as part of the unavoidable labour wastage, and hence a withdrawal from the experience. Which of the two methods was to be adopted in any particular case might depend upon such considerations as whether or not the transferee was appointed as the result of open competition or whether he was asked by the management to make the change. Rice discussing Departmental Labour Turnover (7) says:-

"An examination of one aspect of Departmental Labour Turnover of the London Factory of Glacier Metal Co., Ltd., has suggested that the interaction between entrants and the departments, they enter, has more relevance for their behaviour as to entering and leaving departments than the interaction between entrants and the total factory or between the departments themselves. Transfers from one Department to another would appear to have the effect of the beginning of a new life within the factory."

It is at least arguable that employees who have learnt their job and been of service to their employers for a period of years and who have not been subject to the transfers mentioned earlier are likely to benefit themselves and the economy as a whole by moving elsewhere. These are not the fly-by-night type of worker, the unstable and the drifters. Their movement should be encouraged in the interests of mobility, in any developing economy. Moreover if they have been with the firm for a substantial length of time they may be amongst the least adaptable to changes within the organisation and offer resistance to new developments, thus giving rise to a hidden cost which may be as substantial as the cost incurred as a result of their departure. It is true that if an employee with five years of service or more, leaves, a new entrant, inherently less stable will presumably replace him, and this will increase costs. Such costs are probably inseparable, from an economy in which labour mobility is performing its economic function.

It is, of course possible that a firm may experience a rise in the labour wastage of its long service personnel, (e.g. on a change of management or of organisation within the firm, or competition for labour by another company) but it is contended that if this is an undesirable development from the point of view of the firm such increase in wastage is unlikely to be confined to such

long service workers, but to show itself in an increase in the instability of the medium service (say one to five years) groups also. In any case the stability of long service workers is such that the foregoing discussion is probably of purely academic interest. One might adapt the old adage 'Look after the pence and the pounds will look after themselves' to the situation 'Look after the short service employees and the long service ones will look after themselves'.

A P P E N D I X A.

An example illustrating the calculation of Survival Curves and a truncated expectation of service.

Firm x has 120 male entrants between 1st. January and 31st. December, 1956.

As each worker from this group leaves, his length of service is checked on a Data sheet similar to that given below:-

No. of Entrants.									Remaining over 1 year.	
	1 w	2 w	3 w	4 w	8 w	13 w	26 w	39 w		52 w.
120										72

(each leaver is marked with a stroke, in groups of five, as shown, the fifth leaver in each group being indicated by a horizontal line through the previous four.)

Making the entries on the Data Sheet for the purpose of a special survey will take some time, but very little extra work is needed when the method is used in practice. In the latter case, when a member of the group leaves, his record card will be entered up in the usual manner and a mark put on the appropriate section of the Data Sheet at the same time.

It must be noted that the length of service for each

individual is calculated from his date of entry and not from the end of the entrance year.

e.g. An entrant on 2nd. February, 1956, who left on 31st. January, 1957 has between 39 and 52 weeks service and is entered on the Data sheet under column 52 w.

The number of entrants who survive beyond the one year period is placed in the last column.

When the Data sheet has been completed the check marks are added up giving:-

No. of Entrants. Males.	Leavers within.									Over 1 year.
	1 w	2 w	3 w	4 w	8 w	13w	26w	39w	52w	
120	10	10	7	6	5	3	3	3	1	72.

This can be converted into a list of survivors, as below:-

<u>Surviving to</u>										
120	110	100	93	87	82	79	76	73	72	

These figures can be converted to percentages (in practice the accuracy obtained by reading off a slide rule is sufficient) to facilitate comparison.

<u>%</u>	<u>% Survivors.</u>									
100	92	83	77.5	72.5	68	66	63	61	60	

This information can be shown on a graph. The graph can be used directly for comparison with groups of entrants in previous years and it is extremely useful for detecting changes in the stability of new entrants.

An expectation of service can be calculated in the following manner.

From the above example we construct a frequency table:-

				<u>Average service.</u>
10	"	"	within 1 week.	.5 weeks.
10	"	"	between 1 & 2 wks.	1.5 "
7	"	"	" 2 & 3 "	2.5 "
6	"	"	" 3 & 4 "	3.5 "
5	"	"	" 4 & 8 "	6.0 "
3	"	"	" 8 & 13 "	10.5 "
3	"	"	" 13 & 26 "	19.5 "
3	"	"	" 26 & 39 "	32.5 "
1	"	"	" 39 & 52 "	45.5 "

As we have no knowledge of the duration of service of the remaining 72 we assume that they have an average service of 52 weeks.

72 workers have service of 52 weeks.

The Index of service is calculated by multiplying each average service by its corresponding number of workers, totalling the results and dividing by the total number of entrants.

<u>Males.</u>	<u>No. of entrants.</u>		<u>Average Service.</u>	<u>Product.</u>
	10	X	.5	5
	10	X	1.5	15
	7	X	2.5	17.5
	6	X	3.5	21
	5	X	6	30
	3	X	10.5	31.5
	3	X	19.5	58.5
	3	X	32.5	67.5
	1	X	45.5	45.5
	72	X	52	3744
	<hr/>			<hr/>
	120		120 /	4035.5

$$e_{52} = \frac{4035.5}{120} = \underline{\underline{33.63}} \text{ weeks.}$$

The survival curve illustrated covers only one year's service. It is possible to construct curves over any period of time for the entrants in each of a number of years as illustrated on the following sheet. Expectations of service to 1, 2, 3, 4, and 5 years can be calculated where the series are long enough in a manner analogous to that given above. A useful type of data sheet on which to record the information is also given. (see pages 62 and 63.)

Each of the survival curves can be plotted on graph paper, preferably using a large vertical scale so as to

Male entrants. Nos. Surviving to.

	1w.	2w.	3w.	4w.	8w.	13w.	26w.	39w.	52w.	1y. 2m.	1y. 6m.	1y. 9m.	2y.	3y.	4y.	5y.
1952	150	145	140	137	135	130	125	118	113	110	108	107	106	103	100	98
1953	200	195	190	186	180	176	170	166	162	158	155	153	151	148	146	
1954	175	170	160	155	151	146	140	134	130	126	123	118	115	108		
1955	150	140	136	130	127	122	117	112	109	107	105	98	97			
1956	200	190	188	186	184	180	176	173	170	168						

Information available up to 31st. December, 1957.

Male Entrants. %

1952	100	97	93	91	90	87	83	79	75	73	72	71	71	69	67	65
1953	100	97.5	95	93	90	88	85	83	81	79	78	77.5	76.5	75.5	74	73
1954	100	97	92	89	86	83	80	77	74	72	70	69	66	62		
1955	100	93	91	87	83	81	78	75	73	71	70	67	65	65		
1956	100	95	94	93	92	90	88	86.5	85	84						

D A T A S H E E T

1.

no. of entrants.	1w	2w	3w	4w	8w	13 w	26 w	39 w	52 w	Remain- ing over 1 year.
%										
100										

2. Calculation of Service Index.

No. of Entrants Average Service Product.

X	0.5	
X	1.5	
X	2.5	
X	3.5	
X	6.0	
X	10.5	
X	19.5	
X	32.5	
X	45.5	
X	52.0	

show up changes in the rates clearly. On the curves against the duration of service, 1 year, 2 years, 3 years, 4 years, and 5 years can be shown the corresponding service expectations.

Comparison can be obtained, almost at a glance between

a. different entrance groups in any year of service for which information is available,

b. stability of the working group as a whole from one year to the next.

a. above is useful for answering the following questions:-

i. Are our entrants in the most recent period (say 1956) as stable as those in some previous period?

ii. Is there any indication that the greater attention paid (say) to selection methods, or induction procedures, or the higher wages now being paid, is increasing the stability of our new workers.

iii. What number of entrants are likely to be needed in order to ensure a given build up of the labour force.

b. helps in such questions as:-

i. Has there been a general decline (increase) in stability from one year to another or is the change apparent only in certain of the entrance groups.

ii. What effect has a change in the economic situation, redundancies, the opening of labour competitive factory nearby, etc., had on our labour wastage.

Other applications of the method will indicate themselves to the user.

The method has, of course, its limitations. The more curves we wish to compare, the larger the graph it is necessary to use. In practice, more than five or six are rarely needed.

The stability of longer service workers can be measured (if thought necessary) in the following very simple manner.

- Take 1. The number of workers with 5 years or more service on (say) January 1st, 1952. Let these number 320.
2. The number of these workers who leave during the year, say 4.
3. Take the ratio of (2) to (1) X 100.
i.e. $\frac{4}{320} \times 100 = 1.25 \%$
A survival of 98.75 %
4. To the surviving group of 316 must now be added those who have reached 5 years or more service during 1952 and the procedure repeated.

Briefly if N_x is the number of workers with (5 years +)

on 1st. January in the year X; n_x the number of leavers from this group in that year; and m_x the number attaining 5 years in that year and surviving to the following January 1st., we have as a general formula -

we have
$$\frac{n_x}{N_x} \times 100 = \text{compound survival index.}$$

where
$$N_{(x+1)} = N_x - n_x + m_x$$

It is realised that this compound survival index takes no account of those who attain 5 years + in the year and leave before the following January 1st., but this is hardly likely to have any significant influence on the results obtained.

A P P E N D I X B.

A Method of Labour Turnover Analysis.

Lane & Andrews (1955.4)

In an article in the Journal of the Royal Statistical Society Vol. 118; Part III, 1955, Lane & Andrews have developed a method of relating the length of service of an employee to his probability of leaving, so that it is possible to compare leaving rates of two or more groups of employees with differing lengths of service structures. They employ two different approaches which can be called -

- a. the census method; and
- b. the cohort of entrants method.

In developing their ideas they make two assumptions.

1. Similar men joining a firm at the same time or within a short period have identical probabilities of leaving over time.
2. That the probability of leaving of a group of entrants can be predicted by using a probability of leaving function determined from the observation of those entrants for only part of their period of service, or, alternatively a composite probability of leaving function can be obtained from the observation of the leaving characteristics of a group containing

individuals of different service length, so as to be of relevance in the observation of such a group over a period of time.

Four elementary functions are defined and their relationships considered.

1. An Entrants function —

Number of men engaged between times t_1 and t_2

$$\int_{t_1}^{t_2} (t) dt$$

2. A Probability of leaving function —

Probability of entrants at time t leaving with a length of service between x_1 and x_2

$$\int_{x_1}^{x_2} f(x,t) dx$$

This can also be looked upon as the proportion of entrants at time t who leave between x_1 and x_2 .

3. A Leavers' function.

Number of men leaving between t_1 and t_2 with lengths of service between x_1 and x_2 .

$$\int_{t_1}^{t_2} dt \int_{x_1}^{x_2} L(x,t) dx$$

4. A Length of service distribution.

Number of men at time t with lengths of between x_1 and x_2

$$\int_{x_1}^{x_2} F(x,t) dx$$

These functions depend upon time of entry and length of service. They are therefore tackling basically the same problem that we have approached in the earlier part of this chapter using actuarial symbols. From a consideration of the functions the authors show that:-

$$1) L(x,t) = E(t-x) \cdot f(x,t-x)$$

$$2) F(x,t) = E(t-x) \cdot p(x,t-x)$$

$$\text{where } p(x,t) = \int_x^{\infty} f(s,t) ds$$

i.e. $p(x,t)$ is the survival function - the proportion of the entrants who will leave from period x onwards but who have survived to period x .

Lane and Andrews suggest that if one is considering entrants over only a short period of time it is legitimate to treat the function as constant with regard to time of entry and thus use expression (1-) modified.

$$1) \quad L(x,t) = E(t-x) \cdot f(x)$$

From the above the authors show that out of a given batch of entrants, the number of individuals leaving over all time (i.e., through the entire service experience of the group which for the sake of exposition is considered to be a period of indefinite length) with a length of service up to x is equal to the number of entrants multiplied by the probability of leaving up to time x .

$$\text{i.e.} \quad \int_{-\infty}^{+\infty} dt \int_0^x L(s,t) ds = E(t) dt \cdot \int_0^x f(s) ds$$

$$\text{or} \quad \int_{-\infty}^{+\infty} dt \int_0^x L(x,t) ds = E(t) dt (1 - p(x)) \quad \text{because} \quad \int_0^{\infty} f(s) ds = 1$$

$$\text{because} \quad \int_0^{\infty} f(s) ds = 1 \quad \text{Hence} \quad p(x) = \frac{\int_{-\infty}^{+\infty} dt \int_0^x L(s,t) ds}{E(t) \cdot dt}$$

Where the period dt is the period during which the entrants arrive.

In the approach made in Chapter III it is recognised that t_x , and all the other probabilities, are average values. t_x is not strictly speaking the probability of any individual remaining up to a given length of service, but merely the expected value of the probability of survival of, a large number of individuals entering over a considerable period of time. It has been suggested that as such the method might be used for the determination of a trend over time, the estimation of the strength of seasonal variation in survival rates and the calculation of the variability of such rates over time as a result of non-seasonal variations. Lane & Andrews concern themselves, however, solely with estimation of survival and leaving functions which may be considered to be applicable to individuals and hence for their conclusions to be valid it is necessary for them to consider groups of entrants over the very short period. It is true that, as will be seen later, they relax this requirement when they come to consider stability functions obtained from census data (as they are obviously forced to do) but in their handling of entrants data it may be assumed that their intention is to relate the probabilities to individuals of similar characteristics joining at the same time.

Now so long as the function $p(x)$ which is merely the specific survival rate t_x calculated from a number

of entrants joining the firm instantaneously, is used within the terms of reference indicated in the previous paragraph the time of entry can be looked upon as constant and omitted from consideration. However, both in the examples which the authors (Lane & Andrews) quote as well as in their own development this necessary condition is abrogated. The period of entrance dealt with in the application of the method to branches A to D of United Steel Cos., Ltd., is one year - a shorter period being impracticable according to the authors because of the existence of seasonal influences, whilst other writers (Greenwood & Smith, (1936.1) and Rice, Trist & Hill (1950.5; 1951.1)) use entrance periods of up to five years. I would suggest that even if the period of one year is sufficient to smooth out exact variations it is a sufficiently lengthy period for secular changes to take place. This is not to deny any utility to the calculations. They are, after all exactly, what are referred to in this paper as average (or from one point of view, expected) values, but to arrive at them it does not seem necessary to indulge in the mathematical argument which the authors use.

In the same article the writers also use the functions as the basis of estimates of an equivalent to the survival curve for members of the working force at a particular

time amongst which there will be individuals with different lengths of service ranging from zero for new entrants to forty years or more for those approaching retirement.

From the two equations 3 and 4 on page 69 they obtain the following relationships.

$$i) \quad \frac{L(x,t)}{F(x,t)} = \frac{f(x,t-x)}{p(x,t-x)}$$

i.e. the probability of a man with length of service x leaving at time t .

The above expression is integrated and we obtain the probability that a man with length of service from x_{R-1} to x_R will leave between times t_1 and t_2 . The right hand side of the expression becomes

$$ii) \quad \int_{t_1}^{t_2} \int_{x_{R-1}}^{x_R} \frac{f(x,t-x) dx}{p(x,t-x)} \quad \text{where } t_2 - t_1 \text{ equals a unit period of time.}$$

If F_R equals the average number of men in the length of service period concluding with x_R and L_R the total number of leavers in that period then the above expression becomes approximately equal to

$$iii) \quad \frac{(x_R - x_{R-1}) L_R}{F_R}$$

if the unit period of time is small enough and the length

of service period $x_r - x_{(r-1)}$ is of such a length that the rate of departure can be assumed to be constant. *

As the authors show-it is possible to express equation (i) in a different form, for, referring to (2) on page 69 it will be seen that $f(x,t)$ is the first derivative of $p(x,t)$.

* The inclusion of the factor $(x_r - x_{r-1})$ is necessary as the following example will indicate. Consider a unit time period of one year and a value of $(x_r - x_{r-1})$ equal to three months ($\frac{1}{4}$ yr.). Four individuals enter at the beginning of the year and one leaves at the end of three months whilst the other three pass into higher length of service groups; four more enter at the commencement of the second three month period and one leaves when he has seen three months' service; and so on until the four three monthly periods have been completed. During this time four persons have left after serving three months but the average population in the three monthly service group has also been four. Therefore the annual turnover rate for the three monthly group (L_r / F_r) has been $4/4$ i.e. 100%, but the survival percentage has remained at 75%. (This factor is analogous to the factor w_x referred to in the earlier development.

Hence the expression:-

$$\int_{x_{(r-1)}}^{x_r} \frac{f(x,t-x)}{p(x,t-x)} dx = \log p(x,t-x) \Big|_{x_{(r-1)}}^{x_r}$$

If the unit of time is sufficiently small so that the function can be treated as independent of time then

$$\log p(x_r) - \log p(x_{(r-1)}) = \log p(x)$$

and as we are dealing with a unit time interval

$$\log p(x_r) - \log p(x_{(r-1)}) = (x_r - x_{(r-1)}) \frac{Lr}{Fr} = m_r$$

When $r = 1$, $(\log p(x_1) - \log p(x_0)) \times 100 = 4.6052$ (because $\log p(x_0) =$ proportion present at the beginning).

Hence the proportion of members of the group surviving to a length of service r ,

$$\text{i.e. } p(x_r) = \text{antilog. } 4.6052 - (x_r - x_{(r-1)}) \frac{Lr}{Fr}$$

As an illustration of the use of this method there is reproduced below three lines from the table showing the method of calculation used by Lane and Andrews.

(see over leaf)

L. of S. Group.	Average Manning Fr	No. of leavers Lr	Annual turnover Lr rate Fr (%)	Percentage remaining to end of period $p(x_r) \times 100.$
Up to 3ms.	238	406	170.59	65.3
3 to 6ms.	153.5	128	83.39	53.0
6 to 9ms.	154.5	33	34.30	48.6

$p(x_1)$ is the probability of survival to the end of the first length of service period, i.e. in the example above, to the end of the third month. Hence:-

$$\begin{aligned}
 p(x_1) &= \text{antilog of } 4.6052 - \frac{1}{2} (1.7059) = \text{antilog} \\
 (\text{times } 100) & & & (4.1787) \\
 &= 65.3\%
 \end{aligned}$$

In practice it is more convenient to use $\log 10$ ($=2.3026$) than $\log 100$ (because tables of hyperbolic logarithms usually range from 1 to 10) and multiply the answer by 10.

The average manning by Lane and Andrews is obtained as the arithmetic mean of the number of employees in the particular service group, at the beginning and at the end of the period $t_2 - t_1$.

Once having obtained the survival curve for a group of entrants, or the stability curve for the whole population of workers in the firm in a given year, it is possible to fit a curve to the date. From this fitted curve an average length (expectation) of service can be obtained

and used for purpose of comparison just as we would use any other index of Labour Wastage.

It is surprising (see Benjamin, B., remarks (1955.4)) that it was thought necessary to adopt this procedure in the calculation of values of the stability function ($p(x)$) as a much simpler procedure is in use by actuaries which gives, essentially, the same results. If the values of m_x are treated as the central leaving rates for the intervals in question, the probability of surviving to time $(x + 1)$ is given using the symbols introduced at the beginning of this Chapter as: -

$$t_x = p_x \text{ times } t_{[x - w_{(x-1)}]} \quad \text{where}$$

$w_{(x-1)}$ is the size of the class interval immediately below x , and t_x is the proportion surviving to time $x + w_x$.

$$p_x = 1 - \left[\frac{(2m_x)}{2 + m_x} \right]$$

Benjamin gives a series of figures calculated using the above actuarial method alongside figures derived by the logarithmic method.

Branch A. United Steels Co., Ltd.

Time. (x)	Lane & Andrews method $Fp(x)$	Actuarial Method t_x
To 3 mths.	65.3%	64.8%
6	53.0%	52.6%
9	48.6%	48.3%
12	45.4%	44.7%

For a number of other sets of data the agreement has been found by the present writer to be close and therefore there appears to be no reason why the more complicated and less easily comprehended logarithmic method should be used.*

Note:- * The agreement between $p(x)$, the stability function of Lane & Andrews, and t_x is satisfactory up to values for the leaving rate m_x of 0.5. Beyond this the agreement becomes progressively less close. It can, however, be seen from the illustration given below that $p(x)$ is in error, and not t_x .

Consider the following six cases with different leaving rates.

Population of Employees at beginning of period.	Population of Employees at end of period.	Mid year pop n.	Leavers.	m_x	q_x	t_x	$p(x)$
1000	1000	1000	Nil	0	0	1	1
1000	800	900	200	.222	.2	.8	.8025
1000	600	800	400	.500	.4	.6	.6065
1000	400	700	600	.857	.6	.4	.4244
1000	200	600	800	1.333	.8	.2	.2638
1000	nil	500	1000	2.000	1.0	nil	.1357

From the final column which gives values of $p(x)$ for different leaving rates (m_x) it will be seen that $p(x)$ is a close approximation to t_x in the first three rows only. A glance at the last row where no one is left in the given length of service group at the end of the period indicates clearly the error arising out of the use of $p(x)$. It is obvious that the survivors after the elapse of the given service period are non existent, yet, $p(x)$ is equal to .1357 :

CHAPTER FOUR

INDICES BASED ON SPECIFIC LEAVING RATES.

From the discussion in the previous chapter (Appendix B) it can be seen that it is possible to obtain an expression for the expectation of service both for data relating to the survival of a particular group of workers entering within a short period, and also from specific leaving rates at different lengths of service for the whole of the population of workers within a factory at a particular time. In the former case the expectation of service is the average length of service achieved by a group of entrants, but in the latter case the expectation of service can no longer be given such a concrete definition. The data used for obtaining the stability curve of a given working population and hence for the derivation of the expectation of service is drawn from a series of groups with varying lengths of service. It cannot, therefore, be the average length of service for a particular group of individuals. It is merely an index number. What we are doing is using a concept which has a clear and unambiguous meaning for data arranged in a particular form (entrants data) to supply us with a means of comparison of data in an entirely different form. This is not to suggest that comparisons between working populations, using the hypothetical

expectation of service are misleading or invalid, but only that there is no reason to consider that an expectation of service has any special advantage over any other type of index which makes allowance for the undoubted relationship which exists between leaving rates and length of service.

As an alternative to the expectation of service approach we can use an index based directly upon specific leaving rates. Instead of using q_x (the probability of an employee at length of service 'x' leaving before he has attained length of service 'x + w_x '), we can use m_x which is the ratio of the number of leavers with length of service between 'x' and 'x + w_x ' to the number of unit periods of service during which employees were exposed to the risk of leaving. An illustrative example is given below.

Example of the calculation of m_x .

Suppose that in a given year 25 workers with between one and two years service left a firm in which the average number of workers having this length of service throughout the year was 1000, then:-

$$m_x \text{ would equal } \frac{25}{1000} = .025 \text{ or } 2\frac{1}{2}\%$$

(x = 1 year)

The specific leaving rate of workers with lengths of service between 1 year and 2 years is $2\frac{1}{2}\%$. Two and a

half per cent of such workers leave in a year.

If we wish to calculate a specific rate annually for a length of service different from one year the calculation is slightly more complicated.

Let us suppose that in a given year 120 workers leave with between three and six months service. The average number of workers with this length of service throughout the year is 900. It would be quite wrong to assume that m_x (where $x = 3$ months) equalled $120/900$. The 900 workers are, in effect exposed to risk four times during the year. If on January 1st., there were 900 workers with length of service exactly three months they would no longer be in the three months to six months group after April 1st. We can imagine them to be succeeded by another 900 workers who attain three months length of service on April 1st., and are likewise exposed to risk for the succeeding three months until they have achieved six months service. A further 900 would have between three and six months service from July 1st., September 30th., and a fourth group would be exposed to risk from October 1st. to December 31st. There would have been 3600 (i.e. 900×4) workers exposed to the risk of leaving between three months and six months service. The specific leaving rate,

m_x (where x is three months) is $120/(900 \times 4) = .03$ or $3\frac{1}{2}\%$

Our example is of course an artificial one, as we would not expect exactly 900 workers to achieve three months service on January 1st., April 1st., and so on, but the principle illustrated is applicable in all cases.

A general formula for the calculation of m_x for each length of service group is given below:-

$$m_x = \frac{s_x}{P_x}$$

where s_x equals the number of leavers in length of service group 'x' to 'x + w_x ' where ' w_x ' is the duration of that particular service period expressed in years; and where P_x is the average number of workers with length of service in the given year between 'x' and 'x + w_x ', divided by w_x . In what follows P_x will be referred to as the number at risk during length of service period 'x' to 'x + w_x '.

The value of the average number of workers is most frequently calculated by taking the sum of the number of workers in the appropriate length of service group at the beginning of the year and the number in the same group at the end of the year and dividing by two. A more accurate method which is much to be preferred (and has previously been mentioned in a footnote to Chapter II) would be to take averages for each month in the year, on the lines indicated above for the year as a whole, sum them, and

divide by twelve. This method is, however, likely to be a lengthy process unless the records are kept on a punched card system. An alternative method has been suggested by Lloyd and Spratling in an article in the Journal of the Institute of Actuaries (1951.10) but as this does not, to the writer, appear to offer any great advantages over the monthly method quoted above it will not be described here.

The specific rates m_x can now be used to form index numbers analogous to the Laspeyre and Paasche forms used in economic statistics and to the C.M.F., and S.M.R., of actuarial statistics (1952.5).

We define, (1) a standardised leaving ratio:-

$$S.L.R. = \frac{\sum m_x^a \cdot P_x^a}{\sum m_x \cdot P_x^a}$$

which is analogous to the Paasche (current year weighted) index and to the Standardised Mortality Ratio.

and (2) a comparative leaving figure:-

$$C.L.F. = \frac{\sum m_x^a \cdot W}{\sum m_x \cdot W}$$

equivalent to the Laspeyre (base year weighted index) and to the Comparative Mortality Figure.

The S.L.R., is the ratio of the total number of leavers at all lengths of service in a particular period, to those who would have left if the leaving rates had been those applicable to some standard population, but if the actual

numbers at risk had been those of the observed population. Assuming that specific leaving rates for the year 1956 were available for Industry B and also for one firm (say Firm 'a') in Industry B the performance of the single firm could be compared with the performance for the industry as a whole by using S.L.R. i.e.

$$\frac{\sum m_x^a \cdot p_x^a}{\sum m_x \cdot p_x^a} = \text{Standardised Leaving Ratio}$$

where m_x^a = leaving rate for length of service x to $x + w_x$ in Firm a.

p_x^a = numbers at risk at length of service x to $x + w_x$ in Firm a.

m_x = leaving rate at age x to $x + w_x$ in Industry B.

Each individual firm could calculate a similar index to relate its own performance to that of the standard (i.e. the industry as a whole). However the weights (P_x^F) where F stands for the firm under consideration, will tend to be different for each firm and therefore the index cannot be used with any confidence for inter firm comparisons, just as Paasche type indices of prices are only satisfactorily compared with the base year and not inter se. It would appear, therefore, that if we are looking for an index which can be used for comparison of the performance of one firm, or branch with another, or of one firm at different

times, the S.L.R., is not satisfactory. As such comparisons seem to be desirable, it is unlikely that the S.L.R., will meet our requirements.

At this point it is convenient to point out that the above consideration serves as an additional argument against the use of the Crude Labour Turnover rate of the type

$$\frac{\text{Total number of leavers}}{\text{Total Population at risk}}$$

This index, in terms of the nomenclature employed above can be expressed as:-

$$\frac{\sum m_x^a \cdot p_x^a}{\sum p_x^a}$$

Now if we consider a standard population in which the value of m_x is constant and equal to unity the above expression becomes

$$\frac{\sum m_x^a \cdot p_x^a}{\sum m_x \cdot p_x^a} \quad \text{where } m_x = \text{unity for all values of } x.$$

It follows that the crude rate of labour turnover is only suitable for comparison with a standard population which has exactly 100% leavers during the period under consideration. Such comparison does not seem very fruitful.

The comparative leaving figure avoids the difficulty of changing weights by using a weighting system which is not

related to the observed population. The weighting may be related to the standard population, as in the case of the C.M.F., of vital statistics giving

$$\text{C.L.F.} \frac{\sum m_X^B P_X}{\sum m_X P_X} \quad (\text{where } P_X = \text{number at risk at length of service } x \text{ to } x + w_X \text{ in industry B.})$$

or the weights may be selected on some other basis. Whilst the use of constant weights permits of comparison between firms, and over periods of time, it has one important drawback which can best be illustrated from an argument employed by Anderson & Dow (1952.5) (Actuarial Statistics Vol. II) in relation to the C.M.F. - "As an offset to these advantages of the C.M.F., the fact that it is based on a constant system of weights introduces a serious objection. It means that the same weight is attached to the experience of a particular age group whether the data in the age group are large or small in proportion to the total data in the classified group. Clearly this is unsatisfactory, because the larger the quantity of data in an age group, the more reliable is the corresponding mortality figure likely to be and the more weight should be attached to it in calculating the mortality index for the complete range of ages. In extreme cases the failure of the C.M.F., to take account of this factor may seriously

impair its usefulness. The classic example occurred in the Registrar General's occupational investigation of 1921 in which the C.M.F., for barristers, was 1171 (basic value 1000) while the ratio of actual to expected deaths (SMR) was 107%, a difference of 10%. This was because a single death occurred in age group 20-24 in which the population was only 102, and this very high and entirely unreliable death rate had a marked effect on the C.M.F., since the proportion of lives aged 20-24 in the standard population was much greater than in the particular occupation."

Whether or not this consideration applies with equal or greater force to indices of a similar type used for leavers data is conjectural. On the one hand the sizes of the populations considered are likely to be very much smaller than those found in demographic investigations, and the difficulties of deciding as to whether or not a particular leaver is to be included or excluded much greater. These two factors will tend to give less reliable leaving rates as compared with mortality rates. On the other hand the proportion of leavers (and hence the leaving rates) for the earlier periods of service, for which comparisons are most needed is much greater than in the case of most mortality data. Hence errors in the leaving rates due to incorrect exclusion or inclusion will be of less relative importance. Moreover the index would only be used as an indicator of differences which might be of possible significance. An

In the inquiries that follow in Chapter VIII et seq., the data has been collected on an entrants basis and hence the analysis will be conducted in terms of survival curves and truncated expectations of service as seems most appropriate.

Page 89 is lacking

CHAPTER FIVE

EXCLUSIONS

As has been indicated in earlier chapters labour wastage may occur for reasons which appear to be entirely outside the control of the firm. The death of an employee is a case in point. When suspected cases of such unavoidable wastage arise it is necessary to make a decision:-

- 1) as to whether, taking all the known facts into consideration, such wastage was really unavoidable.
- 2) whether or not it is desirable, or practicable, to exclude such a departure, from the population we are measuring.

The analogy between mortality statistics and labour wastage has been stressed on previous occasions, and it has been pointed out that when we are considering mortality from a specific disease or diseases after some form of treatment, it is necessary to exclude those who perish in some other way than as a result of the disease in question, or who are lost sight of from the records. The adjustment can usually be made without difficulty where there is an efficient system of medical records, because diagnosis of cause of death will normally be sufficiently unambiguous for a decision to be made, whilst individuals lost to the record are automatically eliminated.

Turning to the consideration of exclusions from labour wastage records, it might seem that in one respect the difficulties would be less than in the corresponding mortality investigations. After-treatment records of patients are seldom complete because the movement of an ex-patient from one area of the country to another, or his failure to report on his condition regularly for any other reason, results in an incomplete picture being obtained of the results of treatment. Exclusion from the records is the only feasible practice, but there is very little doubt that unless lapses of this nature are entirely independent of the progress of the disease, biased errors will creep in. For example if out of fifty patients treated for tuberculosis of the lungs only forty report on their condition during the ensuing ten years, a bias will occur in any derived statistics if the other ten do not report because they feel so well that they are only too glad to keep out of the way of the hospital, or because they have emigrated to areas where the disease will be less of a handicap for them, or because they feel that the treatment has been of no use to them, ~~or because they feel that the treatment has been of no use to them,~~ or because they prefer to die in their own beds, and so on. In each case the mortality experience of the excluded group is likely to be

different from that of the group for whom records are available. With labour wastage figures however, it is comparatively easy to ensure that such losses from the records are almost non-existent. They can only occur if there is any doubt in the minds of the personnel department as to whether or not an individual has actually left the service of the firm. The necessity of presenting National Health Insurance Cards when new employment is obtained, and the demands of the income tax authorities make the likelihood of such cases very remote.

We are left, then, so far as labour wastage records are concerned with the problem of the exclusion of unavoidable losses, a concept analogous to deaths from causes other than those which are being observed, in the mortality statistics. It is here, however, where a very considerable difficulty arises. Medical diagnosis is fairly certain, particularly if a postmortem examination is conducted. It is true that a patient may be suffering from a number of diseases all of which would have caused death if allowed to pursue their course. A patient dying of cirrhosis of the liver may have his life saved - so far as this cause of death is concerned - by succumbing to an attack of pneumonia or influenza. The present procedure of including a primary, and a secondary

cause of death on the death certificate has mitigated this difficulty. These sources of error apart, however, an uncomplicated case of death from a particular disease will always be recognisable. Such is not the case with Labour wastage. Diagnosis of reasons for leaving is very much in its infancy. With the exception of a small number of cases it is never certain if the reason for leaving given by the employee is the correct one, nor if the ostensible cause of an employer - initiated departure is merely a rationalisation. Moreover, even if diagnosis of reasons for leaving improves, as the result of the development of exit interviewing using hitherto undeveloped psychological techniques, a much more fundamental problem will present itself. Differences in susceptibility to diseases occur. Some patients may be an unconscionably long time a-dying, whilst others may succumb very quickly, but despite the boast that Abyssinian tribesmen never feel well without their tapeworms, it is extremely doubtful if the contraction of a disease, ever confers an immediate benefit on its victim. It is true that resistance to future attacks may develop as the result of successful recovery from the disease, just as a worker who is able to overcome his initial dislike of dirty, or dusty conditions may come to pay little attention to them in the future, but this is not the same thing as was referred to in the previous

sentence. Undoubtedly, conditions which repel certain persons, positively attract others, but a disease which harms one, does not benefit another. Herein lies the fundamental difficulty. In reducing the incidence of a particular disease, medical science is, ceteris paribus, increasing the expectation of life of every susceptible individual in the community. In removing the cause which led to Smith's departure from the firm, the management may however, be encouraging Jones to leave. This simple fact, though so obvious, does not appear to have attracted the attention of many writers on the subject of labour turnover. If Smith has left because he feels that discipline at the firm is too lax, and because he cannot bear to see virtue unrewarded, these are probably just the conditions which are encouraging Jones, who likes a quiet life, to stay.

Having said this it is certain that some reasons offered for leaving are more likely to be unavoidable than others. Death, chronic illness and pregnancy are examples. Where the initiative comes from the employers side, for example in the case of redundancy or discharge for theft or inefficiency, the wastage is really unavoidable at the time, but could have been avoided, perhaps, if different selection policies had been adopted when the leavers first entered the firm. In such cases the departure is certainly cost saving, but the original appointment, may

have been cost inducing, if a different and more favourable selection could have been made at the time. With these facts in mind I will now consider a number of the major causes of Labour Wastage which have been classed as unavoidable by various writers.

In an article in *Psychology at Work* P. Sargent Florence (1949.8) comes down very strongly in favour of the exclusion of redundancy figures from indices of Labour Turnover. In this he receives support from Joyce Long writing in her monograph on Labour Turnover (1951.4). A number of earlier writers also include redundancy as an element of unavoidable turnover, but usually without special discussion. The attitude of the two Birmingham writers (above) is that any increase in labour wastage which actually saves the firm money should not be included. Sargent Florence writes:-

"it seems fantastic to an economist to lump together cost incurring and cost saving events under one definition" (1949.8)

What information, however, are we hoping to obtain from the labour wastage figures? Do we merely wish to know the likely extent of our future expenditure on obtaining and training new workers, or are we concerned primarily with remedying any faults in our organisation which have

led to wasted expenditure of that kind in the past and hence could be expected to do the same in the future? If the former, we should do well to exclude redundancies from our record. If the latter, which the writer submits is a far more intelligent approach, we need to keep wastage figures for all leavers, particularly those who have departed after short periods of service as they represent costs which may not have been fully amortised. Indeed it might be useful to look upon labour wastage as a form of depreciation of an asset. If provision can be made for the depreciation of an asset over its ^{possible} life, say a period of ten years, the nett output expected from the asset can be assessed. Should the asset become obsolete after seven years (assuming straight line depreciation) three years provision for depreciation will have to be written off at once, with a corresponding reduction in the actual nett output of the asset. In the circumstances indicated such writing off will only occur where the reduction in nett output is more than offset by the expectation of increased nett output from the introduction of a new piece of capital equipment which has rendered the old one obsolete. On the other hand if a machine, for example, deteriorates during its anticipated life due to some fault in construction, to rough usage or to destruction or damage, the depreciation provision has still to be made,

but without any offsetting increase in nett output, As the machine has not become obsolete, it is assumed that an identical one would be needed to replace it, or at least one, the increased nett output from which, would not be sufficient to offset the reduction in anticipated nett output from the previous machine. Likewise, if a machine has to be sold at a fraction of the value to which it has been depreciated the excess value must be written off against the previous nett output. For each of these three cases there is a perfect analogy with labour wastage. Leavers who depart at the request of the employer can be likened to machines in the first, second and third cases. Leavers at death, or on sickness come into the second category, whilst complete destruction of the machine can be compared with voluntary labour wastage. Where an employee is declared redundant it will be because the employer can no longer find work for that employee but this does not make any the less real the costs of acquisition and installation of the human asset at some period in the past, together with any expenditure on repairs and renewals (i.e. additional training and possibly pay during sickness). The same applies to a discharge by the employer when it is the intention to appoint someone else to do the work previously done by the

departing worker. In such cases the reasons for discharge will come under the broad heading - Inefficiency relative to the expected performance of the anticipated replacement. The leaving employee may have become -

1. obsolete, because the nature of the work which is required has so changed that he can no longer perform it as satisfactorily (taking into account the relationship between his wages and output) as some other potential recruit, or because more efficient workers are available which were not available previously, or
2. the leaving employees efficiency may have declined below that which was originally anticipated - on account of dishonesty, laziness, poor time keeping, carelessness, illness and so on.

It is suggested that to make a distinction between the categories noted above solely on the grounds that replacement occurs in some cases and not in others is irrelevant so far as costs are concerned. A replacement of man or machine will only be made (assuming that the aim of the business man is to maximise his profits) if its anticipated yield over its lifetime is such as to more than offset all costs incurred in installing and using the asset, As such these costs are strictly referrable to the

replacement and not to any asset which it might have replaced. The departure of a worker indicates that future nett output will be reduced and / or that the past nett output has been assessed at too high a level unless adequate provision has already been made for depreciation. Whether or not the decline in future nett output is in the interests of the employer - that is, whether or not the employer desires to make a replacement which he is unable to obtain, the over assessment of nett output in the past will always be disadvantageous. Such over assessment is just as likely to occur in the cases of redundancy as in any other type of premature leaving.

It is suggested that a main aim of labour wastage investigations should be:-

- 1) To assess the appropriate rate of provision for depreciation of training, induction and other costs directly related to the establishment of the efficient worker in the firm, and
- 2) To reduce to a minimum the rate at which the trained worker depreciates (in the sense we have been discussing.)

Under such circumstances we should be justified in eliminating redundancy from our consideration only if it was completely unavoidable and occurred entirely at

random. It is submitted that such is not the case. Much redundancy could be avoided by careful planning and selection. It is, of course, possible that an increase in expenditure on training and selection which might help to reduce redundancies and other departures could so raise the cost of the asset (the trained worker) ~~and~~ that the nett output after providing for depreciation of all workers was less, despite an extension of average length of service, than in the earlier case where there was a shorter average length of service but a smaller initial amount of capital expenditure. However, unless the firm recognises the likely extent of its labour wastage, including avoidable redundancies, under different conditions, it is not in a position to make an approach to the optimum level of such expenditure. *

* If the increased expenditure resulted in an equal increase in income to all workers (if we assume constant prices money income is equated to real income and henceforth in this note this assumption will be made unless specifically contradicted), it would have the effect of reducing differentials unless all workers received the same income previously. In this equal increment case it is possible that there may be an increase in labour wastage in the higher paid groups who now feel that the rewards which they are receiving relative to those in lower income groups within the firm are not adequate. If other similar firms have not taken the same steps higher paid workers may prefer to move to those firms where the additional satisfaction of being relatively better off than other workers more than offsets the dissatisfaction due to the deprivation of the small amount of additional income. Similarly one might expect that the lower paid workers, would become more

stable as both their relative and absolute positions have improved. Other things being equal the workers with short periods of service will, on the average, be paid less than longer service workers and hence we might expect to see an increase in the stability of short service workers relative to those with longer periods of service. It is likely, but not certain that the effect upon the short service workers, may be more pronounced than upon the long service workers, and therefore a nett increase in the stability of the whole labour force may come about.

—Where the increased expenditure is carried out in such a manner as to maintain the relative positions of all income receivers, the absolute difference between the wages of the higher and the lower paid workers will have become larger. This might lead to additional discontent and instability in lower paid workers (of whom short service workers might be a considerable proportion) whilst accentuating the stability of the higher paid workers. It is very likely that such a procedure would increase overall labour wastage, other things being equal.

In both the above mentioned cases the changes in labour wastage might easily be modified and made more favourable after a short period during which those experiencing increased discontent had left the firm. Those leaving the firm will have their minds fixed upon the disadvantageous effect, whilst new entrants will be attracted by the ~~comparison of the~~ higher incomes to be obtained in their new employment as compared with that which they are leaving. Consequently after the first impact effect has been overcome it is likely that the increased expenditure of the firm we are discussing would result in a somewhat more stable labour force. There is, however, one additional difficulty here. The initial impact effect of the increased expenditure might be, as we have seen to increase instability temporarily. This implies that the length of service structure of the firm is likely to be adversely affected, as whatever the length of service of the leavers, that of the entrants must be less. Now if we can assume that short service workers tend to be more unstable than longer service ones, and that the stability increases rapidly up to a certain length of service it would appear that anything which temporarily increases labour wastage, even though it brings in

workers who are more stable than others with similar lengths of service elsewhere, will increase the overall labour wastage. This has of course been recognised in earlier chapters and an attempt has been made to eliminate the disturbing effect of length of service structure from measures of labour turnover. There is, however, all the difference in the world between making a valid comparison between two firms whose length of service structure differs considerably, eliminating the effect of the length of service structure by using, for example, specific turnover rates for each length of service group; and comparing in a similar manner a firm at two particular times, one before a temporary increase in labour wastage amongst the longer length of service groups and one after the losses so sustained have been made up by new entrants. It must be made quite clear that in the latter case a more favourable survival experience in each length of service group (or a more favourable length of service standardised index) could exist whilst the actual amount of labour wastage, and the costs which it gives rise to were greater than before the temporary disturbance. The more favourable underlying situation could be expected to give rise to a larger proportion of workers in the higher length of service groups as time went by and hence to an eventual reduction in labour wastage below that which was in operation prior to the temporary disturbance mentioned previously. But there is no means of ascertaining, a priori, whether this eventual reduction in labour wastage costs would offset the increased costs arising as a result of the temporary disturbance. In concrete terms of our original example, the increased labour wastage amongst established workers which might arise if additional expenditure on 'benefits' changed their relative positions in the wage structure would give rise to additional costs by increasing the proportion of workers in the naturally more unstable groups, even though the increased expenditure on benefits had the effect of reducing the probability of leaving at all lengths of service. There would be no guarantee that the extra labour wastage prevention costs would be less than the reduction in future costs as the labour wastage declined. Indeed it is likely, in a dynamic situation that the situation may so change within a short time that the level of total labour wastage prevention expenditure and its optimum distribution differ from that which brought about the temporary

disturbance. If now we make the assumption that the original change in total expenditure on labour wastage prevention was distributed in an optimum manner, (i.e. so that the nett output of the labour force, less such expenditure was maximised in the long run in a static situation) the changed situation might necessitate a new distribution of changed total expenditure so that, a further temporary disturbance in the labour force, ~~occurs~~ and so on indefinitely. Hence an attempt to approach a static optimum, might lead, under dynamic conditions to a greater deviation from a long period dynamic optimum than if no action at all had been taken.

The foregoing assumes that expenditure on establishing the trained worker will vary inversely as the level of avoidable labour wastage, with the expenditure being ^{the} causal factor. This assumption is only valid if the firm is already combining the various factors which influence labour wastage (to the extent that lies within its power, taking into consideration any factors which have to be taken as fixed over the period during which adjustment has been made) so that a marginal change in expenditure on two or more of the relevant factors, total expenditure remaining fixed, will result in greater avoidable labour wastage. Assuming further that the marginal utility of money is always greater than zero an increase in total expenditure of any finite amount could be used in such a manner as to give an increase in satisfaction to all workers at the firm, which would, ceteris paribus, improve their position relative to that of all other workers and thus deter leavers to a greater extent than hitherto. For example if any increased expenditure was handed over

merely in the form of an increase in wages to each worker we could expect the desired result - a lower rate of labour wastage (avoidable) assuming no change in other relevant factors. The note on pages 102 - 104 indicates some limitations to the foregoing analysis which are probably not of vital practical importance. It will be realised that the optimum combination of labour wastage factors at each varying level of expenditure on them is unlikely to occur in practice. Hence it is more than likely that a rearrangement of existing expenditure, or even a reduction in a given level of expenditure might result in reduced labour wastage. Moreover as population characteristics will never, in real life, remain exactly constant (no two individuals are exactly alike) the optimum distribution of expenditure at any particular level of total expenditure on the labour wastage factors will be constantly changing. The larger the population of workers with which we are dealing the more stable are likely to be the population characteristics and hence the greater the likelihood of a stable optimum at each total expenditure level. In determining the optimum level of expenditure on labour wastage factors it is necessary to estimate for a particular set of population characteristics such allocation of expenditure amongst the labour wastage prevention factors that any change in total expenditure and consequent

reallocation will result in a decline in nett output after provision for depreciation.

Afer all reduction in Labour Wastage, even considered from the narrow viewpoint of the firm is not an aim in itself. The cost of reducing the labour turnover should always be less than the cost of allowing it to continue at any given level. Any action taken by a firm which at the same time increased other costs to a greater extent would be uneconomic. Probably such cases are unlikely to occur to a great extent in practice, though the experience of Glacier Metal (1950.5) where the induction and training procedures are given such close attention (presumably at some additional cost) suggests that a relatively high level of labour wastage, after the completion of the unstable entrance period, found in that firm might be due to the departure of some employees who would, under other circumstances have left at a very early stage. If considerable training expense has been involved in these cases it might, conceivably have been uneconomic to encourage them to stay as long as they have stayed.

Returning to the question of redundancy, the fact that it tends to occur in lumps and to be concentrated in the shorter service groups indicates that the inclusion of redundancies - without further comment - in indices or

survival rates might give rise to misconceptions. This is not a reason for omitting redundancies entirely - because any large number of leavers, for a particular cause, would have a similar disturbing effect. It is desirable, however, that special attention should be called to any changes in leaving due to a specific cause, which could be of use in enabling remedial action to be taken in future. Redundancies are of such a character and therefore it would be useful, as well as including them along with other leavers in a suitable index or schedule of survival rates, for a separate rate of redundancy to be employed. In 'Recording Labour Turnover' (1947.1) it is suggested that an index of the form

$$\frac{\text{No. of Redundants}}{\text{Average Employment}} \times 100$$

should be used. This crude index has more to recommend it than the similarly based index for all leavers. Nevertheless as our 'all leavers' indices or survival rates will be based upon Length of Service it is desirable that the redundancy index should be also so based to permit of the elimination of redundancies in any particular Length of Service group for the purposes of comparison. Whether we use indices of the form:-

i) Redundants in x length of service groups X 100
Average in x length of service group.

or

ii) Redundants in x Length of service group X 100
All leavers in x length of service group.

or whether we use survival or leaving rates of the form

Present at start of Period.	ALL LEAVERS	$\frac{L}{P} \times$	Redundants.	$\frac{R}{L}$	
1000	200	20	5	0.5	up to 3aths.
800	160	20	7	0.7 $\frac{1}{2}$	3 up to 6 months.

will depend upon the manner in which it is desired to record the data.

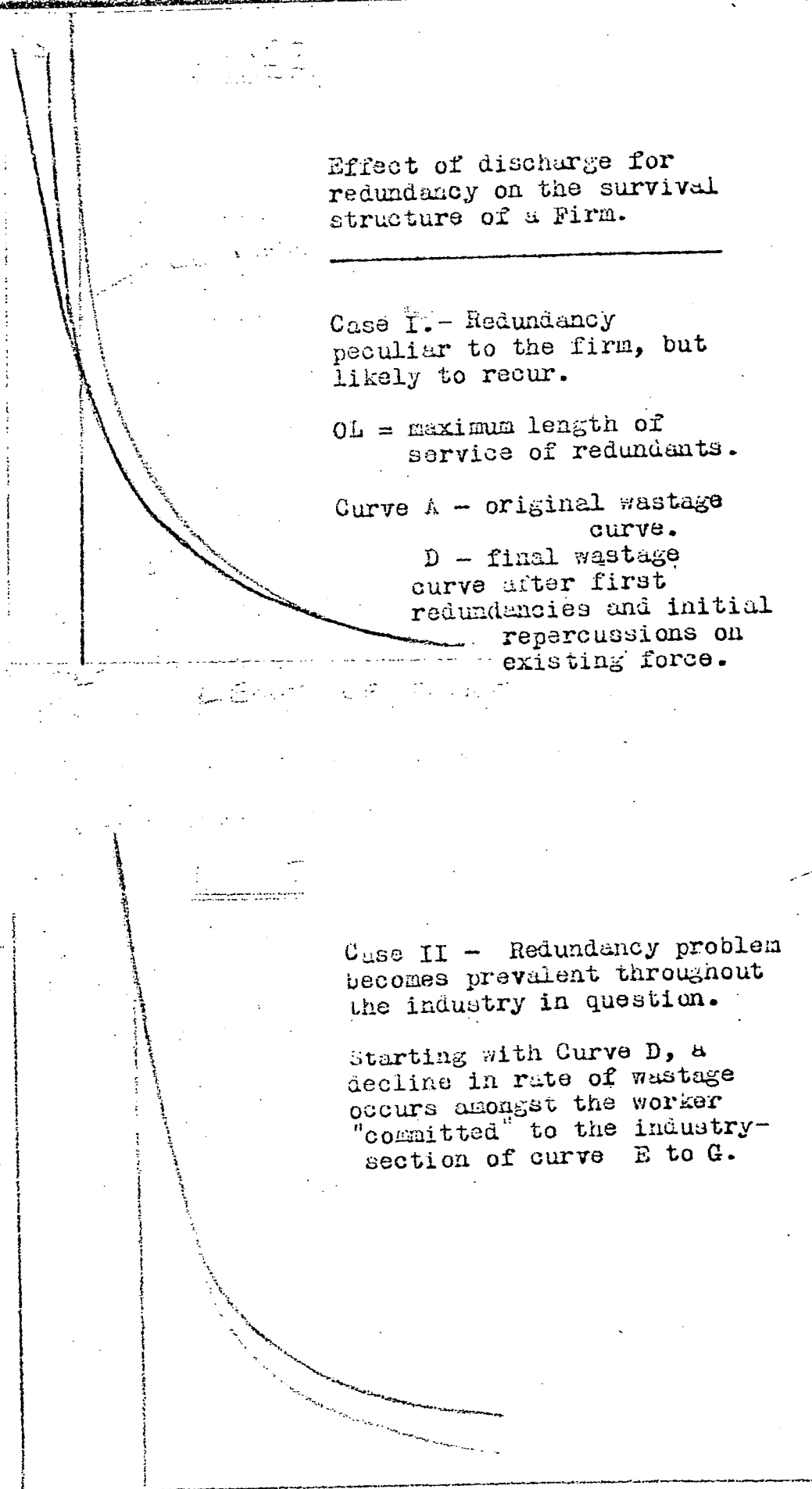
Just as the inclusion of redundants in the main index or survival rates will tend to give an upward bias to the figures to the extent that redundancy is unavoidable, so the exclusion of redundants tends to give a downward bias where the redundants are avoidable. Ideally some method of weighting redundancies would probably be satisfactory if it proved possible to estimate the proportion of redundants, on the average, arising from unpredictable trade

developments, but such estimates cannot be made in the present state of economic knowledge. The best we can do at present is to follow the procedure indicated in earlier paragraphs. Unfortunately, as mentioned in Chapter III a further and quite distinct downward bias tends to result from exclusion, because some of those who are declared redundant during a period might not have survived beyond the period under consideration in any case. The tendency for redundants to be concentrated in the short Length of Service groups accentuates this problem. Furthermore, though some redundancy may lead to increased labour wastage in anticipation of further discharges the less favourable economic climate may possibly be encouraging others to hold on to their jobs more tightly. The relative strengths of the two opposing forces will depend upon the extent to which redundancy affects the economy as a whole.

The diagram indicates the possible effects of these two forces.

CASE I

Starting from a given survival pattern (Curve A) a number of redundancies raises the first portion of the curve (to which redundancies are for the moment confined - Be dotted line). This gives rise to an increase in departures 'in anticipation' which raises the whole of



Effect of discharge for
redundancy on the survival
structure of a Firm.

Case I. - Redundancy
peculiar to the firm, but
likely to recur.

OL = maximum length of
service of redundants.

Curve A - original wastage
curve.

D - final wastage
curve after first
redundancies and initial
repercussions on
existing force.

Case II - Redundancy problem
becomes prevalent throughout
the industry in question.

Starting with Curve D, a
decline in rate of wastage
occurs amongst the worker
"committed" to the industry-
section of curve E to G.

the curve D once again to a greater extent in the short service groups. The longer service groups will be affected to some degree but this depends upon the policy of the firm so far as redundancy discharges are concerned, and upon the prospects for the future in the eyes of these employees.

CASE II

If the redundancy is not confined to the firm, but also shows itself in other firms in the same industry a further relative increase in voluntary departures in short service groups, compared with those of longer service may be evident. This is likely to occur because many trainees, and unskilled workers (in whom labour wastage is normally highest and amongst whom one can therefore expect there to be a greater proportion of short service members) who are not fully committed to the industry will be able to move into other industries more easily than fully trained skilled workers. This depends to some degree however on our definition of 'the industry' and the extent to which work for skilled employees is available elsewhere at the same job, but in a different industry. As an illustration we may cite the case of the pattern maker in an engineering factory. Redundancy in the engineering industry as a whole may lead to a number of patternmakers leaving to

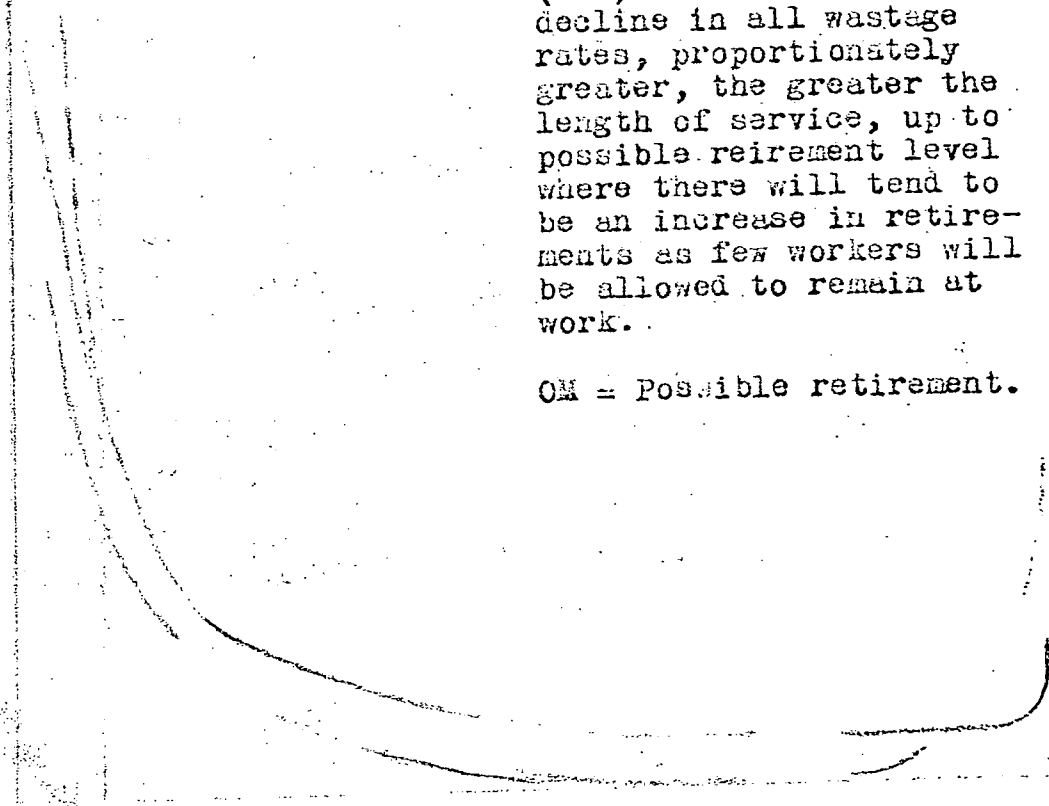
Effect of discharge for
redundancy on the survival
structure of a Firm.

CASE III

Case III.- From the
position after redundancy
(BCA) there is a step
decline in all wastage
rates, proportionately
greater, the greater the
length of service, up to
possible retirement level
where there will tend to
be an increase in retire-
ments as few workers will
be allowed to remain at
work.

OM = Possible retirement.

WASTAGE
RATE.



work for cabinet makers, or as joiners in the building industry.

CASE III

Finally if the economic conditions in most industries were such as to lead to the laying off and discharge of workers it is likely that there would be a reversal of the tendencies noted above. It has been abundantly demonstrated in the past, and in recent years (See Behrend 1955.2) that a decline in the employment level over a substantial part of the economy tends to reduce labour wastage in all service groups. As it will, in such circumstances, be to every individual's advantage to have as long a length of service behind him as possible in accordance with the principle of 'last in first out' the decline in the rate of wastage of the longer service groups will be very pronounced. The rate of voluntary wastage amongst the short service groups will also decline rapidly but probably not to the same extent, although as time passes this is likely to be more than offset by increased redundancy discharges.

Causes of wastage that have been classified as unavoidable are, in addition to redundancy, death of employee, sickness, marriage (of female), pregnancy, husband leaving for job in other area, retirement,

discharge for dishonesty and call up for the forces. In each of these cases there is some element of avoidability even if we agree to take the reasons at their face value. If, as mentioned previously, we cannot be certain that the reasons given are the correct ones, a further source of error exists. Here we shall not deal with the latter, assuming that the reasons are genuine ones.

Labour wastage due to death and sickness may arise because of inadequate attention to sanitation or to protection of the worker against the hazards of the occupation. For example the present processes involving the production of certain dyestuffs involve the probability that some employees will contract cancer of the bladder. There are numerous industrial diseases in the narrow sense, the incidence of which varies from firm to firm in the same industry because of different degrees of care taken to ensure that necessary precautions are observed. A firm which supplies masks to its employees engaged on quarrying siliceous materials and takes measures to ensure that they are worn is likely to have fewer employees incapacitated by silicosis than is a firm where such precautions are ignored. Moreover such differences are not restricted to those ailments which have been shown to have a direct connection with certain types of processes. A firm which ignores a machine safety regulation, or allows

its employees to do so, or has dirty, dusty, draughty or damp working conditions when it could avoid them is not only encouraging an increased accident and sickness rate, but is also likely to have a higher labour wastage through death and chronic sickness than firms where these conditions do not appertain.

Despite the fact that not all women cease to work upon marriage, this reason is often excluded when labour wastage indices are being compiled. Greenwood (1919.3; 1936.1) brought out quite clearly that in certain munitions factories marriage was a significant factor so far as labour wastage went in certain types of heavy work, but relatively insignificant in lighter work. It is not outside the bounds of possibility that alterations to processes or the transfer of married women to other types of work could reduce labour turnover amongst this class of persons. Indeed it is well known that welfare schemes, children's nurseries, special periods of leave for pregnancy, or for sickness of other members of the family, and so on have been used with considerable success as inducements to married women to continue at work. Once again it might be very desirable to compare rates of labour turnover of married women with those of other females, but there seems little reason why their departure should be excluded from

any general indices as the costs incurred by the employer are no different in kind (though they may be in degree) ~~from~~ those of any other type of labour wastage. The reference made to pregnancy in the foregoing should indicate that this cause of leaving is not necessarily unavoidable either. Indeed it is possible that in certain instances, both marriage and pregnancy may be used as an excuse rather than as reasons. It is a well known fact that a good number of women obtained release from distasteful jobs in wartime (when female labour was directed into certain occupations in some instances) by becoming married or (if already married) pregnant. Direction of labour does not exist nowadays but it is nevertheless highly probable that many women look upon marriage, at any rate, as an opportunity to escape from a job which they do not find very satisfying - a circumstance which it is not always out of the employer's control to alter.

Discharge for dishonesty may in some cases arise out of ~~a~~ faulty selection methods, because steps have not been taken to ascertain the previous character of the entrant, or because the employee's thefts arise out of an unsatisfactory work situation. Frustration, unhappiness, discontent with one's work are very potent factors in encouraging petty theft. Obviously theft and general dishonesty may arise

from conditions existing outside the work situation but they can be encouraged by defects in the employee-employer relationship.

Another instance where selection influences turnover occurs where the employee is liable for callup. However, as it occurs, under present circumstances at a specific age only and therefore can be forecast to a high degree of accuracy it can be classed as unavoidable if the firm feels it necessary to employ persons of that age or less. Similar remarks apply to age retirement. In view of the fact that all firms have these problems it would appear to be justifiable to exclude both these causes from our indices, if they occurred in sufficiently large numbers to be likely to affect the calculations.

The final category mentioned viz. (husband moving to another area) will usually contain such a small number of members that whatever course we adopt is hardly likely to affect the result of the calculation. Probably the safest thing to do is to omit the leavers under this heading, as in the two cases above, if the numbers are significant.

What has been said in the foregoing paragraphs suggests that for practically all ostensible causes of labour wastage there are some departures which are really unavoidable and some which could have been avoided if

appropriate action had been taken. It is never very satisfactory, with the exception of the cases just mentioned, therefore, to omit any class of leaver from our calculations of wastage rates if the numbers are sufficiently large to be of significance. On the other hand to include them all may be only slightly less unsatisfactory. What is needed is some method whereby attention is drawn to the various broad categories discussed so that significant changes are not overlooked. The ideas advanced in respect of the measurement of redundancy wastage i.e., separate analysis and comparison with a general index or indices are probably of equal value in other cases of doubtful unavoidable labour wastage.

CHAPTER SIX

THE COST OF LABOUR TURNOVER

In the previous chapter reference was made to the Capital Cost of workers and the provision for depreciation in connexion with the problem of exclusions. For the convenience of the development, at that stage, price changes and the problem of the replacement costs of an asset, were ignored. Now, however, that it is hoped to use this concept of Capital Cost as the basis of a method for the Costing of Labour Turnover it is desirable to remove the simplifying assumption of constant prices and this will be done below.

The individual worker (or in certain cases a homogeneous group of entrants) is considered as a Capital Asset and just as with a machine, or a vehicle, the purchase and introduction of the worker into the firm makes up the Capital Cost. The capital asset has an estimated life which might, for example, be taken as the length of time from entrance to anticipated age retirement, or the expectation of service, (based upon past experience) as illustrated in Chapter III. Provision for depreciation is made so that the Capital Cost of the worker will be written off over the estimated life of the asset. If the worker

leaves before his estimated survival period any remaining Capital Cost will be written off at once. Hence we should be able to estimate the Cost of Labour wastage over any given period as the sum of the total depreciation provisions made during that time. The problems involved are basically two:

- a. The making of proper provision estimate of the original capital cost.
- b. The making of adequate provision for depreciation.

Dealing with the latter first it is suggested that straight line depreciation be used, there being no information at present available to suggest that any more refined method would fit more closely the real rate of depreciation of the worker. In addition, as the calculations will be only for the internal consumption of the firm and not for the benefit of the Inland Revenue Authorities there seems no reason why a replacement cost basis should not be adopted.

It is, perhaps, necessary to state that the charging of provision for depreciation at replacement cost is not dependent upon the asset actually being replaced. It is solely an attempt to assess the loss in real income to a firm which arises owing to the use and possession of the asset over a period of time. Presumably if money income had not been used in some past period to purchase the

asset (in the case of labour to obtain and train the workers) it could have been invested in some other manner, e.g. in stocks of goods, so as to leave the owner with a constant amount of purchasing power in real terms. No account is taken of the rate of interest, the expectation of which is necessary to induce the given investment, as the writer thinks that such interest should be considered as an integral part of final nett output and not confused with depreciation provision. The principle however would not be altered if an additional allowance were made for interest, though any practical calculations would be made considerably more difficult. The amount of provision for depreciation of the asset over its life should, then, be such that the total has equivalent purchasing power to the original outlay on the asset, assuming that when any provision is made during the course of the life of the asset it is used in such a way that its purchasing power is maintained. As a simple illustration of the foregoing we might consider £200. spent on the training and induction, etc., of 20 workers whose estimated length of service is five periods. A straight line provision of £2 per worker per period is to be made at constant prices. We have now the following:-

<u>Price Index.</u>	<u>Period</u>	<u>Total Depreciation Provn.</u>	<u>Leavers.</u>
100	1	£ 40	0
150	2	£ 60	0
300	3	£ 180 = £ 120 + £ 60	5
300	4	£ 120 = £ 90 + £ 30	5
400	5	£ 80 = £ 80	<u>10</u>
			20

The price index represents the average level of prices for the period concerned. Some ambiguity arises here because no one price index can reflect changes in the prices of every individual commodity and capital goods. Ideally the index should relate to the thing or things in which the total amount set aside from nett output in the period in question is to be invested. Thus if exact replacements of the asset (the worker) is required then the index should be related to price changes in training, induction etc. If exact replacement is not likely then the index should be related to what it is anticipated will be the use of the accumulated resources at the end of the periods. Generally speaking an index including all possible uses of the resources, weighted according to the probability of each individual use would be most satisfactory. It is realised that in a dynamic situation the forecasting of such probabilities could never be completely accurate but if continuous and cumulatively retrospective assessments were made a high degree of accuracy could be obtained.

It is assumed that as each provision is made the amount of nett output set aside in the particular period in question will be used in such a manner as to maintain its purchasing power. The £ 40. set aside in Period One would be used to invest in stocks, or in capital equipment, or in new members of the labour force, or in other companies, so that (taking into account the provisions for depreciation on these assets, the assets purchased would be expected to realise £ 160 at the end of period five (or a corresponding sum according to the level of the price index if the asset were realised at some earlier period.)

Hence the total final purchasing power available would be

£ 40	X	4	=	£ 160
£ 60	X	$\frac{22}{3}$	=	£ 160
£ 180	X	$1\frac{1}{3}$	=	£ 240
£ 120	X	$1\frac{1}{3}$	=	£ 160
£ 80	X	1	=	£ 80

Total £ 800 equivalent to £ 200 at commencement.

The amount, therefore, to be set against the nett output of the workers is the amount which has the purchasing power equivalent to the amount actually spent on their

installation and training. Needless to say for an estimation of the nett output of the worker(s) at any given time adjustments must be made for price changes similar to those made for the depreciation provision.

With workers, replacement cost depreciation is more feasible than with other types of capital asset, as the problem involved in estimating costs when a new type of asset replaces an old one does not arise so frequently as in other cases. With nearly all classes of physical capital assets there is no exact replacement. Indeed it may not be possible to obtain a machine similar to the one which is going out of use, and hence it may not be possible to ascertain what the replacement cost would have been if an exact replacement had been desired. So far as workers are concerned it is possible, but not as likely that actual replacement of a particular worker or particular class of worker may not be desired but it will be possible to estimate what the training and other costs for such a worker would have been. This is partly due to the fact that, so far as workers are concerned, the firm is making its own assets and not relying upon purchasing them from elsewhere.

Hence, even if the type of training changes, a detailed breakdown of the costs incurred will usually enable a reasonable estimate of the replacement cost of the old type of training to be made. A further reason is that, by

and large, changes in types and grades of workers employed do not occur either so rapidly nor so abruptly as with some types of physical assets.

It is now necessary to discuss what we consider to be the costs of installing the new worker. Should we attempt to include all elements of costs which could conceivably be attributed to the search for the entrance of workers, and the continued existence of inexperienced workers within the firm? This is the approach adopted by the majority of investigators into the Cost of Labour Turnover., Furness (1950.2) includes the following factors:-

Personnel administration, medical services, welfare schemes, pension schemes, inefficiency of new labour, employment department, training costs, less of output due to delay in getting new labour, breakages of equipment, accidents, and scrap.

To these Frank Pearce (1954.2) adds the cost of maintaining the labour force at a higher level than would otherwise be necessary so as to provide some insurance against a fall in out-put when workers leave. The recent B.I.M. (1956.2; 1958.2) survey lists a series of cost headings similar to these given by Furness.

The difficulty of all these approaches is that many of the costs included may be due only partly to the existence

of labour wastage, and partly to other causes. The cost of the personnel department is included as a Labour wastage cost. This is not entirely true. Expansion of a firm necessitates selection of workers, records must be kept for the existing staff at any particular time, promotions and transfers arranged, additional training for established workers may be necessary from time to time, all presumably falling within the ambit of the Personnel Department. When it comes to including in Labour wastage costs a part of the expenditure on welfare or on accident prevention, only an arbitrary proportion can be charged. To attempt to cost such factors as extra overtime worked owing to inability to make replacements, loss of output for similar reasons, or failure to obtain orders due to requiring longer delivery dates, and so on is merely chasing a chimera, both because such losses are, to a large extent unascertainable, and because labour wastage is not the only possible cause. Absenteeism, strikes, cacanny, poor supervision to name only a few influences also affect output, lose orders, and bring about the need to work overtime in certain cases.

It is not at all surprising that the BIM (1956.2;1958.2) survey, 'Cost of Labour Turnover' finds very wide differences in Labour Turnover costs of the twelve firms chosen for the investigation. The cost categories chosen often invite quite arbitrary estimates, and have obviously been

interpreted very differently by different firms.

The foregoing criticism does not mean that attempts to cost Labour wastage are doomed to failure and that (to quote the article in 'Manager' 1956.2) because

"we know that Labour Turnover costs us something there is no need to obtain more accurate estimates".

On the contrary, as was indicated earlier in this chapter a useful approach is to consider Labour Turnover Cost as a form of depreciation. But we can only do this if we have information on the Capital Cost of the worker. Does not this involve the solution of the formidable problems which we have just referred to? The writer thinks not. Consider the analogy with the physical capital once again. The depreciation provision for such an asset will be based upon the cost of the machine from the suppliers, plus any carriage cost together with the expenses of installation. It is unlikely that any additional expense incurred due to unfamiliarity with the machine on the part of the operator will be included in the Capital cost. Certainly repairs and renewals that may need to be made from time to time would not be considered to be part of the Capital Cost. Why therefore is it thought necessary to lump together Capital costs and revenue costs in the case of Labour wastage? If the cost of training and induction and scrap directly attributable to a new entrant can be estimated -

certainly a much easier task than a full costing as outlined by Furness the total can be looked upon as the Capital cost of the worker. Similar estimates for a number of similar workers entering within a given time would enable us to calculate an average Capital Cost which could be depreciated over the estimated maximum length of service of the worker (or group of workers) as indicated earlier in this chapter. Changes in the total depreciation provision (including amounts written off when workers leave before the completion of their estimated service length) - as well as giving an indication of the changes in costs incurred could also be used as an index for comparison with an 'ideal' situation in which all workers stayed for their estimated maximum length of service. It is, of course true that the expectation of service index and the indices based upon specific leaving rates would also give this latter information - in a situation where the Capital cost of the worker was constant, but if variations occurred in such costs (due to price changes or differences in the length or type of training required) they would only be allowed for in the cost based index.

One criticism which was offered earlier in this chapter of attempts to include the various current costs, personnel, medical, welfare, canteen facilities etc., was that only an arbitrary amount could be related to labour wastage in some of these cases and that other influences e.g. the

expansion of the labour force, absenteeism, strikes, poor supervision, the situation of the factory, the type of work, would lead to changes in the level of such costs. Bearing this in mind it is suggested that in addition to using the concept of Capital cost it might be worth while to examine the desirability of obtaining information on the current cost of Worker Maintenance, i.e. all expenditure which arises because the firm is employing human beings, (including their wages) - and not automata. There would be no need here to make arbitrary divisions of expenditure on Personnel service, for example, between that relating to labour wastage and that due to other factors - the whole expenditure would be included in Worker Maintenance. The only difficulty that would arise would be in allocating expenditure on articles or equipment which are partly for the benefit of the worker and partly necessary tools for the job. IS, for example, the provision of a chair for an office worker expenditure on necessary equipment for the job, or is it for the benefit of the worker? In practice some arbitrary decision would have to be made, but, so long as such decisions were consistent over the period for which comparisons were required there would seem no reason why they should give rise to difficulty nor to misleading comparisons. Such cases calling for arbitrary judgement are likely to be of much less importance than corresponding cases arising where

an attempt is made to relate appropriate proportions of current expenditure to Labour wastage alone. It will be noted that the term "Worker Maintenance, has a very much wider connotation than the prevention of Labour wastage. "Worker Maintenance expenditure is looked upon as expenditure calculated to keep the Capital Asset - the worker - in existence and capable of producing at as high a level of efficiency as possible. By relating the current expenditure on "Worker Maintenance and the amount of provision for depreciation to some concept of Nett output of the worker we could examine the success of the aforementioned expenditure in raising the level of nett output.

The adoption of a dual scheme such as the aforementioned, considering "Worker Capital Cost and "Worker Maintenance separately, is likely to be more useful than one which considers a variety of expenses and lumps them together under one heading, such as "The Cost of Labour Turnover". Moreover, having two categories, corresponding to Fixed and Variable Costs the system fits in with existing accounting methods. In addition the dual method enables us to take into consideration more easily those changes in Labour Costs which are not due to changes in Labour Wastage. Where a single total is obtained for Labour Wastage Cost or where the subject is treated under a number of category headings such as those given by Furness and others an increase in

costs due to the recruitment of additional labour cannot easily be differentiated from an increase due to a growth in the replacement rate. When using the dual system however we are more likely to be able to recognise the different causes.

Consider the following simplified example. (See Appendix A)

Firm A has a factory with 100 workers. The capital cost of each worker is £ 120 and the estimated maximum length of service is given as ten periods. The depreciation provision is therefore, £ 12 per period. The Worker Maintenance Cost is assumed to be made up of Wages and other current charges. Each worker earns £ 500 per period and the remaining current costs amount to £ 50 each. Worker maintenance cost is therefore £55,000 per period.

At the end of one particular period, at the beginning of which there were still one hundred employees, 15 workers leave with only eight periods of service.

During this period the total depreciation provision becomes:-

$$\begin{array}{r}
 100 \times 12 = 1200 \text{ (normal depreciation)} \\
 \text{plus } 15 \times 2 \times 12 = 360 \text{ (amount written off for} \\
 \text{early leavers.)}
 \end{array}$$

Total depreciation charge is £ 1560.

To this must be added the Worker Maintenance cost of £55,000 giving a total current Labour cost expenditure of £56,560.

Firm B has the same number of employees as Firm A and similar Capital and Worker's Maintenance Cost, but instead of losing workers earlier than the end of ten periods of service, it gains 15 additional workers.

At the beginning of the period in question fifteen new workers are set on and the total depreciation charge becomes

$$\begin{array}{r}
 100 \times 12 = 1200 \quad (\text{normal depreciation on existing workers}) \\
 15 \times 12 = 180 \quad (\text{normal depreciation on new entrants}) \\
 \hline
 1380
 \end{array}$$

It is assumed that the new workers are paid at the same rate as the existing ones, namely £ 500 per period and that other current costs remain at £ 50 per worker per period. Worker maintenance cost therefore becomes $115 \times £ 550$, namely £ 63,250.

Note - Arguments can be adduced for assuming that other current costs increase proportionately to the number of workers, as we have assumed, or that they increase at a slower or more rapid rate. If, for example, there is unused capacity on the personnel department it will be possible for that department to deal with the fifteen additional workers without any extra costs being incurred by the firm - hence a slower rate of increase of other

current costs as defined above, would be expected. On the other hand if the introduction of new workers necessitated the introduction of canteen or medical services which it had been considered uneconomical to provide before, the other current costs would increase more than proportionately to rate of increase of workers. In the example a proportionate rate of increase has been assumed for convenience of exposition. The general argument is not likely to be affected by any other assumption..

The total Labour cost expenditure for firm B amounts to £ 64,630.

This gives an average Labour Cost of £ 565.6 for Firm A during the period in question and a similar figure of £ 562. for Firm B. There is nothing about these two figures which indicates that Firm A has had a much more unfavourable experience than firm B. This is because worker maintenance costs are related to numbers actually employed and not to the number of leavers. Indeed if we had chosen for the example a case in which Workers Maintenance costs increased more than proportionately as the labour force grew the gap between the average Labour Costs would have become smaller. Of course, if the converse had been true the two figures for average labour cost would have shown a larger discrepancy, but in neither case would the size of the gap have had any diagnostic value from the

point of view of Labour wastage. However if we consider only the average depreciation charge per worker employed over the whole period in each case

$$\text{Firm A } \frac{1560}{100} = 15.6$$

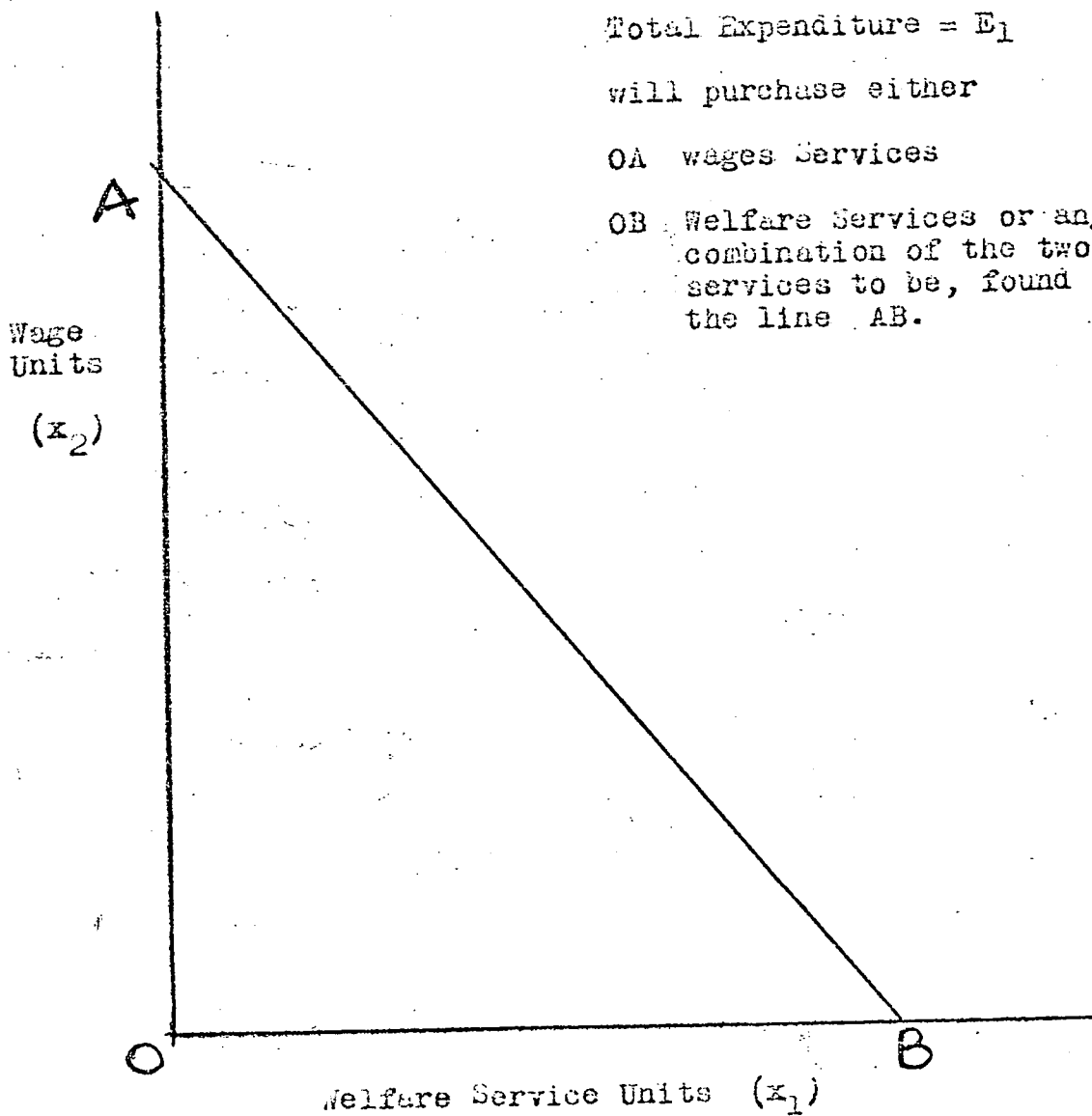
$$\text{Firm B } \frac{1380}{115} = 12.0$$

we see that the relative magnitude of the difference stands out and enables us to come to the correct conclusion.*

So far we have only considered the magnitude of the expenditure on Capital Cost and Worker Maintenance, and not the distribution of that expenditure amongst the various components of the two costs. Perhaps in the case of Capital Cost there is very little to be said regarding such distribution. It is assumed that the cost of training, and induction are to a very large extent determined by institutional factors and cannot easily be varied at the will of the firm, whilst the amount of scrap which can be directly attributed to the worker during the training period is not amenable to direct influence. In the case of Worker Maintenance expenditure however, it is theoretically possible for the firm to make marginal adjustments in the various services it provides, and in wages, in an infinite variety of ways. Has this

* See also Appendix C. 132.

GRAPH I



Total Expenditure = E_1

will purchase either

OA wages Services

OB Welfare Services or any combination of the two services to be, found on the line AB.

possibility of choosing many different combinations at any given level of expenditure any significance for our purposes ?

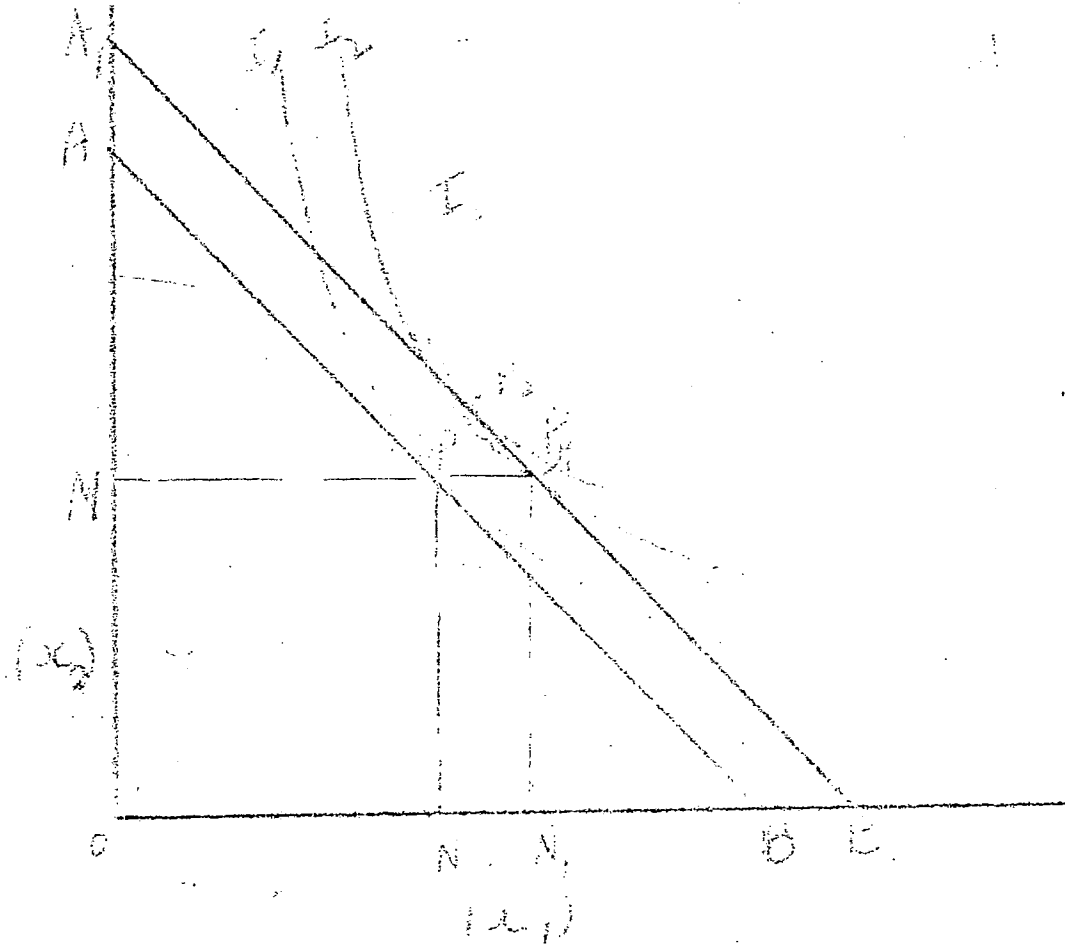
Assume that a firm is spending a certain sum per unit of time, on Worker Maintenance. In whatever way this expenditure is distributed amongst the various objects of expenditure it is suggested that a marginal increase in the expenditure on any one of these objects, would, ceteris paribus, either have no effect at all upon the worker's satisfaction with his job, or would increase that satisfaction. In addition, of the many combinations at a given level of expenditure, one, or more will be superior in satisfaction yielding quality to the rest.

We postulate two categories of Worker Maintenance expenditure - say on Wages and on Welfare services both of which can be divided into homogeneous units. The total expenditure E_1 may be distributed in any way between these two components. On the graph wages are measured on the vertical scale and welfare services on the horizontal scale, the unit wage being E_1/OA and the unit cost of welfare services being E_1/OB . See Graph I.

The line AB is the locus of all the combinations of Wage and Welfare service expenditure totalling to E_1 .

On the same graph we may draw a series of Indifference curves giving the various combinations of wages and

GRAPH V



On the increase of expenditure on welfare services a position on I_2 is reached.

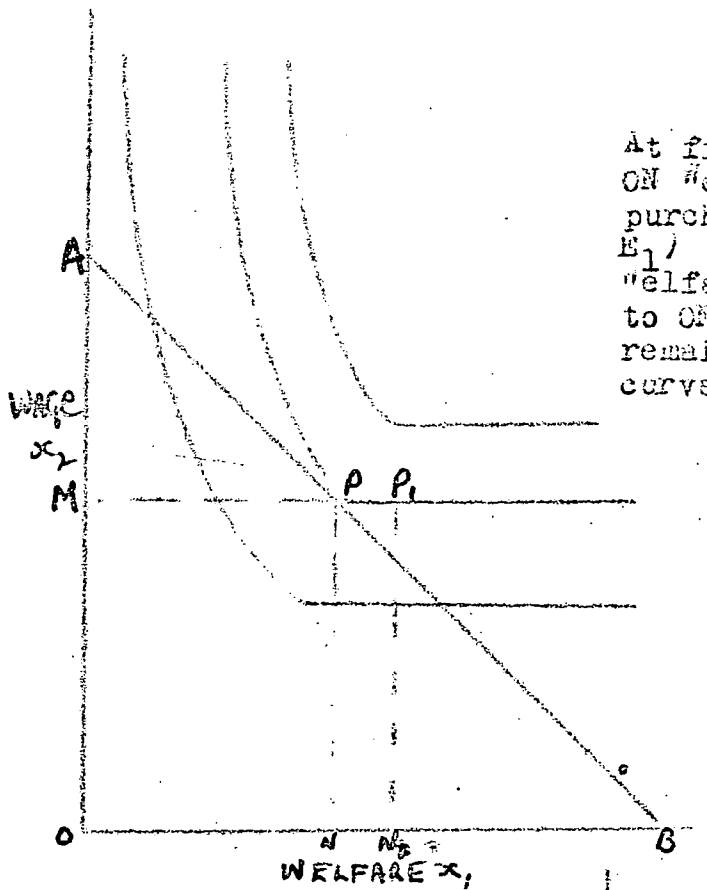
This position indicates a certain level of expenditure (E_2)

All combinations of Wage and Welfare Service expenditure costing E_2 are on line A_1B_1

(Parallel to AB and passing through)

However a redistribution of the expenditure (in this case to the proportions given by point P_2) will always reach a higher Indifference curve.

GRAPH III



At first OM Wage units and ON Welfare Service units are purchased (total expenditure E_1) Now expenditure on Welfare Service units increases to ON_1 but as the individual remains on the same indifference curve there is no increase in satisfaction.

Here the increased expenditure on Welfare Services allows the worker to move to a higher indifference curve.

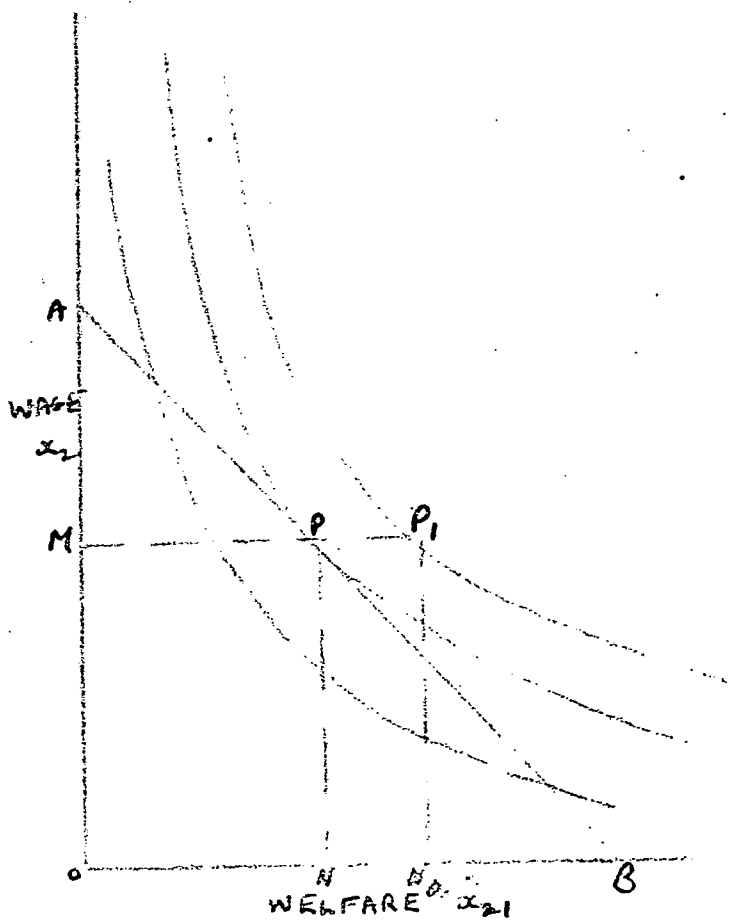
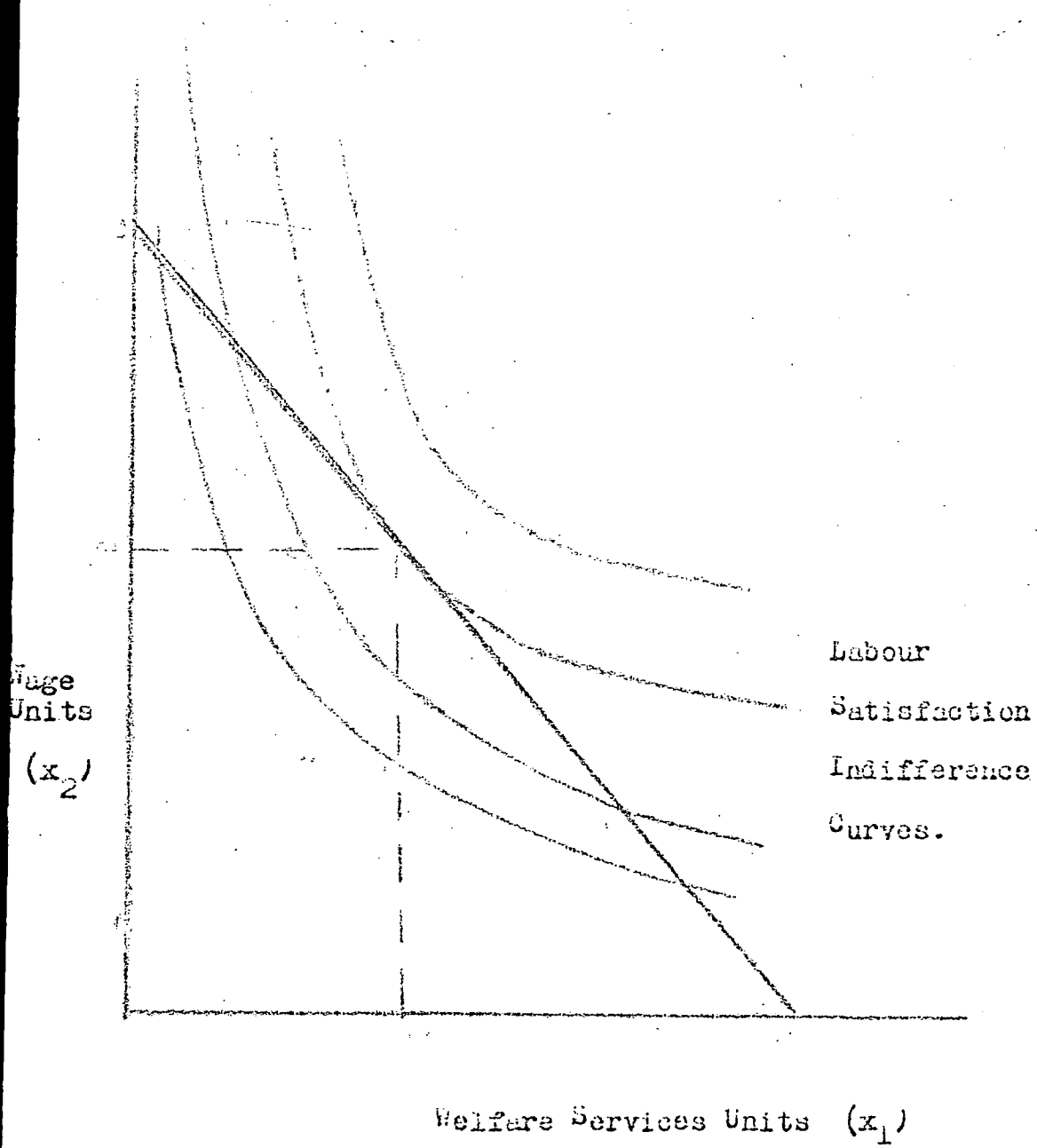


Figure 5
Labour Satisfaction



Welfare services which yield equal satisfaction to the worker. The point of tangency of the line with one of these curves gives the distribution of expenditure which gives the maximum satisfaction for the expenditure E_1 .

Graph 2.

A marginal increase of expenditure on, say welfare services will, as explained earlier either cause no change in satisfaction (Graph 3), or will increase satisfaction (Graph 4) - the more usual case.

Graph 3 & 4.

In either instance a redistribution of expenditure at the new level will be more advantageous than an increase in the expenditure on one only of the two components. (Graph 5)

Graph 5.

The explanations above can be generalised to relate to three or more objects of expenditure without fundamental alteration.

Worker maintenance expenditure, by increasing worker satisfaction, will increase total output, either by increasing the average length of service of the workers or by increasing efficiency for a given length of service. However it is always possible that the increase in total output might be less than the increase

in Worker Maintenance expenditure, if the latter is carried beyond a certain level. The stage at which this occurs will depend upon the ⁽¹⁾ relationship between changes in Worker Maintenance Expenditure and the changes in efficiency and/or length of service achieved and (2.) the effect on Nett output of the changes in efficiency and length of service.

We can define nett output of a group of workers as the market value of the output, less the cost of materials consumed in production, less all current costs (including the costs of Worker maintenance but omitting the depreciation provision on the Capital cost of the worker); and nett return as nett output minus the aforesaid depreciation provision. The two definitions are made because it is useful to use the concept nett output in a later development. For the time being, however, attention will be directed to the nett return as defined above.

Let y = Nett output per unit period. α = normal worker group depreciation provision per unit period (i.e. the sum of each worker's depreciation provision)

w = excess depreciation being the amount of the Capital cost of the workers which has not been written off by the time each worker leaves.

Now if $s =$ Nett return then

$$s = y - w - a. \quad \text{for unit period of time "t"}$$

'a' is constant being determined by the maximum estimated possible length of service of the worker group, but both y and w are functions of the expenditure on Worker Maintenance (v)

$$\text{Therefore } s = f(v) - a - F(v)$$

$$\text{where } y = f(v) \quad \text{and} \quad w = F(v)$$

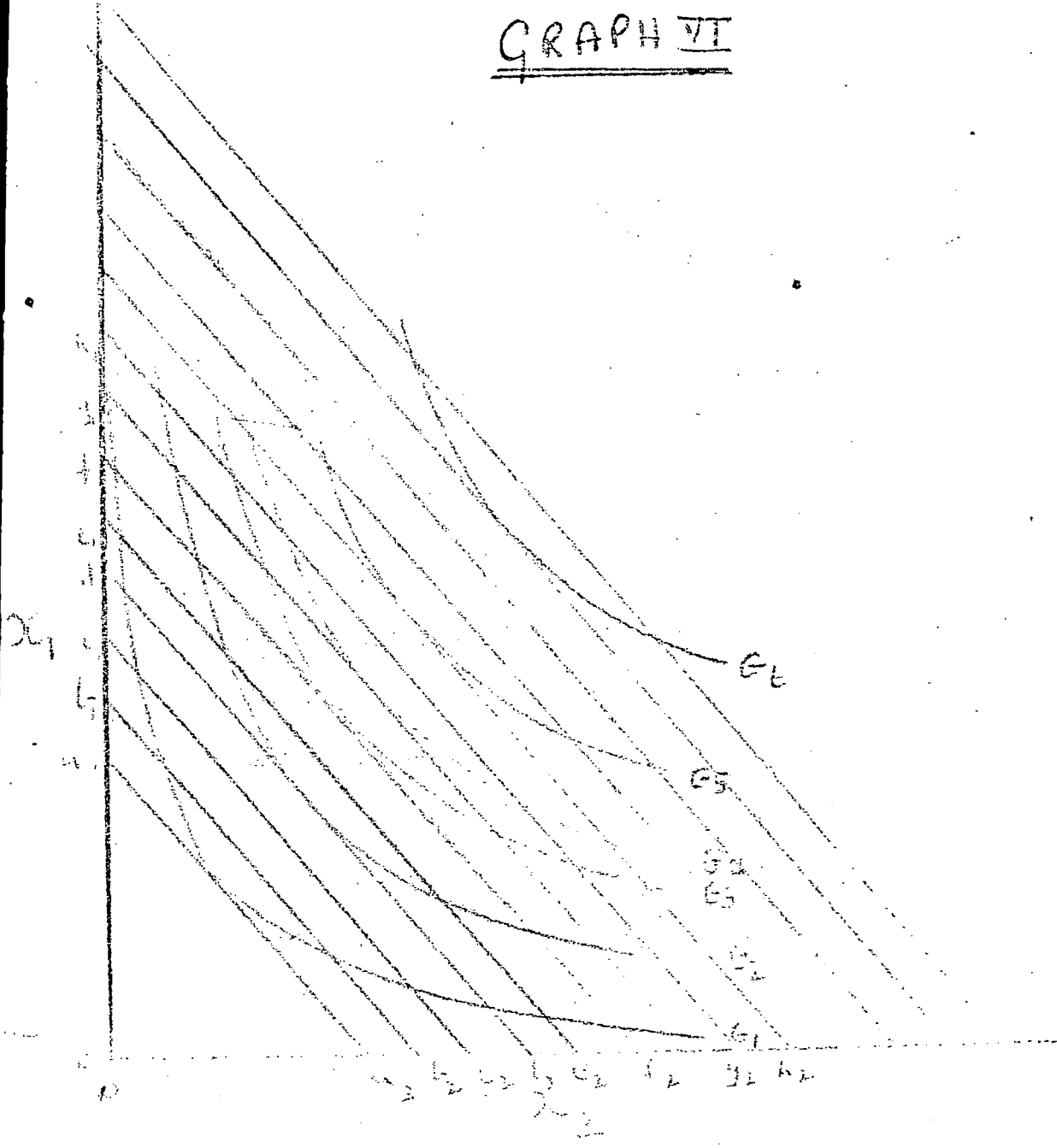
Now for a given value of s the optimum distribution of worker maintenance expenditure v is that which makes;-

$$v = p_1 x_1 + p_2 x_2 + \dots + p_r x_r \text{ a minimum}$$

where p_r is the unit cost of service 'r' and x_r is the number of units of service 'r', where not all x_r are zero.

Now 's' may vary and for each value which 's' may take there will be a minimum 'v'. It seems reasonable to assume that 's' will have a maximum value. If 'v' is zero 'y' will be zero, as no worker will work without recompense, and hence 's' will be negative. If, on the other hand 'y' is allowed to increase indefinitely 'y's' rate of growth will eventually decrease in a manner analogous to that implied by the law of returns to

GRAPH VI



variable proportions of factors - marginal increases in 'v' giving rise to marginal increases in worker satisfaction which less than compensate in terms of output for the increased cost of 'v'.

We now define gross return (z) as nett return plus Worker maintenance expenditure.

i.e.
$$z = s + v$$

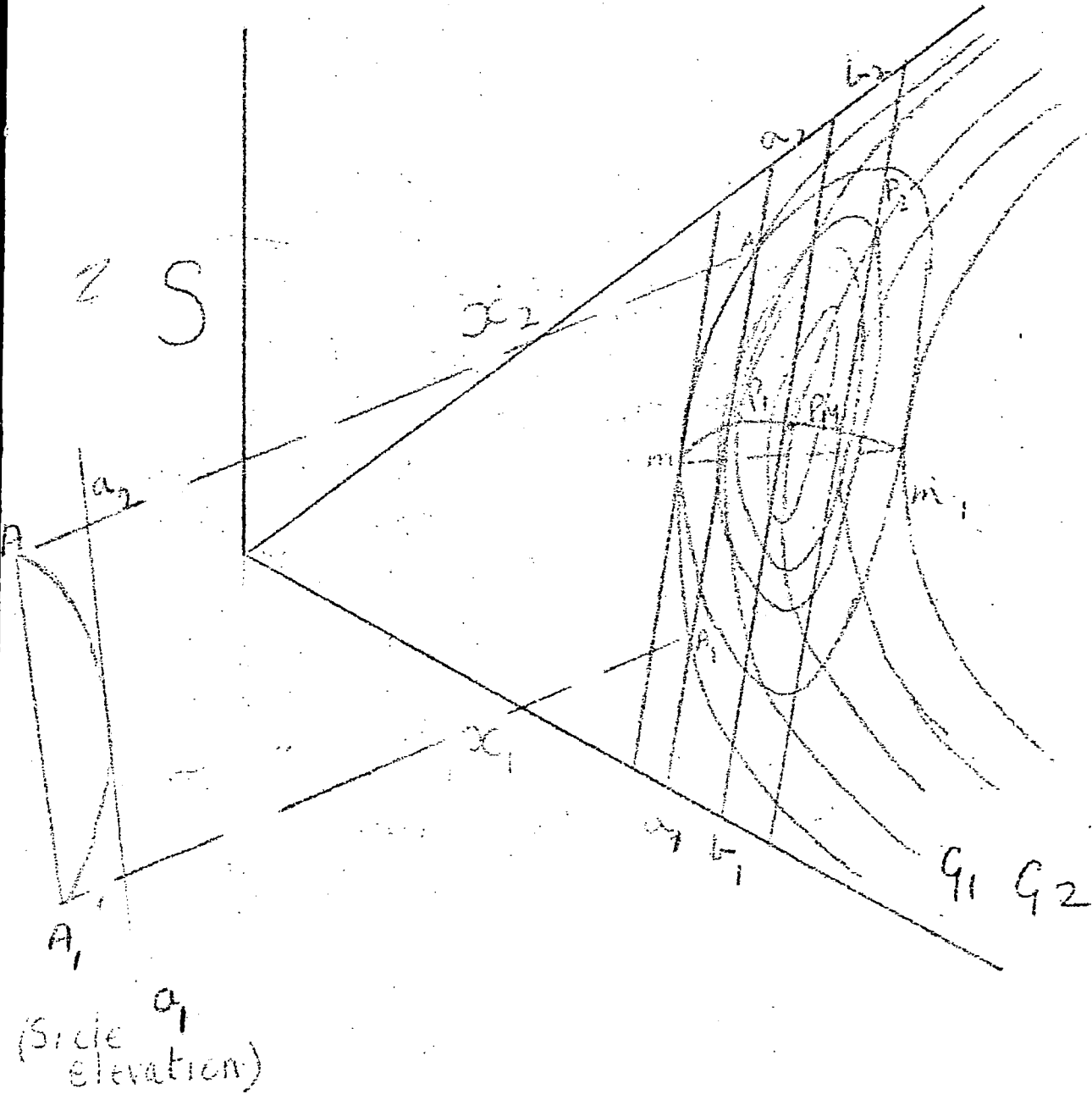
At each level of expenditure (v) there will be an infinite number of values of z and s (assuming continuous variation). Conversely if 'z' is held constant different values of v can be associated with any particular value of z

This can be illustrated clearly from the No. 6 Graph.

a_1 a_2 b_1 b_2 and so on are cost contours giving the various combinations of two worker maintenance services wages and welfare for a given total expenditure V_a, V_b etc. The curves G_1, G_2, G_3, \dots , give these combinations of expenditure on wages (x_1) and welfare (x_2) giving rise to Gross returns, z_1, z_2, z_3 and so on.

where $z_2 - z_1 = z_3 - z_2 = \dots = z_n - z_{(n-1)}$

GRAPH VII



The curves have been drawn so as to indicate increasing Gross returns to expenditure at the optimum level (maximum 's') at first and decreasing returns thereafter. This seems to be in accord with experience in as much as expenditure on worker maintenance beyond a certain point (ceteris paribus) is likely to meet with less and less response from the employees, if only because each worker has an upper limit to his capacity which he will approach with increasing difficulty. Up to that certain point the curves drawn assume increasing Gross returns to worker Maintenance expenditure, although it is possible that the trend may be interspersed with periods of constant or decreasing returns, or that a sinusoidal function may be more suitable (see Appendix B.)

Now, though Gross returns might be expected to increase, though at a decreasing rate towards some limit, Nett Returns will first increase then decrease as marginal expenditure on worker maintenance becomes greater than the marginal increase in Gross returns. This is illustrated in the following 3 - dimensional diagram (Graph 7)

On Graph 7 the cost contours a_1 a_2 b_1 b_2 , can be looked upon as a set of wires which have cut sections out

of a surface which extends above the plane of the gross return curves G_1 G_2 etc. and which reveal boundaries of the newly cut surface $A A_1$ and so on (see side elevation on left of chart 7) The height of the curve $A A_1$ represents various values of 's' the best position being at P_1 a point of double tangency - a_1 a_2 line touching $A A_1$ and also touching a vertical extension of G_1 . This gives a maximum value of 's' for a given value of 'v'. Taking values of 'v' in increasing order we reach the point P_m giving the maximum value of 's' on the curve $m m_1$

All possible values of s (greater than 0) are points on a surface. Where more than two worker maintenance services are involved a graphical illustration cannot be given but the result can easily be expressed in vector notation.

If there are $n - 1$ workers maintenance services any point P in the resulting $n -$ dimensional space ($s = 0$) can be represented by the vector

$$[a_1 \ a_2 \ a_3 \ \dots \ a_{(n-1)}, g]$$

where (1) g may vary between 0 and s (the extreme value)

(2) $a_r = P_r \ x_r$ (in the notation of page 136)

Any point on the surface of such an n-dimensional solid is given by

$$a_1^k, a_2^k, a_3^k, \dots, a_{n-1}^k, s^k$$

and the point of maximum 's' can be represented by

$$a_1^M, a_2^M, a_3^M, \dots, a_{n-1}^M, s^M$$

Now over a period of time T which we may divide arbitrarily into 'm' periods of duration 't' within each of which periods conditions are assumed to be static, there will be 'm' such maximum points of 's'. These points can be represented in matrix form as follows:-

$$\begin{bmatrix} a_1^{M1}, a_2^{M1}, \dots, a_{(n-1)}^{M1}, s^{M1} \\ \dots \\ a_1^{Mm}, a_2^{Mm}, \dots, a_{(n-1)}^{Mm}, s^{Mm} \end{bmatrix} = \left[\begin{array}{c} (Mt) \\ a_r \end{array} \right] S^{(Mt)}$$

where 't' denotes the rows and 'r' the columns

and the success of a firm in choosing the set of points out of a more general set

$$\begin{bmatrix} a_r^{(k1)} & s^{(k1)} \\ \dots & \dots \\ a_r^{(km)} & s^{(km)} \end{bmatrix}$$

where
 $r = (1, 2, \dots, (n-1))$
 $k = (1, 2, \dots, u)$
 $t = (1, 2, \dots, m)$

is a measure of the success of the firm in maintaining its labour force in the most economical manner

The changes in the points P_M over the periods $t_1(1,2,3,\dots m) = T$ will be influenced by the following:-

- a. Changes in the indifference surface of the worker group which might be expected to affect the nett return surface.
- b. Changes in the cost and/or availability of the various components of 'v'
- c. Changes in the productive capacity of the worker.
- d. Changes in the value of the nett return due to changes in the demand for, or supply of the product(s) of the group.

These changes can be summed up under three headings:-

- i. Price changes
- ii. Changes in the characteristics of the Labour force
- iii. Changes in the other factors with which the labour force works, i.e. in the capital equipment, for example.

The influence of price changes is self evident. Anything which changes the relative costs of the factors or products involved is bound to affect the proportions in which they can most economically be combined.

Even if costs remain the same from one period to another however changes in attitude of the members of the work group (which may or may not be due to a change in its composition) or in the efficiency with which its members operate will give rise to a different optimum position.

Finally it must be realised that when we speak of the nett output or the nett return of a group of workers, or the average nett return or output per worker, that output was only achieved with the cooperation of ^{the} capital factor. Different amounts or different types of capital equipment, or raw materials used with a given labour force will most likely result in a change in the level of nett output. Indeed we could easily look at the matter from the opposite angle and refer to so much nett output per unit of capital, placing the labour factor in the background. This is of course one aspect of the fundamental problem - is it possible to measure the productivity of labour, separately from the productivity of capital? So far the answer appears to be no, although a recent article by M.J. Farrell (1957.1) would seem to point the way to a possible answer. Farrell's conclusions are not, however, in a form suitable for use in connection with our particular problem.

To sum up, it is fair to say that the change in nett output which takes place after a change in the level, or in the distribution of expenditure on worker maintenance will be due only in part to the influence of such expenditure, and in part to other changes of the type outlined on the previous page. Moreover, within a given firm we have no hope in a practical situation of holding other things equal whilst we may observe the effect of a particular change, say in wages, upon the stability of the working force.

If we cannot make experiments within firms at a particular time, we can nevertheless, provided sufficient data are available, make comparisons between firms, and by a process of averaging seek to eliminate those influences which we are not at any particular time concerned to measure.

Such comparative studies of firms, with a view to isolating the influence of different levels of worker maintenance expenditure are perfectly practicable. Indeed such studies are absolutely essential for the rational determination of policy. It is, of course, possible that there may be a reluctance upon the part of some firms to make available the necessary information for detailed study, because they fear that their competitors

would be able to steal a march upon them. Even so it should be possible to go some way towards the solution of the problem, so far as public companies are concerned, by using information that is published or that is otherwise easily available.

Worker maintenance expenditure cannot be looked at in isolation from other forms of expenditure - ^{on} capital equipment, or on raw materials, - or from possibilities of changes in organisation. A firm should be in the position to weigh the influences of changes in its level of expenditure (say) on each of these factors, in the light of the experience of the organisations with which comparison is made. It may, in such circumstances appear economically sound, for example, to reduce the level of expenditure on certain forms of worker maintenance, accepting the possibility of a reduced stability or efficiency of the labour force, if increased capital investment is likely to prove particularly advantageous. What the foregoing discussion has attempted to bring out is that worker maintenance expenditure as a concept is useful in enabling a decision to be reached, more useful, for example than if we considered wages alone, or labour wastage cost alone, or absenteeism alone, and so on.

In conclusion it may be remarked that in following a

policy dictated by such comparative studies the firm is only making adjustments which are calculated to bring its policy closer to that of the 'best' firms, and that such changes as it makes are likely to leave it still very far from the optimum point P_m . Of course this is true, but the best firms are constantly making alterations in their structure in order to improve their overall efficiency and they are likely to take advantage of any indications for future policy offered by the developments we have described, and in so doing help to raise the whole industrial structure nearer to the theoretical optimum in any given situation.

APPENDIX A

The example of the calculation of the average depreciation charge is simplified for the purposes of exposition. A more general derivation of the formula used is given below, followed by an example showing the detailed working.

A.) Let the number of workers in employment with the firm at the beginning of the period be

$$\sum_{s=0} \sum_{c=0} f_{cs} = (\text{say}) f$$

where 'c' is the capital cost of the worker and 's' is the estimated expectation of service in unit periods; f_{cs} is therefore the number of workers in employment at the beginning of the period whose capital cost was 'c' and expectation of service was 's'.

Now the depreciation provision per unit period for any worker with capital cost 'c' and expectation of service 's,' is

$$\frac{c}{s}$$

and the total depreciation for

$f_{(cs)}$ workers is

$$\frac{c}{s} f_{(cs)}$$

Therefore the depreciation provision for the whole of the group, in service at the beginning of the period is

$$\sum_{s=0}^{\infty} \sum_{c=0}^{\infty} \frac{c}{s} f_{(cs)} \quad (1)$$

This may be called the normal or basic depreciation charge and is fixed whatever happens to the workers in question during the period.

B.) Let y_{csj} workers (of capital cost c and expectation of service a) enter the firm's employment after a fraction $(1 - j)$ of the period has passed, then the depreciation provision for the period for this group of workers is:-

$$\frac{jc}{s} y_{(csj)}$$

and therefore the depreciation charge for the period for all such workers is:-

$$\sum_j \sum_s \sum_c \frac{jc}{s} y_{csj} \quad (2)$$

C.) Any workers who leave within the period must have the whole of their outstanding capital cost written off. Let x_{cs} be the number of workers leaving during the period irrespective of whether or not they were employed prior

to the beginning of the period) whose capital cost was c , expectation of service s and who would have had $(s - i)$ periods to serve until fully amortised at the end of the period.

Then the excess depreciation charge for the group x_{csi} is

$$\frac{ic}{s} x_{(csi)}$$

and for all the leavers is

$$\sum_{i=0}^{i=s} \sum_{s \in C} \frac{ic}{s} x_{csi} \quad (3)$$

D.) The total depreciation charge in any period is given by

$$\sum_s \sum_c \frac{c}{s} x_{(cs)} + \sum_j \sum_s \sum_c \frac{jc}{s} y_{(csj)} + \sum_{i=0}^{i=s} \sum_{s \in C} \frac{ic}{s} x_{csi}$$

This provides the numerator for the calculation of the average depreciation charge per worker.

If there had been no entrants or leavers during the period the denominator of the expression would be simply

the number of workers employed. However, as in all practical circumstances, there will be both entrants and leavers during the period, who will serve only a fraction of the period, an allowance must be made for this in the denominator.

The denominator is made up of worker units, a worker unit being one worker in employment with the firm for the whole of the period, half a worker unit being one worker in employment for half the period, or two workers in employment for a quarter of the period and so on.

The number of worker units applicable to a particular period is obtained as follows:-

A. The number of workers who serve throughout the period:-

$$\sum_c \sum_s f_{cs} - \sum_{i=0}^{i=(s-D)} \sum_c \sum_s x_{(csi)} \quad (4)$$

where i ranges only from zero to $(s-1)$ i.e. includes only those leavers who would have completed at least one period of service had they served to the end of the given period.

B. Consider y_{csj} (defined on page 147)

Now $\sum_c \sum_s y_{(csj)}$ must equal y_j

i.e. the number of entrants of all c and s , who

joined the firm, when $(1 - j)$ of the period had passed.

Of this group a number of y_{jk} would leave when a fraction k (less than or equal to j) of the period remained. Hence the number of the original group y_j remaining beyond the end of the period is given by:-

$$y_j - \sum_{k=0}^j y_{(jk)}$$

and number of worker units given by this remainder would

$$j \left(y_j - \sum_{k=0}^j y_{(jk)} \right)$$

In addition for each value of k the length of service of the group y_{jk} would be $(j - k)$. Therefore the total number of worker units obtained from the original group y_j becomes:-

$$j \left(y_j - \sum_{k=0}^j y_{(jk)} \right) + \sum_{k=0}^j (j-k) y_{(jk)}$$

Summing for all values of 'j' we obtain the total number of worker units arising out of the entrants during the period as:-

$$\sum_{j=0}^{j=1} \left(j \left[y_j - \sum_{k=0}^j y_{(jk)} \right] + \sum_{k=0}^j (j-k) y_{(jk)} \right) \quad (5)$$

C.) It is easily seen from the above that

$$\sum_{j=0}^{j=1} \left(\sum_{k=0}^k y_{(jk)} \right) = \sum_{i=(s-1).c.s}^{i=s} \sum \sum x_{csi}$$

Hence it only remains to include the number of worker units applicable to the leavers from the group in employment with the firm at the beginning of the period.

An alternative expression for (4) above is :-

$$f - \sum_{k=0}^1 f(k) \quad \text{where } f \text{ is the}$$

total number of workers present when the period began (see A. page 146.) and f_k the number of such workers who leave when a fraction k of the period remains.

Therefore the required number of worker units for these

leavers $(\sum f(k))$ is:-
$$\sum_{k=0}^{k=1} (1-k) f(k) \tag{6}$$

and obviously (by definition)

$$\sum_{k=0}^1 f(k) = \sum_{i=0}^{i=(s-1)} \sum_c \sum_s x_{(csi)}$$

The terms obtained in (1) to (6) above give us the average depreciation charge per worker:-

$$\sum_s \sum_c \frac{c}{s} f_{(cs)} + \sum_j \sum_s \sum_c \frac{jc}{s} y_{(csj)} + \sum_{(i=0)}^{(i=s)} \sum_{s,c} \frac{ic}{s} x_{csi}$$

$$f = \sum_{k=0}^1 f_k + \sum_{k=0}^{k=1} (1-k) f_k + \sum_{j=0}^{j=1} j \left[y_j - \sum_{(k=0)}^j y_{(j,k)} \right] + \sum_{k=0}^{k=j} (j-k) y_{jk}$$

where all workers have a similar capital cost and expectation of service the numerator of the expression is very much simplified and the practical calculations facilitated.

A worked example of the calculation of the Worker depreciation index (as we may call it) is given below:-

Example.

At the beginning of a period a firm has 100 workers,

(a) 40 of which have an estimated expectation of

service of 10 periods and a capital cost of £200.;

(b) the remaining 60 have an estimated expectation of service of 5 periods and a capital cost of \$150.

1. During the period the following workers entered

Entering in interval.			a.	b.
	1 - j	j	c = 200 s = 10 No. of workers.	c = 150 s = 5 No. of workers
0 and under $\frac{1}{4}$ period			2	4
$\frac{1}{4}$ " " $\frac{1}{2}$ "			2	3
$\frac{1}{2}$ " " $\frac{3}{4}$ "			-	2
$\frac{3}{4}$ " " 1 "			1	1

2. The following left from the original group

Leaving after serving in this period.	k	1 - k	No. of periods to serve at end of present one (1) under				
			2	u4	u6	u8	u10
0 and under $\frac{1}{4}$ period			2	1	2	-	-
$\frac{1}{4}$ " " $\frac{1}{2}$ "			2	2	-	1	-
$\frac{1}{2}$ " " $\frac{3}{4}$ "			-	2	1	-	-
$\frac{3}{4}$ " " 1 "			1	1	-	-	-

3. The following left from the entrants within the period.

Leaving after serving in this period.	j - k	4 u 4 $\frac{1}{4}$	4 $\frac{1}{2}$ u 4 $\frac{1}{2}$	4 $\frac{3}{4}$ u 4 $\frac{3}{4}$	4 $\frac{3}{2}$ u5	9 u 9 $\frac{1}{4}$	9 $\frac{1}{2}$ u 9 $\frac{1}{2}$	9 $\frac{3}{4}$ u 9 $\frac{3}{4}$	9 $\frac{3}{2}$ u 10.
0 u $\frac{1}{4}$ period				2					1
$\frac{1}{4}$ u $\frac{1}{2}$ "		2							
$\frac{1}{2}$ u $\frac{3}{4}$ "						1			
$\frac{3}{4}$ u 1 "									

Depreciation charge per period for workers in group 'a' is ~~£2~~ and for those in group 'b' it is ~~£30~~

The total depreciation charge is -

1. The basic depreciation charge for existing workers at the commencement of the period.

$$20 \times 40 + 30 \times 60 = 800 + 1800 = \underline{2600.}$$

2. The depreciation charge for the new entrants is:-

$$20 \left(\frac{7}{8} \times 2 \right) + \left(\frac{5}{8} \times 2 \right) + \left(\frac{1}{8} \times 1 \right) + 30 \left(\frac{7}{8} \times 4 \right) =$$

$$\left(\frac{5}{8} \times 3 \right) + \left(\frac{3}{8} \times 2 \right) + \left(\frac{1}{8} \times 1 \right) = \underline{250.}$$

3. The excess depreciation charge on leavers from the original group is:-

$$20 \left[(3 \times 1) + (5 \times 3) + (7 \times 1) \right] + 30 \left[(1 \times 5) + (3 \times 5) \right] = \underline{1100}$$

4. The excess depreciation charge on leavers from the entrants is

$$20 \left(\frac{3}{8} \times 1 \right) + \left(9 \frac{7}{8} \times 1 \right) + 30 \left(4 \frac{5}{8} \times 2 \right) + \left(4 \frac{1}{8} \times 2 \right) = \underline{910}$$

$$\text{Total depreciation charge} = \underline{\underline{\pounds 4860.}}$$

The average number of worker units is obtained below.

1. The number of worker units obtained from the workers remaining throughout the period

$$(60 - 10) + (40 - 5) = 85$$

2. The number of worker units obtained from the leavers from the group of existing workers -

$$\left(\frac{1}{8} \times 5 \right) + \left(\frac{3}{8} \times 5 \right) + \left(\frac{5}{8} \times 3 \right) + \left(\frac{7}{8} \times 2 \right) = 6.125$$

3. The number of worker units obtained from the new entrants who did not leave within the period.

$$\frac{7}{8}(6 - 2) + \frac{5}{8}(5 - 1) + \frac{3}{8}(2 - 2) + \frac{1}{8}(2 - 1) = 6.125$$

4. The number of worker units obtained from the new entrants who left within the period

$$\left(\frac{3}{8} \times 2 \right) + \left(\frac{1}{8} \times 3 \right) + \left(\frac{5}{8} \times 1 \right) = 1.75$$

$$\text{Total number of worker units} = \underline{\underline{99}}$$

The average depreciation per worker unit is -

$$\frac{4860}{99} = \underline{\underline{\pounds 49.9}}$$

A P P E N D I X B

It may be postulated that $f(v) = y$ will be an increasing function of v , the rate of increase at any point being $\gg 0$ but decreasing as v grows larger.

In mathematical terms

i. $f(v_{rt}) \ll f(v_{r+1}, t)$ $0 \leq r \leq \infty$
 $v_r < v_{r+1}$

ii. $\frac{d(f(v_{rt}))}{dv} \gg \frac{d(f(v_{r+1}, t))}{dv}$

$F(v) = w$ on the other hand is likely to be a decreasing positive function of v ; the rate of increase at any point being ≤ 0 but approaching zero as v grows larger i.e. -

i. $F(v_{rt}) \gg F(v_{r+1}, t)$

ii $\frac{d F(v_{rt})}{dv} \ll \frac{d F(v_{r+1}, t)}{dv}$

A P P E N D I X C

In addition to the advantages claimed for this method in the text the following points might be noted.

1. Where we attempt to measure labour wastage cost by the classical methods (Furness 1950.2)(and Manager 1956.2) we confine our attention to costs which arise out of employees leaving, and (in some cases) their replacements. Costs which occur in the absence of leavers, e.g., the basic depreciation charge (expression 1 on page 147) are ignored. In other words the usual method of estimating the cost of labour wastage is to add up all the 'extra' costs incurred, in as far as they can be assessed. Quite apart from the conceptual error involved this gives rise to difficulties when it is desired to make comparisons of labour wastage cost in two or more situations. For this purpose an average is required (there is no sense in saying that labour wastage cost in Firm A is x pounds and in Firm B. it is y pounds if the sizes of the firms are widely different) but in the classical method no unequivocal decision as to how to calculate the average can be taken. $\frac{1}{2}$ Shall we divide the total cost by the average number of workers employed, by the value of output, by the volume

of production, by the number of leavers, or what? All these denominators have been suggested and cogent reasons can be given for all of them, and probably the list is not exhaustive. If such a vague concept as the cost of labour wastage is employed we can expect our results to be vague also. Contrast this with the twin concepts of Worker depreciation charge, and Worker Maintenance. Both are rigorously defined, and both cover the relevant costs for the whole of the working force. The average used would seem to be a 'Natural' one and offers little scope for ambiguity.

2. For a given number of leavers the effect on the index advocated here is the greater, the smaller the size of the labour force. This is not necessarily the case with the classical method. In as much as the larger the labour force the less important any given amount of wastage is likely to be such a relationship would seem to be satisfactory.

CHAPTER SEVEN

ECONOMIC LABOUR WASTAGE AND ITS MEASUREMENT

At any given time there will be areas of the country in which the productivity of labour is higher than in other areas; and industries in which labour productivity is greater than in others, whilst within a particular industry there will be differences in labour productivity from one firm to another. Under dynamic conditions where hindrances exist to the mobility of labour such differences never vanish, but we may, nevertheless, expect to reduce them in the measure than we can encourage such desirable mobility. Mobility of Labour in the direction of decreasing productivity is just as obviously undesirable for the economy as a whole. It does not mean, however, that the individual firm will benefit by a movement of some of its workers to firms where marginal productivity is higher, nor that it must lose if it increases its labour force if its marginal productivity is already relatively low. Thus the interests of a particular firm may be in opposition to those of the industry of which it is a member, and to those of the community as a whole. Much of the movement which a firm designates as Labour Wastage - and considers to be an economic loss - may indeed

represent an economic gain from the point of view of the broader group of which the firm is a part. On the other hand, doubtless much of the movement of labour, consists of the transfer from one firm to another either irrespective of, or in direct opposition to that which would be dictated by the increasing productivity principle. This latter is true Labour wastage in the economic sense, but so also is the retention by a firm of workers whose productivity would be increased if they were to move elsewhere.

In as much as measures of labour wastage have been considered hitherto from the viewpoint of the individual firm we have not made any attempt to establish a measure of Economic Labour wastage looked at from the point of view of the community. It is possible that by analysing the problem from the worker standpoint i.e., the job histories or individual workers, we could develop a measure which could give us information on one of the components of economic labour wastage. The other component - retention of workers who could be more economically employed elsewhere - is not so easily assessed. We need to know the marginal productivity of labour in the firm where the worker is at present, and that in the firm to which he transfers. As a first approximation it would probably be legitimate to assume that over a fairly

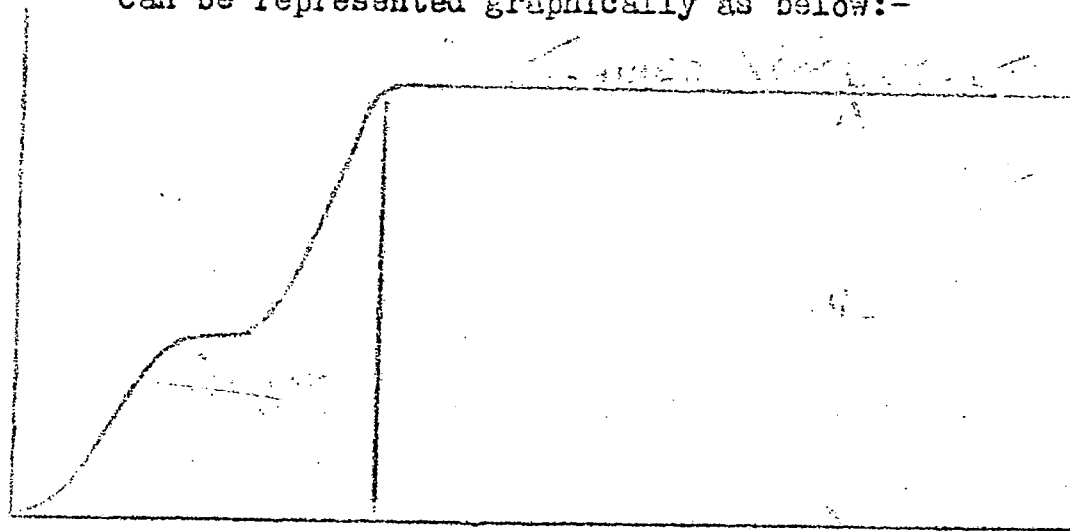
wide range the marginal productivity would be constant in both firms, so that the transfer would not appreciably change that factor in the first firm nor in the second one. Such a simple approach will not, unfortunately, suffice because, it does not take into account the costs of training, induction, etc., (the Capital Cost of Labour) nor the possible loss of output in one firm or the other whilst replacements are being made. The following analysis is developed in order to clarify these conditions and to indicate a method of approach to the problem.

The main assumptions we make are as under:-

1. A worker reaches a given nett output per unit time after completion of his training period and this remains constant apart from random fluctuations which will be ignored.
2. A worker can be taken to have a maximum possible length of service which is the same for all firms.
3. The nett output in the training period is either zero or is treated as a deduction from the Capital Cost of the worker.
4. No worker leaves before his training period is completed.

The nett output of a worker with a particular firm can

can be represented graphically as below:-



$$i) \text{ Let } D - \int_0^{t_0} y \cdot dt = C$$

where D = Capital cost of the worker

C = Nett Capital cost of the worker after the deduction of training nett output.

y = nett output per unit period.

t = time.

ii) Let t_0 = length of training period

$\therefore y_a \cdot t_0$ = loss of nett output during training.

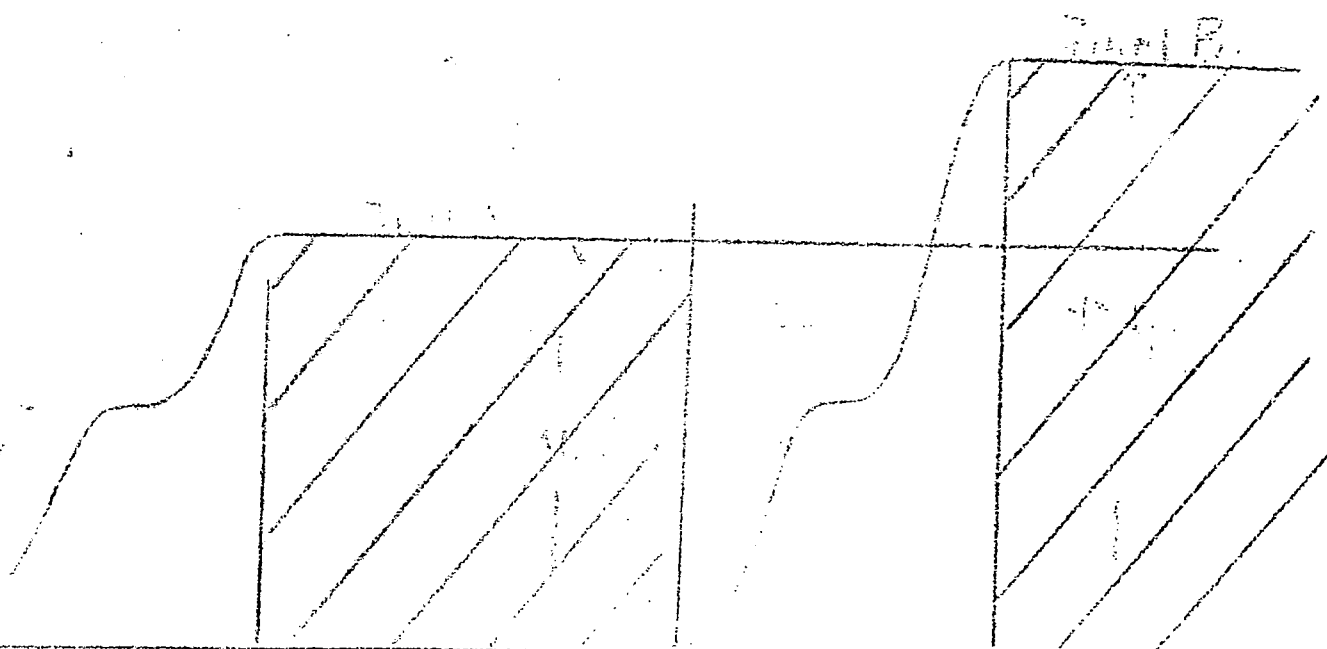
Total nett output of worker to time (where $y = y_a$)

$$t_1 \text{ is } \int_{t_0}^{t_1} y \cdot dt = \int_{t_0}^{t_1} y_a \cdot dt = \left[y_a t = y_a \cdot t_1 - y_a t_0 \right]$$

iii) Let t_M be the maximum length of service which the worker can reasonably be expected to attain.

As C = Nett Capital Cost, a straight line depreciation provision would necessitate writing off $\frac{C}{t_M - t_0}$ during each unit period of service after training.

Now let us assume that the worker leaves the firm (A) after a period of service t_1 to join firm (B). Let it further be assumed that on entry to firm B he has to be trained for a period equal to ' t_0 ' at a Nett Capital Cost of C . The worker's fully trained nett output at Firm B. is $r \cdot y_a$ where $r > 1$.



The foregoing graph illustrates the position, the shaded area indicating the nett output of the worker, excluding (D - C).

Let us suppose that Firm A can replace its lost worker at once. The extra loss in nett output to Firm A will be:-

$$\int_{t_1}^{t_2} y \cdot dt = \int_{t_1}^{t_2} y_a \cdot t = y_a (t_2 - t_1) = y_a \cdot t_0$$

because $t_2 - t_1 = t_0$

In addition by time t_1 only $\frac{C(t_1 - t_0)}{t_M - t_0}$ of the Capital

Cost of the original worker will have been written off. Hence there will remain an amount of Capital Expenditure on the worker

$$C - \frac{C(t_1 - t_0)}{(t_M - t_0)} \quad \text{which represents a loss.}$$

Therefore the total loss to firm A will be

$$y_a \cdot t_0 + C - \frac{C(t_1 - t_0)}{t_M - t_0}$$

At firm B the Capital Cost of the new entrant is 'C' whilst his nett output to time ' t_3 ' will be -

$$\int_{t_2}^{t_3} r \cdot y_a \cdot dt$$

for a length of service ' $t_1 - t_0$ ' = (say) ' t '

And nett output is therefore $(t - t_0) r \cdot y_a$

where ' t ' may take any value from 1 to t_M .

The nett output yielded at Firm B in excess of what would have arisen at Firm A is given by

$$(t - t_0) r \cdot y_a - t \cdot y_a$$

From this excess nett output must be deducted the costs incurred by Firms A and B.

$$\begin{aligned} \therefore G &= (t - t_0) r \cdot y_a - t \cdot y_a - C - y_a t_0 - C + \frac{C(t_1 - t_0)}{t_M - t_0} \\ &= (t - t_0) r \cdot y_a - (t + t_0) y_a - 2C + \frac{C(t_1 - t_0)}{t_M - t_0} \quad \text{Equation 1.} \end{aligned}$$

For the transfer from firm A to firm B to be economic G must be greater than zero.

For $G = 0$ we find

$$\begin{aligned} 0 &= (t - t_0) r \cdot y_a - (t + t_0) y_a - 2C + \frac{C(t_1 - t_0)}{t_M - t_0} \\ &= y_a t (r - 1) - y_a t_0 (r + 1) - 2C + \frac{C(t_1 - t_0)}{t_M - t_0} \quad \text{Equation 2.} \end{aligned}$$

If we take unit period as equal to ' t_0 ' (i.e. $t = 1$) and let $(t_M - t_0)$ be fifty periods we are left with the variables, t_1 , t , y_a and C .

(Note - we have selected a purely arbitrary length of

time for $(t_M - t_0)$ for the purposes of the exposition. The important point to note is that t_M would always be a constant determined in the light of the age and possibly other attributes of the worker in question.

C is the nett capital cost (and y_a is the nett output in Firm A per unit period. Hence we can take either as our unit of value (at constant prices) treating the other as a given constant.

i.e. $\frac{y_a}{C} = K$ Thus if C is taken to equal one value unit $y_a = K$

Now from equation 2.

$$t = \frac{y_a t_0 (r + 1) + 2C - \frac{C(t_1 - t_0)}{t_M - t_0}}{y_a (r - 1)}$$

and therefore substituting K for $\frac{y_a}{C}$ in this equation we have

$$t = \frac{K(r + 1) + 2 - \frac{(t_1 - t_0)}{50}}{K(r - 1)}$$

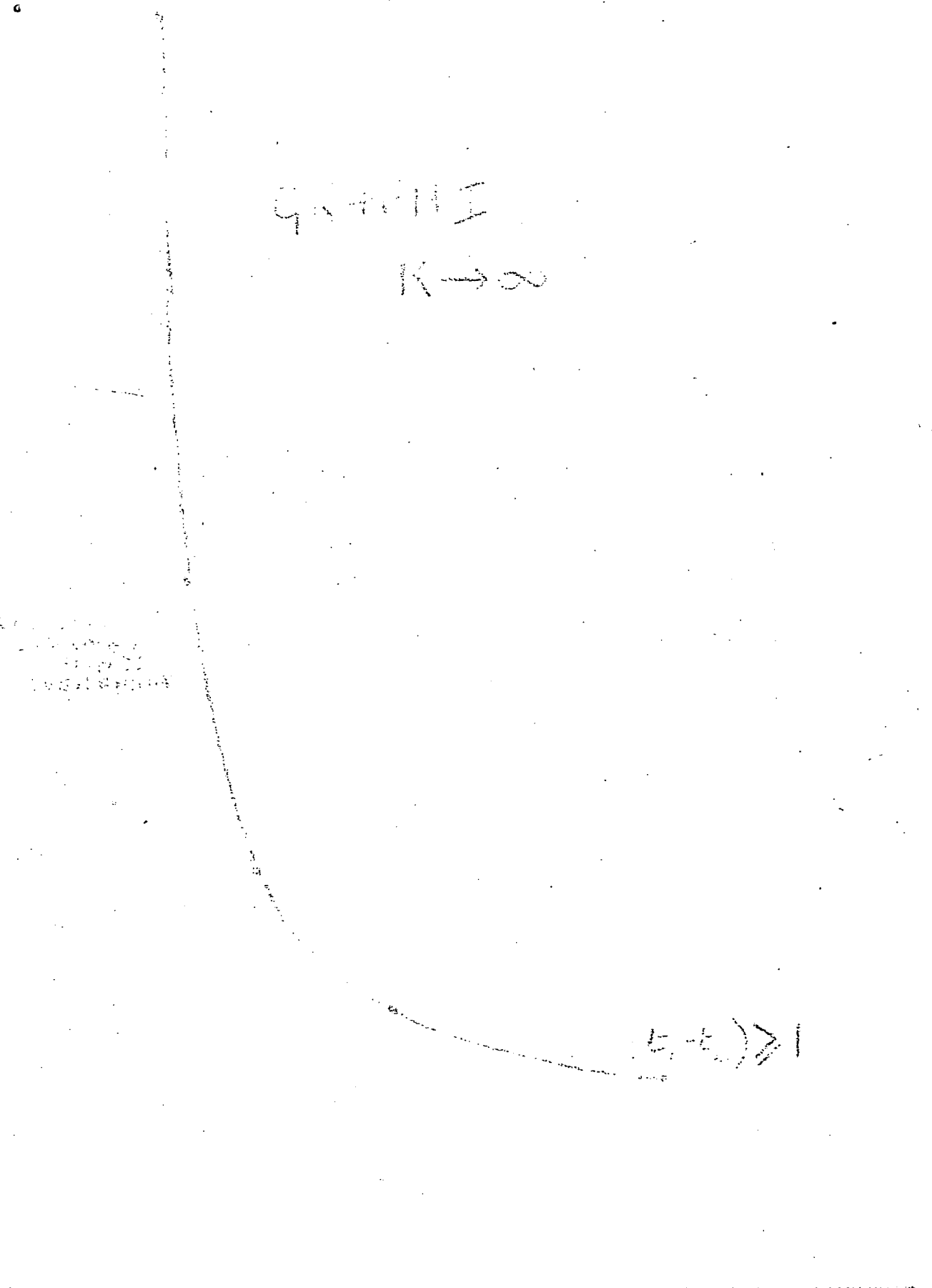
t and r are variables and thus this equation is a rectangular hyperbola, which, put into its more usual form is:-

$$(t - 1)(r - 1) = \frac{2 - \frac{(t_1 - t_0)}{50}}{K} + 2 = \frac{100 - (t_1 - t_0)}{50 K} + 2$$

GRAPH I

$K \rightarrow \infty$

6
5
4
3
2
1



1 2 3 4 5
C = L... ..

We are now in a position to consider the values of 't' and 'r' for different Nett output ratios (K) and for different lengths of service at the primary firm.

Consider first when K is very great and $t_1 - t_0 = 1$

$$\text{Limit}_{K \rightarrow \infty} \frac{100 - 1}{50 K} + 2 = 2 \quad \text{as } y \text{ is finite this implies that } C \text{ is very small.}$$

Hence if training costs are negligible we can expect the conditions under which a transfer would be economically sound to be the co-ordinates of any point within the concave portion of the curve in Graph 1.

e.g. if the efficiency (as measured by the ratios of nett output 'r' of firm B to firm A were 2 the transfer would be beneficial if the worker stayed with firm B for no more than three periods.

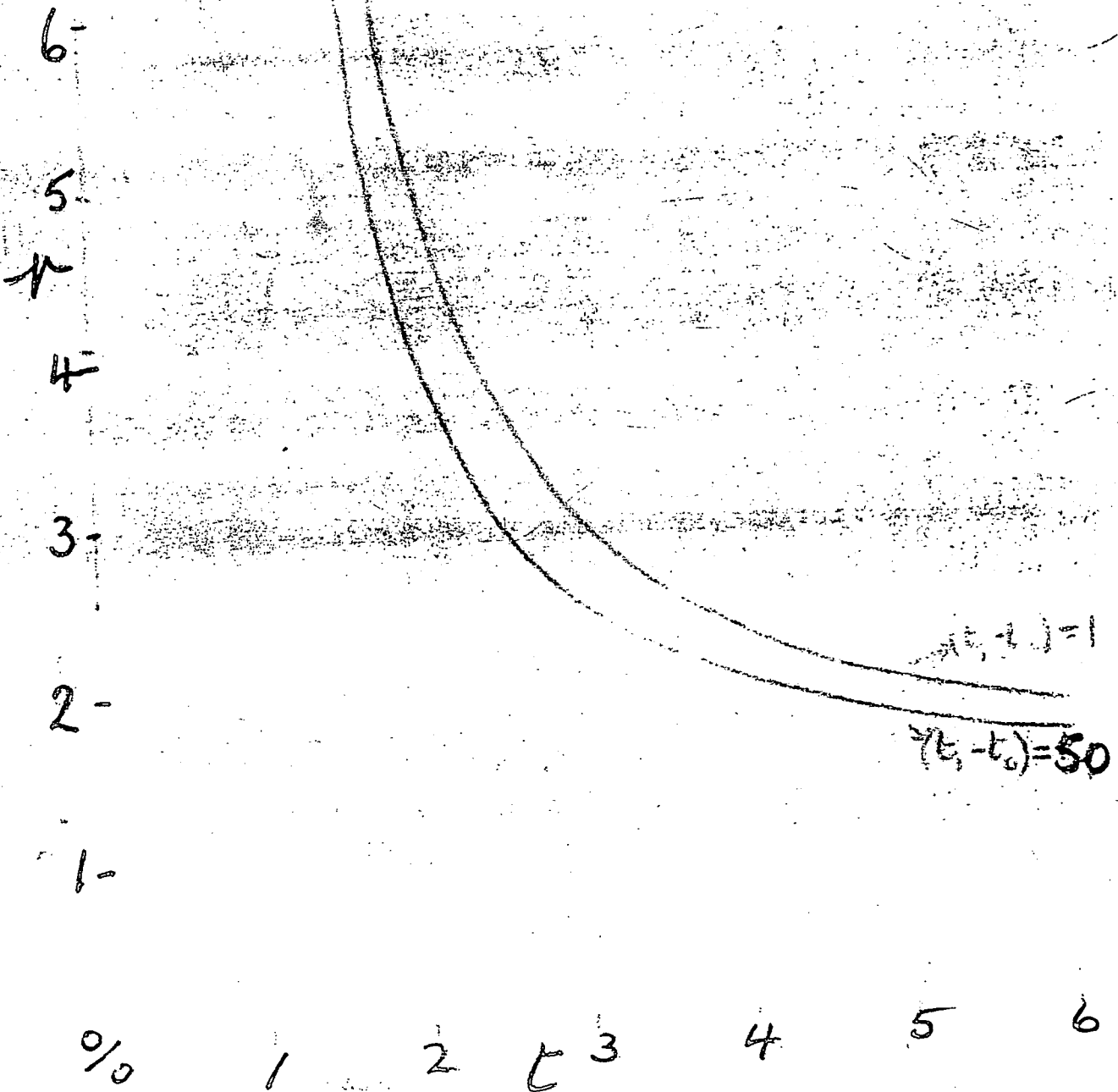
If we now examine the case where the employee had been with Firm A for the maximum length of service - 50 periods after training we see that as

$$\text{Limit}_{K \rightarrow \infty} \frac{100 - 50}{50 K} + 2 = 2$$

the conditions are exactly as before. No matter how long a worker has stayed with the firm A he will still require the same length of service at the second firm at a given level of efficiency for the transfer to be economic. This arises because the depreciation provision tends to zero

GRAPH II

$$K=1$$



when C tends to zero as in this example.

We will now look at the case where $K = 1$,
i.e. $y_a = C$ and both are finite.

$$\therefore (t - 1)(r - 1) = 2 - \frac{(t_1 - t_0)}{50} + 2 = 4 - \frac{(t_1 - t_0)}{50} = \frac{200 - (t_1 - t_0)}{50}$$

For $(t_1 - t_0)$ equals 1 this gives

$$(t - 1)(r - 1) = \underline{3.98}$$

and for $(t_1 - t_0) = 50$

we have $(t - 1)(r - 1) = \underline{3}$

Here the difference between the required length of service at the second firm in the two limiting cases is considerable for low values of 'r'. (3.98 - 3)

We now take the instance where K is very small (C greater than y_a). The minimum value of K can reasonably be assumed to be 0.02 because y_a must be at least equal to

$$\frac{C}{t_M - t_0}$$

in order that a provision for depreciation may be covered over the anticipated length of service

Therefore assuming that $K = 1/50$ we have

$$(t - 1)(r - 1) = 100 - (t_1 - t_0) + 2$$

GRAPH III

$$K = 0.02$$

μ

20

15

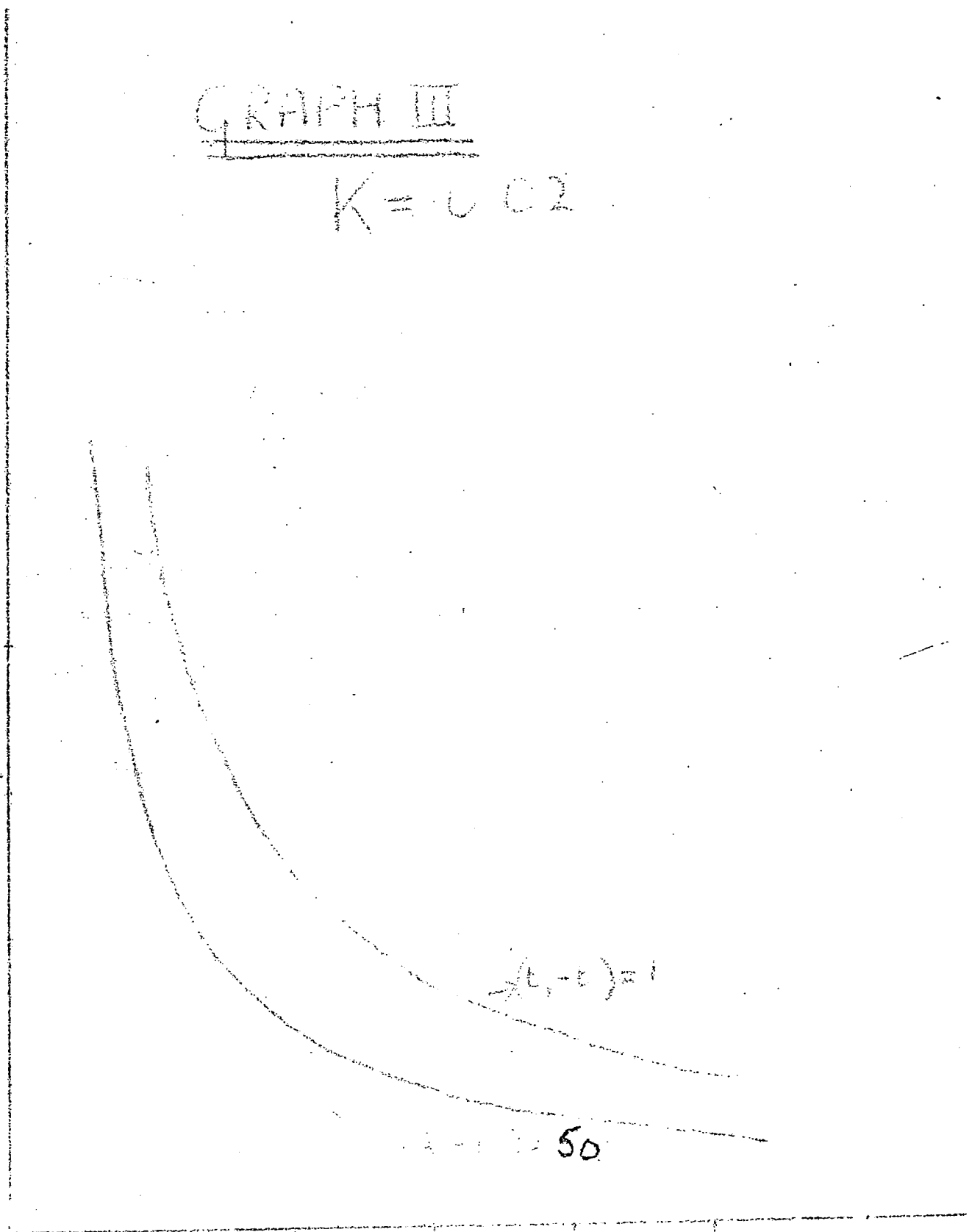
10

5

$$\frac{1}{L_1 - L_2} = 1$$

$$L_1 - L_2 = 50$$

5 10 L 15 20



where $(t_1 - t_0) = 1$

we have $(t - 1)(r - 1) = \underline{101}$

and where $(t_1 - t_0) = 50$

we obtain $(t - 1)(r - 1) = \underline{52}$

From GRAPH 3 it can be seen that the length of service required at the second firm is for all values of 'r' very much greater than in the two previous cases and also that the values of 't' required to satisfy a given value of 'r' are widely different for the two cases just considered.

The illustrations offered indicate that the more expensive the Capital Cost of the worker in relation to his nett output the less likely it becomes that any movement of the worker elsewhere will be economically sound unless the efficiency ratio of the new employment is high/ or a high proportion of the possible service at the original firm has been completed.

It is now proposed to relax some of the unrealistic assumptions made in the foregoing.

The assumptions that equal training periods and equal capital costs are involved at the two firms, will be removed. In so far as a transfer takes place from one firm to another whilst the same general type of occupation is carried on it is likely that both training period and

capital costs will be lower at the second firm. On the other hand if the transfer is to another type of occupation it is unlikely that either training period or capital costs will be the same in both occupations. Moreover different degrees of efficiency from one firm to another will give rise to differences in Capital Costs and training time.

Consider a transfer from firm to firm, the employee remaining in the same broad occupational group

$$\text{where } C_A \geq C_B \quad \text{and} \quad t_0 \geq (t_2 - t_1)$$

$$\text{let } C_A = mC_B \quad \text{and} \quad t_0 = n(t_2 - t_1)$$

$$\text{where } m \geq 1 \quad \text{and} \quad n \geq 1$$

(whether a ratio mC_B rather than a linear form $(C_B + M)$ is the more suitable is a question which we cannot decide without extensive practical investigation. The ratio is adopted here merely because it is easier to handle)

The capital cost to firm B of the worker is C_B

and the nett output at firm B is $(t - \frac{t_0}{n}) r \cdot y_a$

Therefore excess nett output at firm B over firm A is now

$$(t - \frac{t_0}{n}) r \cdot y_a - t y_a$$

From this excess nett output must be deducted (as in equation I) the additional costs incurred by Firms A and B, giving

$$G = \left(t - \frac{t_0}{n}\right) r \cdot y_a - t y_a - C_B - y_a t_0 - m C_B + \frac{m C_B (t_1 - t_0)}{t_M - t_0}$$

$$= y_a t (r - 1) - y_a t_0 \left(\frac{r}{n} + 1\right) - (m + 1) C_B + \frac{m C_B (t_1 - t_0)}{t_M - t_0}$$

Now letting $G = 0$ we have

$$t = \frac{-m C_B (t_1 - t_0)}{t_M - t_0} + \frac{y_a t_0 \left(\frac{r}{n} + 1\right) + (m + 1) C_B}{y_a (r - 1)}$$

If, as before we let ' t_0 ' = 1; $(t_M - t_0) = 50$ and $C_A = m C_B = 1$, we obtain:-

$$(r - 1) t = \frac{y_a \left(\frac{r}{n} + 1\right) + \frac{(m + 1)}{m} - \frac{(t_1 - t_0)}{50}}{y_a}$$

Taking $\frac{y_a}{C_A} = K$ (as before) this gives us

$$(r - 1) t = \left(\frac{r}{n} + 1\right) + \frac{m + 1}{m K} - \frac{(t_1 - t_0)}{50 K}$$

Let us consider first the cases where m is very great, i.e. C_B is very small in comparison with C_A . This would

arise where an employee was trained merely by observing the work of another, during which period the new employee received no pay or when any pay received was less than his net output during that period.

$$\text{Now } \lim_{m \rightarrow \infty} \frac{m+1}{mk} = \lim_{m \rightarrow \infty} \frac{1}{k} + \frac{1}{mk} = \frac{1}{k}$$

Taking n to be unity (i.e. equal lengths of training periods) we have

$$(r-1)t = \frac{-(t_1 - t_0)}{50K} + (r+1) + \frac{1}{K}$$

$$(r-1)(t-1) = \frac{1}{K} - \frac{(t_1 - t_0)}{50K} + 2 = \frac{50 - (t_1 - t_0)}{50K} + 2$$

It can be seen at once that

$$\lim_{K \rightarrow \infty} (r-1)(t-1) = 2$$

as in the case previously discussed (Graph I), and the same remarks apply.

If we now look at the case where $K = 1$ under our relaxed assumptions we obtain

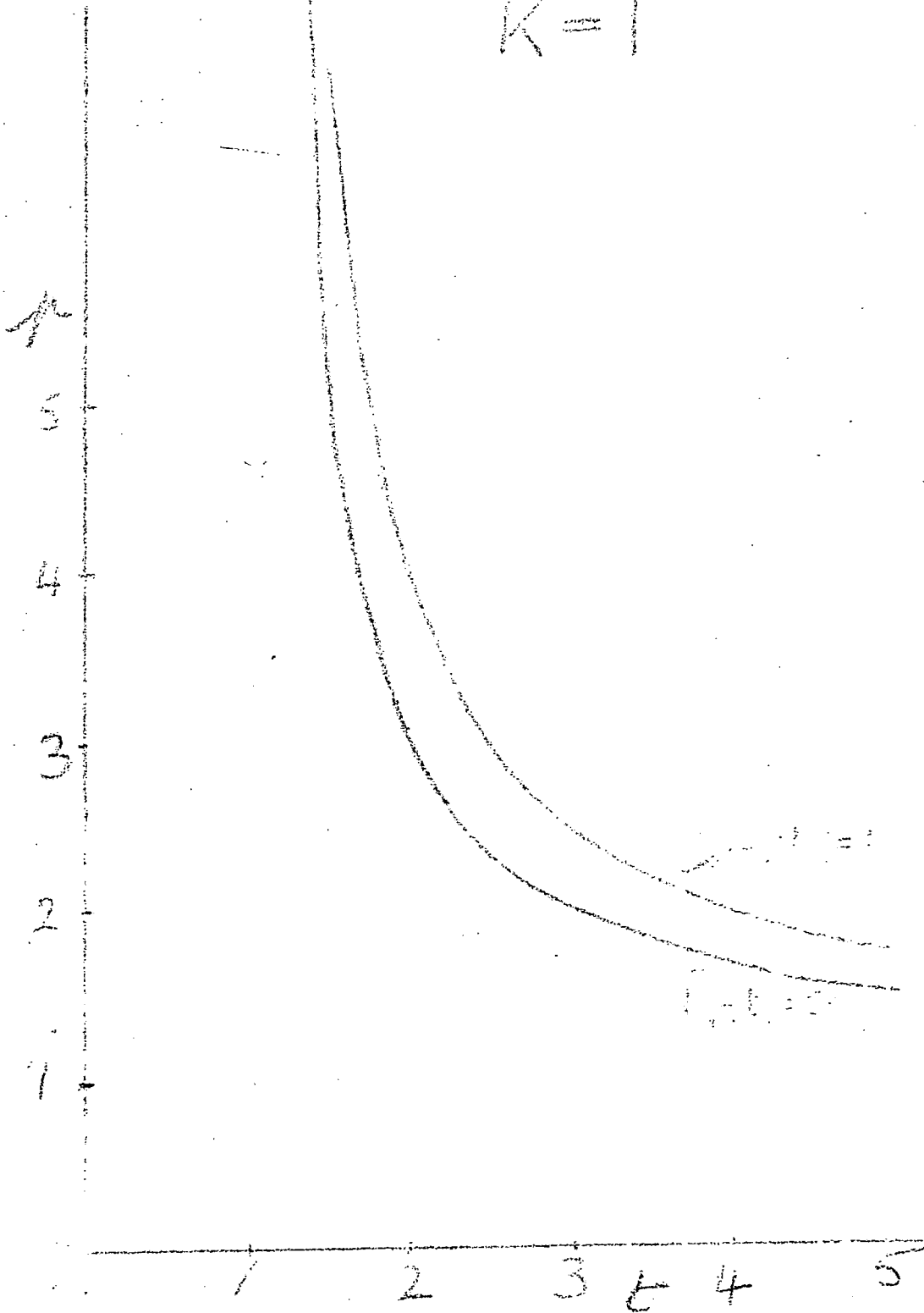
$$(t-1)(r-1) = 1 - \frac{(t_1 - t_0)'}{50} + 2 = 3 - \frac{(t_1 - t_0)'}{50} = \frac{150 - (t_1 - t_0)'}{50}$$

for $(t_1 - t_0)' = 1$ this gives:-

$$(t-1)(r-1) = \frac{150 - 1}{50} = \underline{2.98}$$

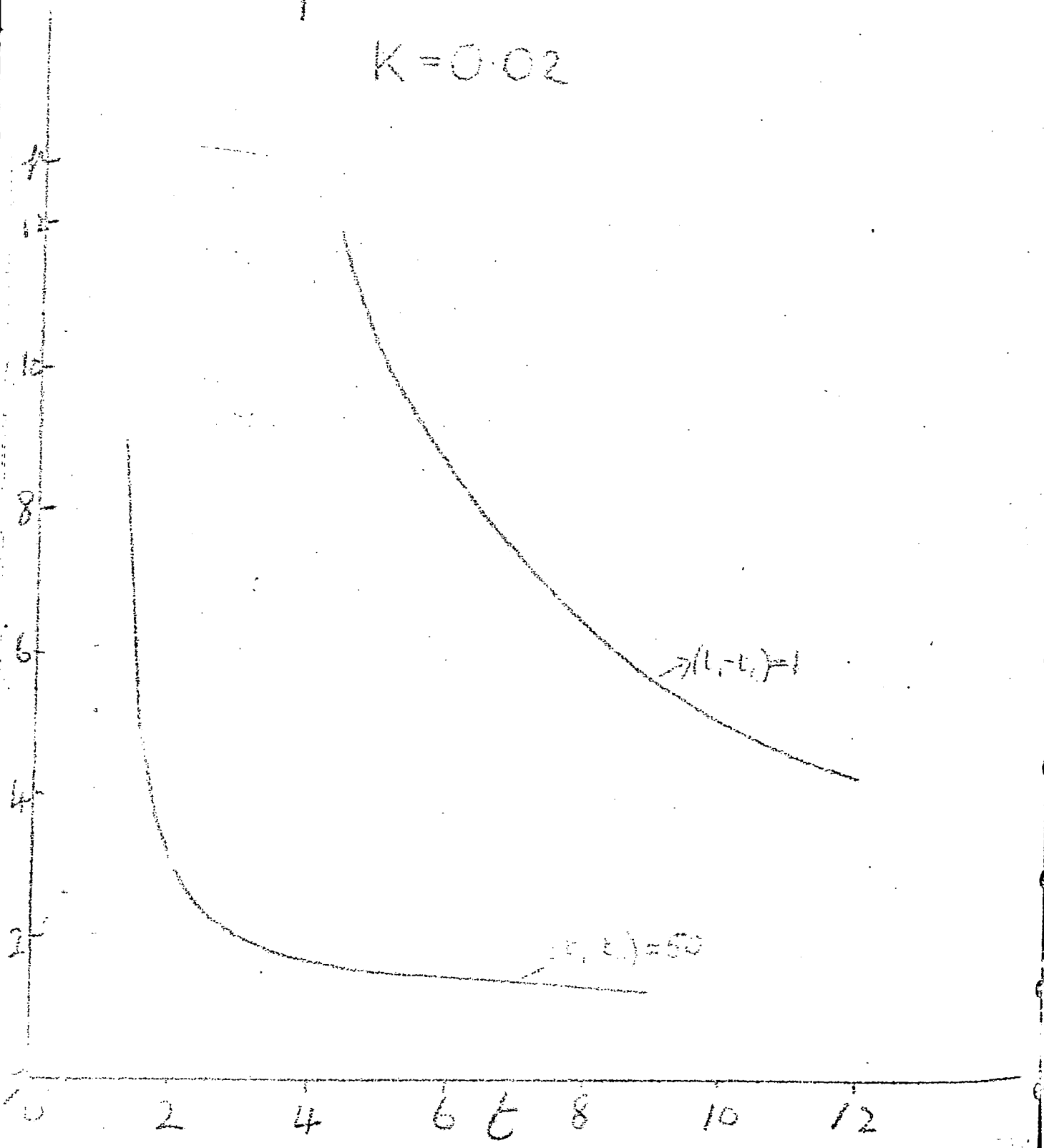
GRAPH IV

$$K=1$$



GRAPH V

$$K = 0.02$$



and for $(t_1 - t_0)' = 50$

we obtain $(t - 1)(r - 1) = \underline{2}$

Comparing GRAPH 4. which illustrates the position above with Graph 2 we find that the relationship between the two extreme periods of service, with Firm A (1 period and 50 periods) and the length of service required at firm B is maintained, but that Firm B's efficiency ratio can be less in the present case than in the one illustrated in Graph 2.

We now allow K to have its minimum value, i.e., 0.02 (the comparable case is illustrated in Graph 3)

Letting $(t_1 - t_0)' = 1$

we have $(t - 1)(r - 1) = 50 - 1 + 2 = 51$

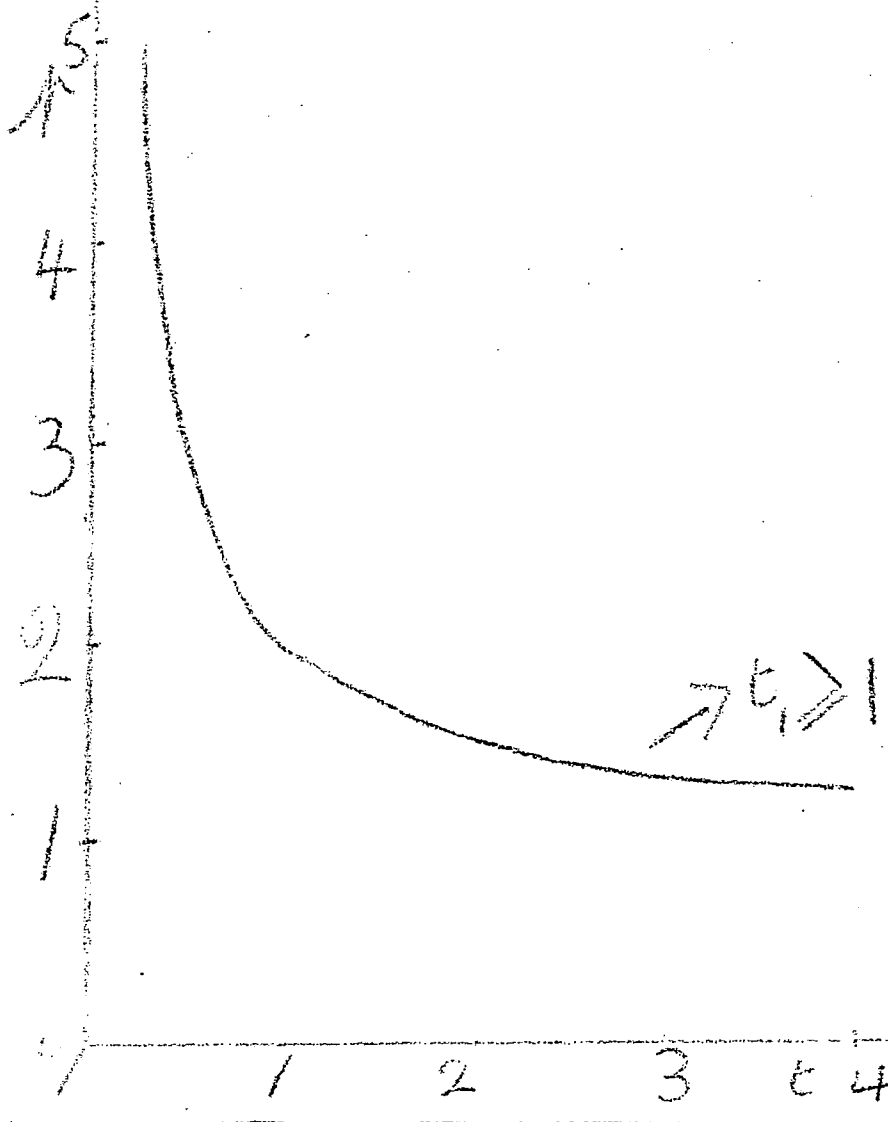
and for $(t_1 - t_0)' = 50$ we obtain $(t - 1)(r - 1) = 2$

The GRAPH 5. shows that the length of services required at the new firm for a given efficiency ratio 'r' is very great, when t_1 is short, unless 'r' is large; but is small when t_1 approaches its maximum value, unless 'r' is very small.

We now allow 'n' to become very great, keeping 'm' constant at each of the levels $n = 1, 2, 3, \dots$ and $m = 1$.

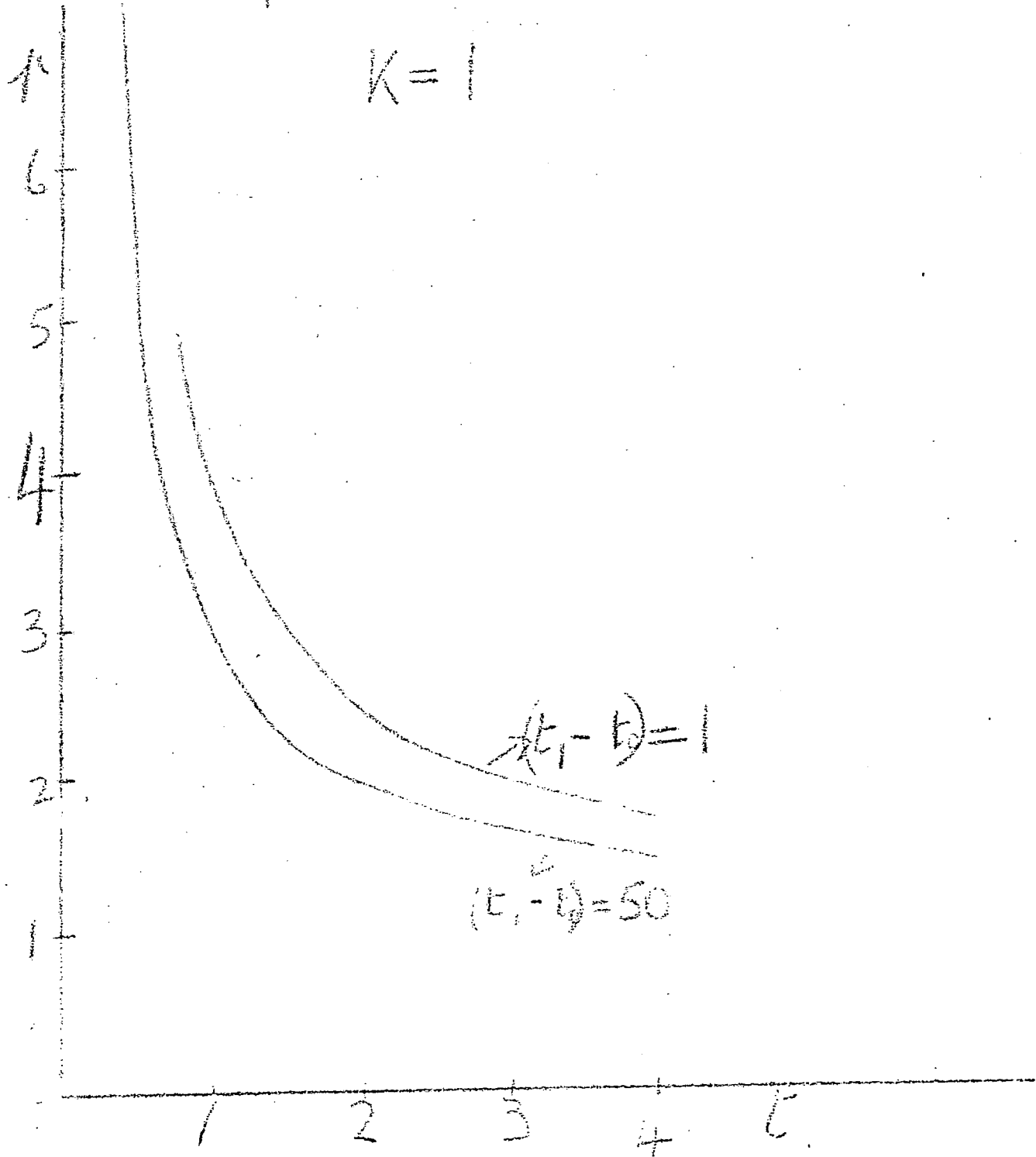
GRAPH VI

$$K \rightarrow \infty$$



GRAPH VII

$$K = 1$$



In this case we get:-

$$(r - 1) t = \left(\frac{r}{n} + 1 \right) - \frac{(t_1 - t_0)}{50 K} + \frac{(m + 1)}{mK}$$

We let $m = 1$; $K \rightarrow \infty$ and $n \rightarrow \infty$

This gives us $(r - 1) t = 1$

The curve in GRAPH 6 is the same for all values of t_1 . Hence where the duration of training at the Firm B is very short, but where the ratio of unit period output to Capital cost at the first firm is very high with Capital costs equal at both firms, the duration of service at Firm A has little relevance for the required length of service at B.

We will now let $m = 1$; $K = 1$ $n \rightarrow \infty$

$$\therefore (r - 1) t = 1 - \frac{(t_1 - t_0)}{50} + 2$$

(i) if $(t_1 - t_0) = 1$ we obtain

$$(r - 1) t = 1 - \frac{1}{50} + 2 = 3 - \frac{1}{50} = \underline{2.98}$$

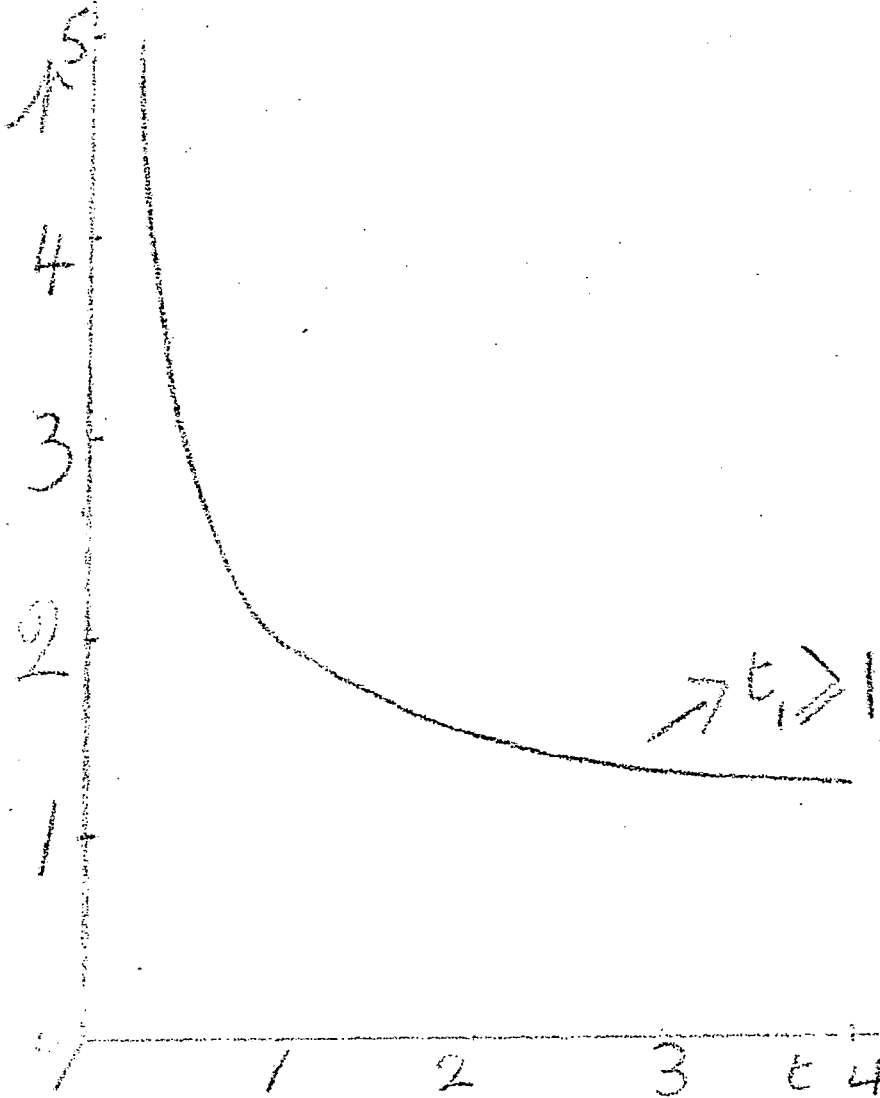
(ii) if $(t_1 - t_0) = 50$ we have

$$(r - 1) t = 1 - 1 + 2 = \underline{2.}$$

The curve obtained in this case (GRAPH 7) is similar to Graph 4. The case is slightly less favourable for transfer than in Graph 6 and the differences in previous

GRAPH VI

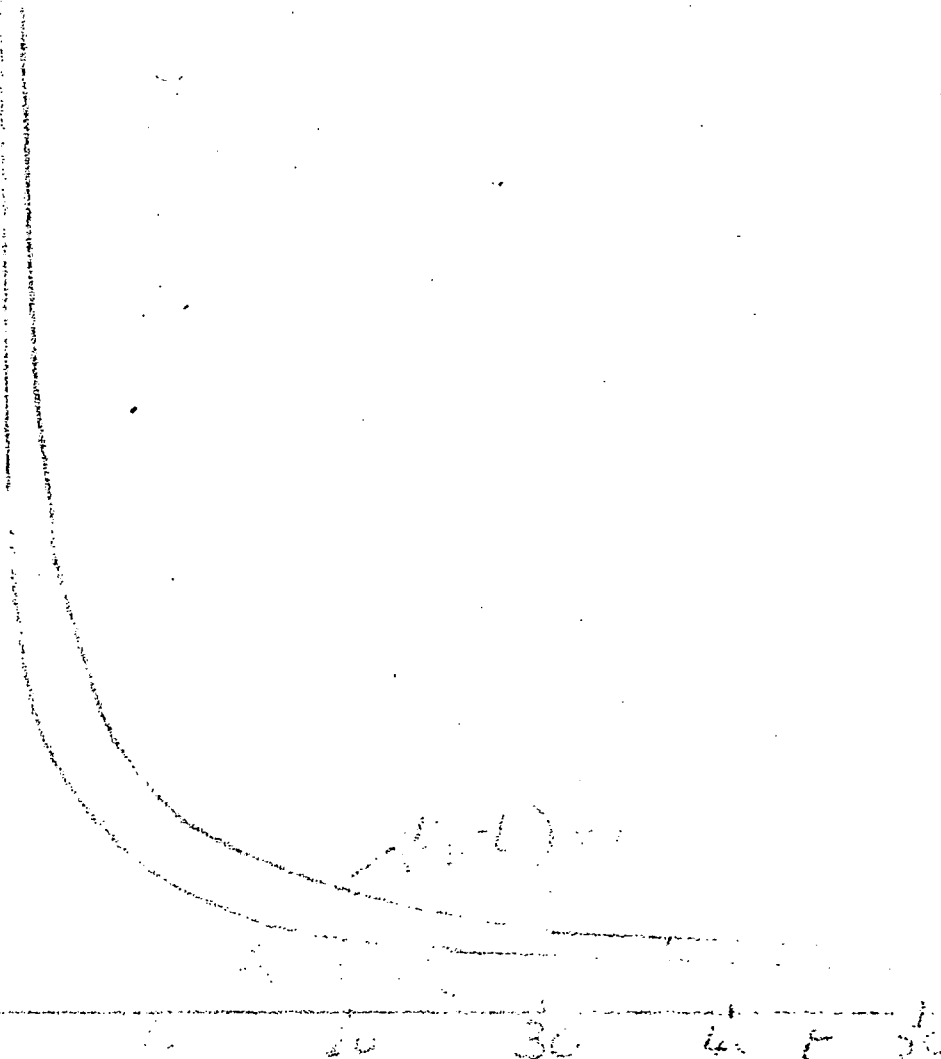
$$K \rightarrow \infty$$



GRAPH VIII

$$K = 0.02$$

70
60
50
40
30
20
10



lengths of service are quite marked.

Making a further alteration to our conditions we allow K to equal 0.02 whilst $m = 1$ and $n \rightarrow \infty$

$$(r - 1) t = 1 - (t_1 - t_0) + \frac{2}{0.02} = 101 - (t_1 - 1)$$

(i) If $(t_1 - t_0) = 1$ we have $(r - 1) t = 100$

and with $(t_1 - t_0) = 50$ we get $(r - 1) t = 1 - 50 + 100 = 51$

Here the difference in lengths of service required at B are as great as on previous occasions when K was equal to 0.02, but the required efficiency (r) at any given length of service is less. (GRAPH 8)

Finally we take the various combinations of the conditions in which $m \rightarrow \infty$

Let $m \rightarrow \infty$; $n \rightarrow \infty$

$$\text{Now } (r - 1) t = 1 - \frac{(t_1 - t_0)}{50 K} + \frac{1}{K}$$

If $K \rightarrow \infty$ we have $(r - 1) t = 1$

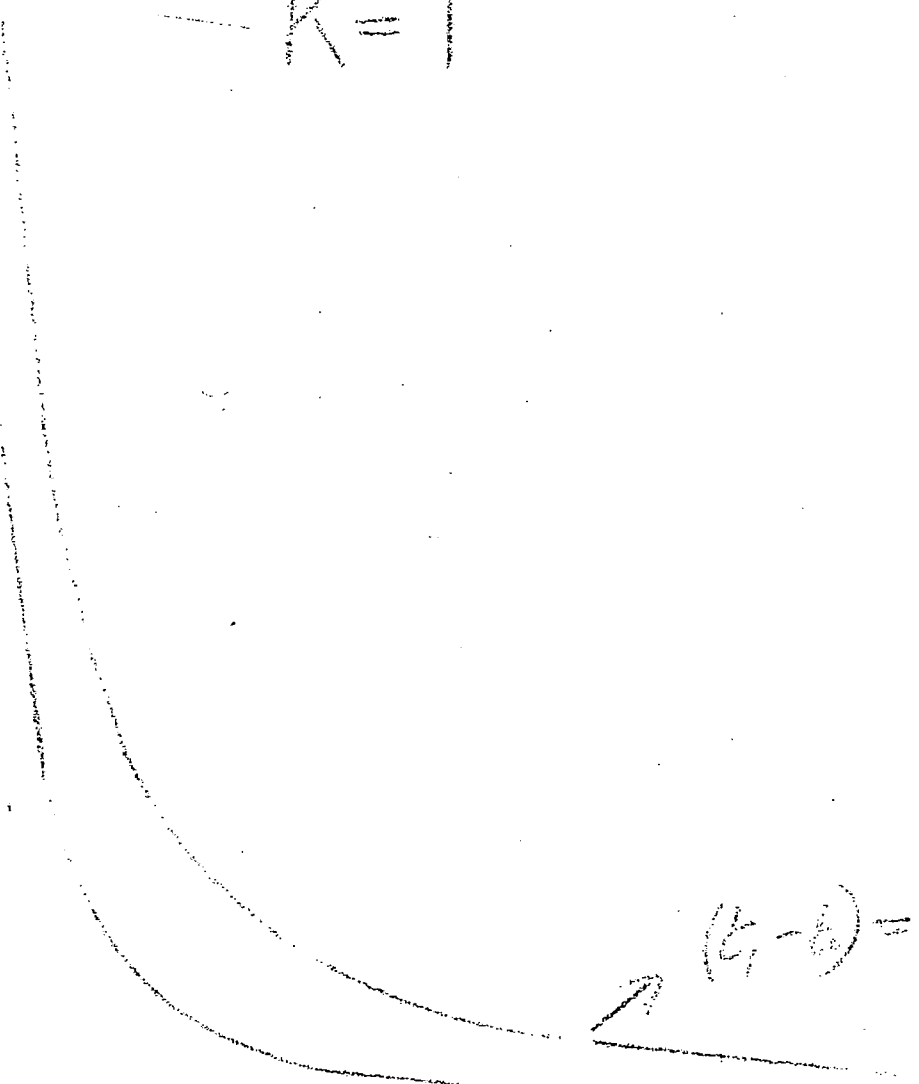
which is exactly the same as the case illustrated in Graph 6.

This is as expected because where the ratio of output to Capital Cost is high changes in Capital cost are of very little importance.

GRAPH IX

$K=1$

A
6
5
4
3
2
1
1 2 3 4 t

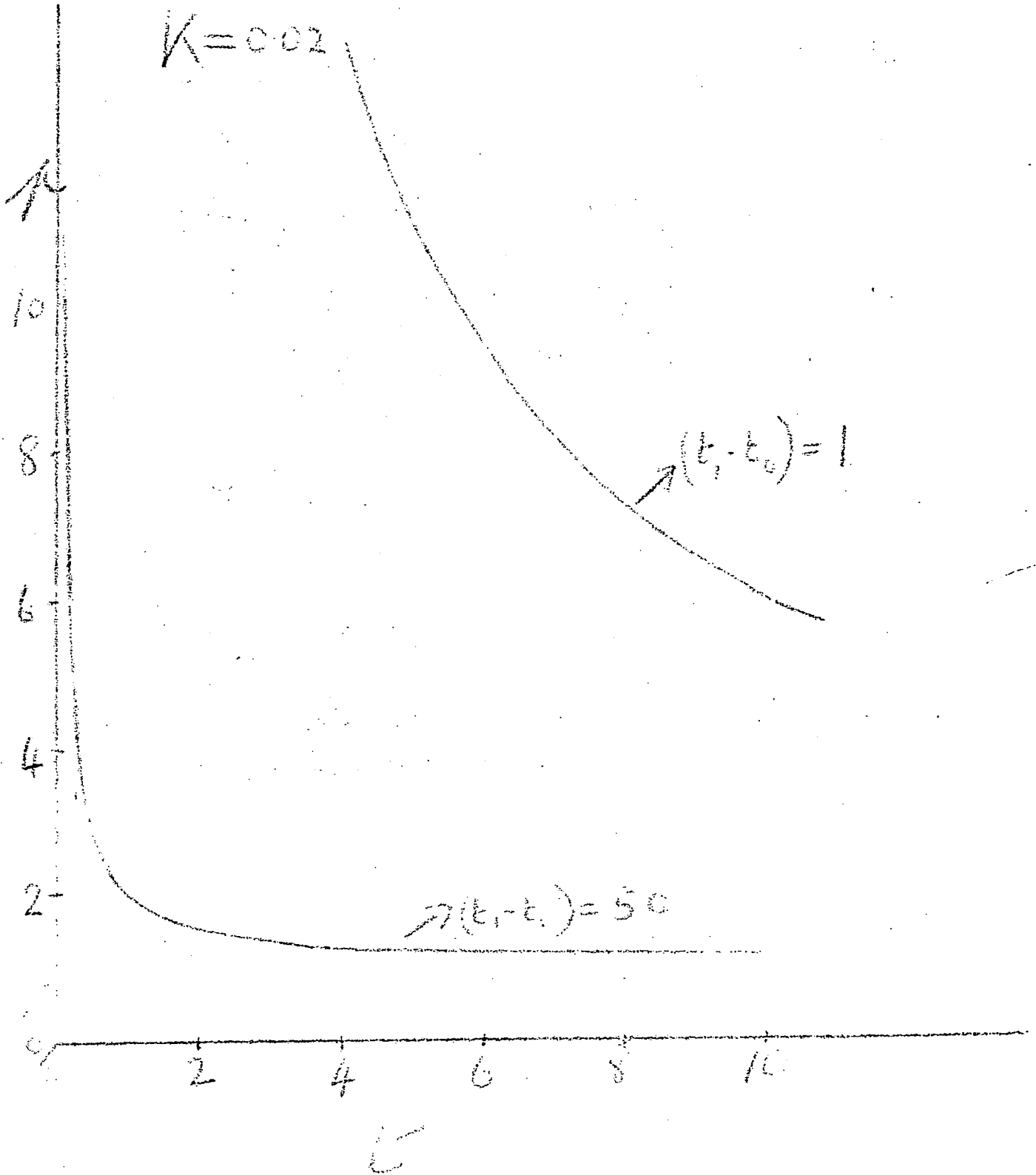


$(t-6)=1$

$(t-1)=5L$

GRAPH X

$$K = 0.02$$



If $K = 1$: $m \rightarrow \infty$ and $n \rightarrow \infty$

$$\text{we have } (r - 1) t = 1 - \frac{(t_1 - t_0)}{50} + 1 = 2 - \frac{(t_1 - t_0)}{50}$$

for $(t_1 - t_0) = 1$ gives (i) $(r - 1) t = \underline{1.98}$.

and for $(t_1 - t_0) = 50$ we obtained (ii) $(r - 1) t = \underline{1}$

Where $K = 1$ the provision for depreciation once again becomes important and the Length of Service required at firm B varies according to the Length of Service ' t_1 ' at firm A. This is illustrated in GRAPH 9.

Where $K = 0.02$: $m \rightarrow \infty$ $n \rightarrow \infty$

$$\text{we have } (r - 1) t = 1 - (t - t_0) + 50$$

$$\text{for } (t_1 - t_0) = 1$$

$$(i) (r - 1) t = \underline{50}$$

$$\text{and for } (t_1 - t_0) = 50 \quad (r - 1) t = \underline{1}$$

In this case the difference for various Lengths of Service at Firm A is great because the depreciation provision is the only major cost involved (GRAPH 10)

The four assumptions which we have made (page 161) can be modified without destroying the validity of the method of approach here adopted.

Instead of assuming constant nett output for the trained worker we could assume that it increased, decreased or

oscillated in any manner, so long as we could express it in some algebraic form. Total nett output of workers to time 't₁' would still be $\int_{t_0}^{t_1} y \cdot dt$ but instead of

$y = y_a$ we should have $y = f(t)$ and hence total nett output of worker at Firm A to time 't₁' would equal

$\int_{t_0}^{t_1} f(t) \cdot dt$ which, of course can be integrated if the form of $f(t)$ is known.

The loss of nett output during the training of a replacement in Firm A will no longer be $y_a t_0$ but will depend upon the actual time at which the worker leaves.

Assuming the worker leaves Firm A at length of service

't₁' the loss to nett output is $\int_{t_1}^{t_2} f(t) \cdot dt$

Similar considerations apply to the determination of the output and costs relevant to Firm B.

The assumption of a maximum possible length of service for all firms is of course, unrealistic. If the employees working life extends over say, t_M periods, then his maximum length of service with Firm B would be (including

any training period with that firm) equal to $(t_M - t_1)$. There is no difficulty in allowing for this although it obviously increases the complexity of the analysis.

Our final assumption of no leavers during the training period can be removed. If the duration of service of a worker leaving prior to the end of training is ' t_1 ' (as before) but this time with $t_1 < t_0$ the cost of training, the whole of which is a loss to the firm, becomes Ct_1 . The total nett output of the worker at firm A in this case is obviously zero, whilst the loss of nett output due to having to train a new worker at that firm is

$$\int_0^{t_1} y \cdot dt$$

Thus having defined the three relevant factors for Firm A, an estimate of G can be made in the usual manner.

Whilst the foregoing simple analysis has been offered mainly to clarify the issues involved and to bring out the conditions under which an economic transfer of labour might occur it must not be thought that the method is purely of academic or didactic interest. When a firm decides to transfer a worker within a factory from one job to another rather than to recruit directly from outside the firm the transfer will only be economic if conditions of

the type just discussed are fulfilled. Management should ask, 'How much are we going to lose on the one hand, and gain on the other if this transfer occurs?' How better can it get the answer than by measuring, however, inaccurately, those variables which we have shown to be relevant - the estimated nett output of the worker in both jobs and the worker capital cost and using them in a manner analogous to that we have described. Undoubtedly the answers obtained will be subject to error arising out of the difficulties entailed in measuring nett output - and the problem would be complicated by possible chain repercussions if one internal transfer led to others - but surely a decision based upon such qualitative concepts as 'suitability for the job', yet ignoring the immediate repercussions on costs is likely to be subject to even greater error.

In addition to the practical use within a firm we must not forget the value of the method in economic investigations and analysis. It affords us the opportunity to look at such questions as, 'Have transfers which have occurred as a result of, say government policy, been economic in specific situations in the past?' 'To what extent has the movement of labour within a specific industry, or district had a beneficial economic effect?'; 'In what way should

labour mobility be encouraged ?' and so on, in a new
light and provides us with a practical tool for the
solution of these problems.

CHAPTER EIGHT

CASE STUDY A

LABOUR WASTAGE IN SEVEN PRODUCTION UNITS OF A FIRM IN THE FIRST YEAR OF SERVICE

The first case deals with a large public utility in the North East employing, perhaps, 2000 industrial workers in a number of establishments spread over the whole region. A number of these establishments are due to close down in the near future. Their recruitment of workers is reduced to a minimum, whilst transfers of staff to other units are frequent as a result of gradual reduction in the work at the declining establishment. When large numbers of workers are transferred in such conditions it cannot be assumed that those who are left behind will have similar leaving characteristics to those which the transferred workers would have had if they had stayed. Firstly, there may be some deliberate selection by the management of the more efficient, or of the longer established workers for transfer. Secondly some workers may resist transfer and prefer to look around for other jobs locally rather than move to a new establishment in some other area. Thirdly, some workers whom it is not convenient to transfer may be discharged as redundant.

whilst amongst those who are not so discharged, anxiety to find secure employment may lead to higher leaving rates than hitherto. The difficulties of measuring Labour turnover in these conditions has led to the exclusion of these declining establishments from the following analysis.

Seven establishments were left for investigation. Five of these were in existence before the date chosen for the starting point of the inquiry namely January 1st., 1952, whilst two establishments only commenced staff recruitment on any scale during 1954 (a very small number of maintenance staff were employed earlier.)

The organisation has two employment categories for its industrial workers - temporary and permanent. The privileges of both types of workers are very similar, but a permanent worker has a greater security of tenure and under existing circumstances is only likely to be discharged for misconduct. The temporary worker on the other hand is engaged to fill vacancies when members of the permanent staff are on holiday, for work of a limited duration i.e. overhauls, special maintenance and constructional work and in case of illness of members of the permanent staff. A high rate of labour wastage can, therefore be expected amongst such workers even if none of them leave before the job for which they were engaged is completed. However as

the local manager, who is responsible for engagements, will if he has the choice, offer permanent posts to those whom he considers the better applicants whilst reserving his temporary posts for the less satisfactory workers, it is to be expected that temporary workers as a group will be much less stable than permanent ones. Unfortunately, owing to the widely varying periods for which temporary workers are likely to be required it would appear to be impossible to differentiate between their inherent stability on the one hand and the wastage arising out of the discharge of workers when a job is completed, on the other. Moreover, a temporary worker is likely to be looking around for another more permanent post during his period of service, which will, of course, increase his instability still more. For the foregoing reasons it was decided to concentrate attention upon the stability of the permanent workers, who are not likely to be subject to these influences to any extent.

One further problem presented itself. A worker may be engaged originally as a temporary worker, but before his service period is completed a permanent vacancy may arise to which the temporary worker is transferred. Is the newly permanent worker to be included in the analysis, and if so, from what date? Are we to take his period of service as commencing with the date on which he was first

appointed temporarily or is it to be taken from the date of transfer? There is no really satisfactory solution. If the worker is to be omitted altogether then any leaving rates which are calculated can hardly be said to refer to the whole of the permanent labour force nor to the whole group of entrants at any given time since amongst those groups there will always be members previously temporary who have become permanent. On the other hand, the inclusion of the newly permanent members of the working force from the date of transfer to permanency would mean that previous length of service would be treated as non-existent for the purpose of calculating survival rates. A temporary worker with six months service (temporary service rarely implies a length of service greater than this, and is usually of less than three months in duration) who is appointed to a permanency and leaves after a further five weeks, will be classed as having only five weeks service. He will thus be associated with workers of different stability who enter directly as permanent workers and who serve for only five weeks in all. The alternative approach would be to count service for the newly permanent worker from the time when he entered as a temporary employee. This is the approach to be adopted in the following analysis, but its difficulties must not be ignored. The temporary to permanent worker is now one of

a specially selected group. Generally speaking, if permanent appointments are only offered to temporary workers after a certain period of service, and it is difficult to see how it can be otherwise, the stability of these workers will be biased upwards. This is not, necessarily a vitiating element, provided it is realised

- (1) that survival rates calculated from the permanent groups, so defined, will not be comparable with unselected group rates in other firms or industries;
- (2) the characteristics of the survival curves may differ from those which have been found to be common in earlier research into labour wastage.

where a worker was transferred from one establishment to another during the period under consideration his length of service was treated as commencing when he first entered the service of the firm, not from the date of transfer, although the establishment to which he was 'credited' was the last one at which he served during the period.

All workers were males, there being no female industrial workers employed by this firm.

In what follows, then, we are dealing with all male production and maintenance workers engaged between January 1st, 1952 and December, 1955, who were permanent either on leaving or on 1st. May, 1957 when the collection of the

data commenced. Where specifically indicated entrants between December 31st., 1955 and 30th. April, 1956 are also included.

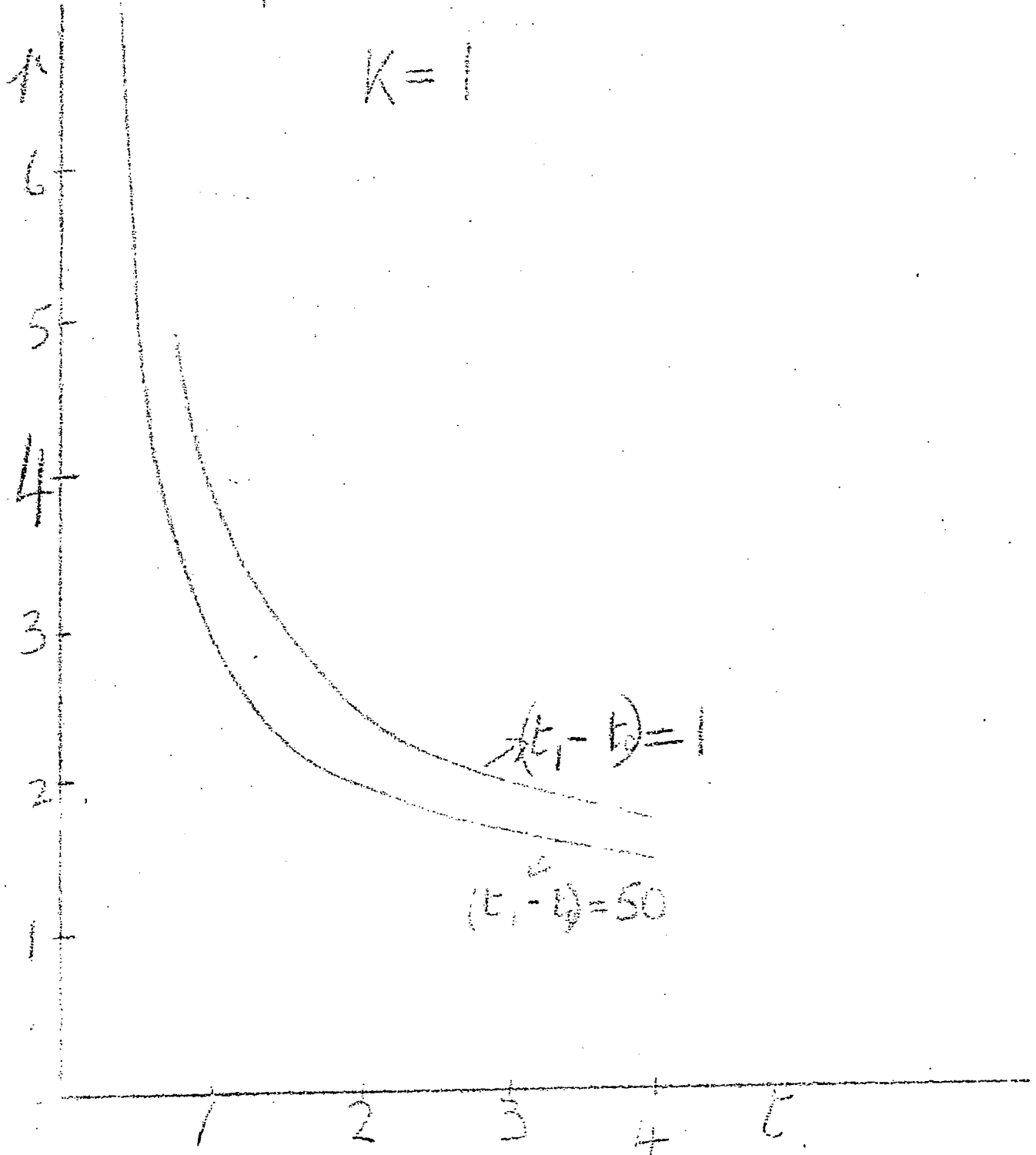
The technique adopted has been to analyse by means of survival curves over a period of fifty two weeks from entrance and to calculate expectations of service from these truncated curves.

We are dealing with permanent workers only who are secure, in an expanding industry, with a high standard of welfare services and an industrial structure somewhat in advance of that found in industry as a whole. It is possible, therefore, that labour wastage might display different characteristics in this organisation than those which previous investigators have found to be common to a wide variety of firms elsewhere.

In all 865 workers in the categories referred to entered the seven establishments during the period January 1st., 1952 to April 30th. 1956. Out of these 865 entrants, 311 left during the period in question and 231 of these left within the first 52 weeks of their service. Excluding the entrants in 1956, there were 776 entrants during 1952 to 1955 inclusive, of which 218 left before completing 52 weeks with the firm. As an indication of the great preponderance of voluntary resignations, even amongst this

GRAPH VII

$$K=1$$



relatively stable (as will be shown later) group of workers the table below gives a classification of the reasons for leaving of the 331 leavers.

Table A.

<u>Leaving Category.</u>	<u>Own Request.</u>	<u>Dismissal.</u>	<u>Health.</u>	<u>Death.</u>	<u>Total.</u>
No. leaving out of 865 entrants.	279	48	1	3	331

All leavers within the relevant period were included in the analysis, the numbers leaving on account of death or a specific health reasons being considered too small in number to have any appreciable influence on the results whilst the dismissals, which were for misconduct and not due to redundancy, were considered to be a necessary aspect of the forces giving rise to wastage.

In the first place an analysis was made to see if it was possible to detect any seasonal pattern of length of survival in relation to time of entry. The question to be answered is:- 'Are entrants at particular times of the year consistently more or less stable so far as service goes than those entering at other times?'

As the total number of entrants was only 865 it is obvious that an analysis month by month might give only small numbers of entrants in some months. However, the results of the following monthly analysis were checked by a

quarterly analysis on the same lines and no significant variation from the one to the other was found.

Table I shows the number of entrants for all seven establishments over the period from January 1st, 1952, to April 30th, 1956, classified according to month of entrance. The figures in the following columns (page 189) show the number of survivors to 1, 2, 3, 4, 8, 13, 26, 39, and 52 weeks. Consider the 15 entrants in January, 1952. One left during the first week of his service leaving only fourteen to survive until the end of the thirteenth week, between week 13 and week 26 one more person left, so that 13 remained at the end of the twenty-sixth week, and so on. A curve could be drawn for each month showing the number of survivors at the end of each period, or preferably for purposes of inter month comparison all the figures could be put on a percentage basis and percentage survival curves drawn. This method will be adopted where convenient in later instances. Unfortunately the comparison of large numbers of survival curves, one for each month, could not easily be effected in this way. It is, therefore, desirable somehow to summarise the information conveyed by the survival curve so that in each case it can be represented by a single figure. This has been done by calculating the expectations of service to one year, for each month separately.

T A B L E I

All entrants by month.

Unit	Partics.	No.	Survivors to weeks.									e ⁵²
			1	2	3	4	8	13	26	39	52	
1952	J	15	14	14	14	14	14	14	13	12	11	44.6
	F	16	16	15	15	15	15	15	15	13	13	46.4
	M	19	19	19	19	19	19	17	17	17	15	47.9
	A	15	15	15	15	15	15	15	15	14	14	43.8
	M	16	16	16	16	16	15	15	13	13	12	43.4
	J	28	28	28	28	28	27	27	25	25	23	47.6
	J	18	18	18	18	18	18	18	15	15	11	45.1
	A	12	12	12	10	10	10	10	6	5	4	30.8
	S	16	16	15	11	11	11	11	8	7	6	28.75
	O	8	6	5	4	4	3	3	1	1	1	12.7
	N	9	9	9	9	9	7	6	5	5	5	33.6
	D	7	7	7	7	7	7	7	6	6	5	46.4
1953	J	17	17	17	17	17	17	17	17	17	16	51.5
	F	13	13	13	13	13	13	13	11	11	11	47.
	M	24	24	24	24	24	23	23	22	21	20	47.6
	A	27	27	27	27	27	27	26	24	21	20	45.6
	M	26	26	26	26	26	25	25	24	21	20	46.5
	J	19	19	19	19	19	16	16	15	14	13	41.
	J	22	22	22	22	22	22	22	20	18	17	46.9
	A	9	9	9	8	8	8	7	7	7	7	41.9
	S	2	2	2	2	2	2	2	2	2	2	52
	O	4	4	4	4	4	3	3	2	2	2	32.4
	N	9	9	9	9	9	9	8	8	8	8	47.4
	D	5	5	5	5	4	4	4	4	4	4	42.3
1954	J	31	31	30	30	30	29	26	21	19	16	37.8
	F	21	16	13	12	12	12	12	10	7	7	24.3
	M	24	24	24	24	24	19	18	18	16	15	38.8
	A	23	23	23	22	22	22	21	21	21	20	47.8
	M	25	23	22	22	22	21	21	19	19	17	40.9
	J	16	16	16	16	16	15	15	14	14	13	46.7
	J	4	4	4	4	4	4	4	3	3	3	43.9
	A	8	8	8	8	7	6	6	6	6	5	39.4
	S	5	5	5	5	5	4	3	3	3	3	34.5
	O	4	4	4	4	4	4	3	3	3	2	40
	N	37	37	37	37	37	36	33	32	24	23	42.1
	D	11	11	11	11	11	11	11	11	11	11	52.
1955	J	24	24	24	24	23	22	22	21	20	20	45.9
	F	13	13	13	13	13	13	13	12	11	8	46.5
	M	23	23	23	23	23	23	23	23	23	23	52.
	A	21	21	21	21	21	19	18	17	15	14	41.9
	M	49	48	48	47	47	47	47	46	45	45	48.9
	J	19	19	19	18	18	18	18	18	17	15	47.7
	J	20	19	19	19	18	18	17	16	15	14	42.
	A	12	12	12	12	12	12	12	9	8	7	41.7
	S	11	11	11	11	11	11	11	11	11	11	52.
	O	6	6	5	4	4	4	4	4	4	4	35.3
	N	8	8	8	7	7	7	7	6	6	6	41.75
	D	5	5	4	4	4	4	4	3	3	3	35.4

The method was explained in Chapter 3 but the following illustration indicates how the expectation of service (e_{52}) was obtained in the case of the January 1952 figures:-

1	person	left in under 1 week.	- av. length of service = 0.5wks.
1	"	"between 13 and 26 "ks.	" =19.5 "
1	"	" " 26 and 39 "	" =32.5 "
1	"	" " 39 and 52 "	" =45.5 "

11 persons say for the full 52 weeks under observation.

$$e_{52} = (1 \times 0.5) + (1 \times 19.5) + (1 \times 32.5) + (1 \times 45.5) + (11 \times 52)$$

$$= \underline{44.6 \text{ weeks.}}$$

It is not assumed that the calculated e_{52} figures are true expectations in the sense of being the average length of service of the group under consideration, as we arbitrarily assume that all workers remaining to the end of the 52 weeks leave at that time. This is manifestly untrue. However the figures do summarise the survival curve over the range for which the information is available. Changes in the expectations do not necessarily reflect changes in the survival curves beyond the period of one year, but as any variations in stability are likely to be more pronounced during the earlier part of the service period than during later service the expectations are useful as indices of such changes.

Graph Ia shows the expectations for each month (the

figures are given on the right hand side of Table I). An examination reveals no clear indication of seasonally influenced variation. There are, however, certain suggestive factors. In 1952, 1953, and 1955, October was the month with the shortest expectation of service, whilst in 1954 the expectation for that month was below the average for the year. The recruitment of workers in the second half of the year in each case, tends to be considerably below that in the first half, and the recruitment in October is particularly low. Hence it is possible that the small number of entrants makes the expectations calculated for that month of doubtful significance. Data over a longer period of time, if it were available, would help to resolve this difficulty. There is however an indication from other months, that the year 1954 was in some ways not typical of the other years. With the exception of that year the early months of the year (and possibly December) show relatively high survival rates. These are the months in which recruitment tends to be fairly heavy, and though we can perform no formal tests of significance, because of the lack of normality in the data, a purely subjective approach indicates that this tendency for higher survival rates in the earlier months of the year is significant. If this is so, and bearing in mind that the October figures are consistently low in survival, with a minor discrepancy in 1954, tentative

conclusion of the existence of seasonal influences on the lines indicated above may be drawn. It must be stressed, however, that these indications are not an adequate basis for assuming any regular seasonal movement, in the absence of confirmation of a longer series taken over a greater period of time.

Though the possibility of a relationship between month of entry and survival does not appear to have been considered by other writers, a number of research workers (1950.5; 1951.4; 1958.1) have suggested that there exists a seasonal pattern of leaving in many industries, i.e. the numbers leaving from month to month show regular seasonal influences. This is undoubtedly the case in some industries. For example in the building industry this seasonal pattern is directly influenced by the changes in the possibility of working out of doors - a greater number of leavers occurring for example in the autumn and winter months than in spring and summer. To test for any such relationship in firm A the numbers leaving between 1953 and 1956 from the 1952 to 1955 group of entrants are given in the following table, in quarterly groupings. There appears to be no indication of any seasonal pattern at all. Admittedly the figures of leavers do not refer to the whole of the leavers during this period, only to those leaving from the group of entrants which we are using in

this inquiry. Nevertheless there seems no reason why this group of entrants should not be influenced by a seasonal leaving pattern (which by its very nature must be independent of length of service) if it exists for the firm as a whole.

Table B.

Number of leavers in each quarter 1953 to 1956 from the entrants in years 1952 - 1955.

	<u>1st.</u>	<u>2nd.</u>	<u>3rd.</u>	<u>4th. quarter.</u>
1953	17	13	18	14
1954	25	25	13	27
1955	11	16	17	16
1956	24	27	23	14

A further examination of Graph 1a brings to light two more points. Firstly the extent of the variations in survival rates, as measured by e_{52} seems to have declined from 1952 to 1956, and secondly there is no indication of any trend in the average e_{52} . There are signs, though, of differences in the average expectation from one year to another.

On Graph 2a are shown survival curves for the firms as a whole for the four years 1952 to 1955. Table 2 gives the corresponding figures, and the percentages on which the survival curves are based. It can be seen that

the curves for the odd years are very close together as are those for the even years.

T A B L E 2.

Number of entrants and survivors for all units.

Number of Entrants.	1	2	3	4	8	13	26	39	52	e_{52}
<u>Year 1952</u>										
179	176	173	164	164	159	158	137	131	118	
%s 100	98.3	96.6	91.6	91.6	88.8	88.3	76.5	72.6	65.9	41.35
<u>Year 1953</u>										
177	177	177	176	175	169	164	154	144	138	
%s 100	100	100	99.4	98.85	95.5	92.7	87.0	81.4	78.0	45.55
<u>Year 1954</u>										
209	202	197	195	194	183	173	162	147	136	
%s 100	96.7	94.3	93.3	92.9	87.6	82.8	77.5	70.3	65.1	40.50
<u>Year 1955</u>										
211	209	207	203	201	198	192	182	174	166	
%s 100	99.1	98.1	96.2	95.3	93.9	91.0	86.2	82.5	78.7	45.27

The marked difference that is shown between 1952 and 1954 on the one hand and 1953 and 1955 on the other appears to be due almost entirely to changes in survival pattern during the first four weeks. In 1953 and 1955 the survival curves appear to be almost linear as are the survival curves for 1952 and 1954 beyond the first four weeks. It was thought that these differences might be capable of being accounted for by changes in the economic climate in the industry from one year to the next or even to changes in

levels of pay relative to those obtainable in other occupations. So far as the latter explanation was concerned no significant variation occurred, as far as could be ascertained, in the relation between the wage rates of the workers in this industry and those in comparable jobs elsewhere. Information on actual earnings is of course more difficult to obtain, and it is possible that some significant change might have occurred. However, the fact that the differences in survival appeared to be confined to the early period of service would suggest that the first explanation - changes in economic climate - might be correct. If, for example there had been an increase in unemployment in the industry of which Firm A is a member it might be expected that those engaged during the period would have been rather more keen to hang on to their jobs than when other jobs were easier to obtain. Unfortunately for such an explanation the level of unemployment, in the industry in question, in other allied industries which were likely to be in competition with it for labour, and indeed in industry as a whole steadily declined from 1952 to 1956. Fluctuations in employment and survival pattern appear to have been uncorrelated.

Whatever the reasons for the inter year variations the difference is sufficiently large to prevent us from assuming that the underlying probability of leaving is the same for groups of workers entering in different years.

It is interesting to compare the survival curves to one year for each of the seven establishments independently to see if there is any difference in wastage between one establishment and another. Table 3 gives the relevant figures and Graphs 3a, and 3b. show the survival curves derived therefrom for each establishment over the whole period 1952 to 1955.

T A B L E 3.

Survival Curves to 1 year.

Number Entrants. 1952-55.	<u>Establishment 1.</u>										
	1	2	3	4	8	13	26	39	52	52	
44	44	44	44	44	44	43	42	41	39	49.58	
100	-	-	-	-	100	97.7	95.4	93.0	88.4		
					<u>Establishment 2.</u>						
128	128	128	128	127	127	127	121	118	116	49.54	
100	-	-	100	99.2	99.2	99.2	94.6	92.2	90.6		
					<u>Establishment 3.</u>						
120	119	118	118	115	118	116	107	95	88	45.80	
100	99.2	98.3	98.3	98.3	98.3	96.7	89.2	79.2	73.3		
					<u>Establishment 4.</u>						
249	249	247	244	243	231	227	206	192	177	43.69	
100	100	99.2	98.0	97.7	92.8	91.2	82.7	77.1	71.1		
					<u>Establishment 5.</u>						
78	69	63	55	53	46	39	29	28	23	23.17	
100	88.5	80.8	70.5	68.0	59.0	50.0	37.2	35.2	29.4		

CONTINUED ON NEXT PAGE

No.	<u>Establishment 6.</u>									
	1	2	3	4	8	13	26	39	52	e ₅₂
70	69	67	65	65	62	62	57	54	51	43.00
100	98.6	95.7	92.9	92.9	88.6	83.6	81.4	77.1	72.9	

<u>Establishment 7.</u>										
58	58	58	57	57	57	56	56	54	54	49.7
100	100	100	98.3	98.3	98.3	96.6	96.6	93.1	93.1	

(Note - We are not precluded from combining the figures for each year in this case as the aim here is to investigate differences due to the character, situation etc., of each establishment, independent of any time-linked effects.)

In order to eliminate as far as possible extraneous influences 29 workers who were transferred from declining establishments to the seven establishments with which we are concerned, were eliminated from the data used here. Hence the number of entrants involved was 747 and not 776. A check, however, was made by recalculating the survival curves for the whole 776 entrants in the period 1952 to 1955 and no material difference in the figures could be observed. For this reason the 29 workers concerned were not omitted in any other analyses.

A glance at Graph 3A shows that there are large differences in survival between the five establishments compared. Graph 3B, which gives survival curves for the two establishments which only came into existence in 1954

also shows a considerable difference in survival experience. In all instances the number of workers involved (with the possible exception of Establishment 1 - 44 entrants and five leavers) appears to be sufficiently large to warrant the conclusion that the differences are significant. Some measure of confirmation may be obtained by noticing that the difference between establishments 1 and 2 and between establishments 3 and 4 are small. Establishments 1 and 2 are close to one another geographically and so are establishments 3 and 4. Unfortunately establishments 6 and 7 are also close to one another and here the difference in survival pattern is considerable. However these are new establishments drawing upon labour unaccustomed to work in the industry and it is possible that factors are at play here which over-ride the influence of geographical proximity. The real problem is presented by establishment 5, the survival curve for which is much inferior to that of any of the others. Indeed the survival curve for establishment 5 is similar to those which have been found by other research workers in firms which make no distinction between temporary and permanent workers. In other words the more volatile and unstable elements do not appear to have been eliminated by selective process as has occurred in the case of the other establishments. At first sight there appears to be no reason why establishment 5 should, or indeed could,

adopt a different method of selection of workers from that adopted for other establishments. The number of permanent workers for each establishment is laid down, and sanction has to be obtained for the appointment of temporary workers for specific purposes. It might have been possible however that the relatively favourable experience in establishments 1 to 4 and 6 and 7, was due to a reluctance on their part to fill permanent posts immediately such a vacancy occurred. If it was the practice of these establishments to make temporary appointments at first and only after some time to transfer workers to the permanent labour force just such a situation as we have found might arise. One would expect in such cases that the permanent staff would tend to be very much below strength at those establishments when compared with establishment 5. Although the figures for the actual permanent strength and the permanent establishment are not available the writer was informed that no such consistent relationship existed. Of course it is always possible that the number of permanent staff sanctioned for establishment 5 is relatively greater than those sanctioned for the other establishments, so that with establishment 5 it is only infrequently necessary to appoint workers on a temporary basis. In fact a smaller number of temporary workers were appointed to this establishment during the four year period considered, but there are so many other

factors which might have influenced this that we can draw no hard and fast conclusions. A further possibility exists. Suppose establishment 5 was in an area where there was considerable competition for labour. In this case a naturally high turnover of labour might mean that it was difficult to obtain the required number of workers, and hence practically all appointments would be made to the permanent force, not because the allowable size of the permanent force was in excess of normal requirements, but because it was difficult to obtain sufficient workers to bring the force up to normal working strength. When enquiries were made on these lines it was shown that though difficulties in filling vacancies did exist at station 5, these difficulties were not considered to be so great as in the case of establishments 3 and 4 where there was very great competition for labour, particularly of the unskilled variety, from a number of large firms in the same locality.

We are left, then with two alternatives, either the greater instability of workers at establishment 5 is due to characteristics peculiar to that establishment; or establishment 5 employs a greater proportion of workers in the more unstable grades than do the other establishments. In other words if alternative one is correct establishment 5 may be in an area where the competition for labour is

keen, the working conditions may be poor, the unit may be relatively inaccessible, and so on. On the other hand, if unskilled workers, for example, have a lower stability than skilled workers, the existence of a high proportion of unskilled workers at establishment 5 might go some way towards explaining the difference in survival experience. Without more information than is at our disposal we cannot tackle the first alternative directly, but we can seek to confirm, or reject second alternative, which will obviously give us an indirect check upon the likelihood of the first explanation also.

Before we take this step however it would be convenient if we could confirm or reject the hypotheses that the differences between the remaining establishments are not due entirely to the time of entry factor. For example if 3 and 4 did most of their recruitment in 1952 and 1954, and establishments 1 and 2 did most of theirs in 1953 and 1955 we would expect the former establishments to have survival rates inferior to the latter, even if the establishment and the entrants are otherwise indistinguishable. It was decided to make an Analysis of Variance to test whether, in the case of station 1 to 4 the variability due to the 'establishment' effect was significant. Undoubtedly the theoretical requirements for such an analysis do not exist in this case. In the first place there is some

evidence of association between survival at the stations 1 and 2, and again at stations 3 and 4 which could give a misleading estimate of variance. Secondly, the requirements of normality are not fulfilled. Expectation of service to one year (e_{52}) were calculated for each of the four stations where the apparent variability was least (Establishments 1 - 4) and these expectations are used in the Analysis of Variance. These expectations are averages calculated from the truncated survival curves, as explained previously, and because of the very skew nature of the parent distribution are not likely to be normally distributed. It is suggested, however, that the effects of this would be to reduce the variance, of the expectations below the Normal, and hence the test which we apply will be less sensitive than would otherwise be the case. In other W8FDs, if the Analysis of Variance reveals a significant variation due to the establishment effect this may be taken as indicative that such a variation exists under the present circumstances.

(see Table for Analysis of Variations, pages 203 - 206)

TABLE FOR ANALYSIS OF VARIANCE.

Station Unit.	<u>Years of entry.</u>				
	1952	1953	1954	1955	
1	48.75	52	49.0	49.64	
2	43.20	45.54	41.3	46.9	
3	47.29	48.96	50.89	50.74	
4	43.71	47.79	45.02	46.68	
<hr/>					
Using only Stations 1, 2, 3, and 4 we have taking 41.3 from each.					<u>Totals.</u>
1	7.45	10.7	7.7	8.34	34.19
4	1.9	4.24	0	5.6	11.74
2	5.99	7.66	9.59	9.44	32.68
3	2.41	6.49	3.72	5.38	18.00
<hr/>					
Totals. 17.75					29.09
					21.01
					28.76
					96.61

A. To Squaring individuals and adding we have

$$\sum x^2 = \begin{array}{r} 55.5 \\ 114.5 \\ 59.3 \\ 69.55 \\ 3.61 \\ 17.93 \\ 31.36 \\ 35.88 \\ 58.67 \\ 91.98 \\ 89.12 \\ 5.81 \\ 42.12 \\ 13.84 \\ \hline 28.94 \\ \hline 718.25 \end{array}$$

B. Obtaining total for each row squaring each total, summing squares and \div by number of Columns.

1169
157.3
1068
324

2698.3 \div 4. Giving:- 677.075.

C. Obtaining total for each column, squaring each total, summing square and \div number of row.

315
846
441.6
327

2429.6 \div 4. Giving:- 607.65.

D. Obtaining Grand Total of all individuals, squaring and dividing by number of individuals.

Total (96.61)² \div 16

= $\frac{96.61^2}{4} = (24.15)^2 \text{ app} = \underline{583.}$

Source of Variance.	Sum of Squares.	Degrees of Freedom.	Mean Square.	Components of variance
Between Rows.	B - D (677.075 - 583) = 94.075	(4 - 1) = 3	31.358	$\sigma_1^2 + \sigma_0^2$
between columns.	(607.65 - 583) = 24.65	(4 - 1) = 3	8.217	$\sigma_1^2 + \sigma_0^2$
Residual.	A 713.25 D + 583.00 1301.25 <u>-1284.725</u> 16.525 677.075 <u>607.65</u> 1284.725 = <u>135.25</u>	(4 - 1) X (4 - 1) = <u>9</u>		σ_0^2

Total (718.25 - 583) 15

n_2 = number of columns.

n_1 = number of rows

σ_2^2 = variance due to difference between calculations.

σ_1^2 = variance due to difference between rows.

σ_0^2 = residual variance.

Test for significance of:-

(a) between row mean square

logs. Variance ratio is:- $\frac{31.358}{1.836} = 16.83$
1.4963
0.2702
1.2261 for d. of f. 3 and 9

This is significant at the 1% level.

(b) between column mean square

logs. Variance ratio is:- $\frac{8.217}{1.836} = 4.411$
0.9147
0.2702
0.6445 for d. of f. 3 and 9

This is significant at the 5% level but not at the 1% level.

The magnitude of the variance between rows is estimated

by:-

$$n_2 \frac{2}{1} + \frac{2}{0} = 31.358$$

$$4 \frac{2}{1} + 1.836 = 31.358$$

$$\therefore \frac{2}{1} = \frac{31.358 - 1.836}{4}$$

$$\frac{31.358 - 1.836}{4} = \frac{29.522}{4} = 7.38$$

and between columns is:-

$$n_1 \frac{2}{1} + \frac{2}{0} = 8.217$$

$$\frac{2}{1} = 8.217 - 1.836 =$$

$$\frac{8.217 - 1.836}{4} = \frac{6.381}{4} = 1.595.$$

Thus there is significant variability over time, but much more variability from station to station.

The residual variability is relatively small which suggests that the labour force is otherwise relatively homogeneous.

The entrants at each establishment were now divided into Skilled and unskilled - giving survival data as in Graphs 4 i to vii, and Table 4.

T A B L E 4.

Survival Curves according to degree of skill
and Establishment (January 1st.1952 - April 30th.1956)

No.	1	2	3	4	5	8	13	26	39	52	weeks. e ₅₂
<u>Establishment 1.</u>											
<u>Skilled.</u>											
16	16	16	16	16	16	16	15	14	14	14	47.38
%											
100	100	100	100	100	100	100	93.8	87.5	87.5	87.5	
<u>Unskilled.</u>											
28	28	28	28	28	28	28	28	28	27	26	51.07
%											
100	100	100	100	100	100	100	100	100	96.4	92.9	
<u>Establishment 2.</u>											
<u>Skilled.</u>											
38	38	38	38	38	38	38	38	38	37	36	51.32
%											
100	100	100	100	100	100	100	100	100	97.4	94.7	
<u>Unskilled.</u>											
107	107	107	107	106	106	106	106	100	97	94	48.99
%											
100	100	100	100	99.1	99.1	99.1	99.1	93.5	90.1	87.9	
<u>Establishment 3.</u>											
<u>Skilled.</u>											
52	52	51	51	51	51	50	44	39	37	37	44.36
%											
100	100	98.1	98.1	98.1	98.1	96.2	84.6	75.0	71.2	71.2	
<u>Unskilled.</u>											
93	92	92	92	92	92	89	86	78	74	74	47.1
%											
100	98.9	98.9	98.9	98.9	98.9	95.1	92.5	83.9	79.6	79.6	

No. 1 2 3 4 8 13 26 39 52 e₅₂

<u>Skilled.</u>		<u>Establishment 4.</u>									
52	52	52	51	50	47	47	44	42	39	44.19	
%	100	100	98.1	96.2	90.4	90.4	84.6	80.3	75.0		

<u>Unskilled.</u>											
208	208	207	205	204	196	192	176	164	151	44.45	
%	100	99.5	98.6	98.1	94.2	92.3	84.6	78.9	72.6		

<u>Skilled.</u>		<u>Establishment 5.</u>									
4	4	4	4	4	4	4	4	4	4	52	
%	100	100	100	100	100	100	100	100	100	100	

<u>Unskilled.</u>											
83	76	68	60	57	49	41	30	28	23	22.66	
%	100	91.6	81.9	72.3	68.7	59.0	49.4	36.1	33.7	27.7	

<u>Skilled.</u>		<u>Establishment 6.</u>									
24	24	23	22	22	21	20	18	16	15	39.58	
%	100	100	95.8	91.7	91.7	87.5	83.3	75.0	66.7	62.5	

<u>Unskilled.</u>											
83	82	80	79	78	74	71	66	62	60	42.21	
%	100	98.8	96.4	95.2	93.9	89.2	85.5	79.5	74.7	72.3	

<u>Skilled.</u>		<u>Establishment 7</u>									
17	17	17	17	17	17	15	14	12	10	42.15	
%	100	100	100	100	100	88.3	82.4	70.6	64.7		

<u>Unskilled.</u>											
60	60	59	58	57	56	55	53	51	50	46.22	
%	100	100	98.3	96.7	95.0	93.3	91.7	88.3	85.0	83.3	

It is well known that the wastage rates of skilled labour are usually much lower than those for unskilled labour, but hitherto little attention has been given to the problem of whether this is due to the tendency for unskilled workers as a class to be relatively more unstable in this respect, or whether it occurs because of the existence of a high degree of instability amongst an identifiable group amongst the unskilled workers. The information we have should enable us to come to some tentative conclusions in the case of Firm A. Establishments 2 and 5 show survival curves for skilled workers superior to those for unskilled ones. The skilled entrants for establishment 5 are so few in number that little reliance can be placed on the 100% survival figure, but it appears likely that even if larger numbers were available the superior stability of skilled workers in this establishment would be evident. The difference in establishment 2 is nowhere near so pronounced but still shows superior stability for the skilled worker. In all the other establishments, excepting unit 4, the stability of the unskilled workers is greater than that of the skilled, whilst in establishment 4 the two curves almost coincide. What can we conclude from this? Perhaps that when a selective process can be brought to bear on a hitherto unselected group it is relatively easy to eliminate the unstable elements. Hence it is probable that degree of skill in itself is not necessarily

closely correlated with stability. The greater stability of the skilled worker in normal circumstances may be due to the fact that he is a member of a selected, privileged, relatively homogeneous group. This conclusion has some implications for policy. If unskilled workers can be selected so that one group is highly stable it might pay a firm to organise its labour force so that these workers would be engaged on the more nearly essential unskilled work whilst the remainder, the temporaries - (who have been selected so to speak by rejection) could be employed on work where their greater instability was likely to cause the least disturbance and dislocation. Even if this meant an increase in wastage for a small section of the working group (because they would realise that they were the dispensible elements) it might be more economical in the long run than if jobs were allocated at random to a widely heterogeneous unskilled group.

It does not appear, incidentally that the low survival rate at establishment 5, though it is evidenced in the unskilled group of workers, is due to lack of skill alone, for unskilled workers in the other establishments do not show similar movements. Hence one of the alternatives discussed on pages 200 and 201, can be eliminated.

This firm employs both day shift workers, and workers on a three shift system, the latter receiving additional

hourly payments to compensate them for the shift working. In what follows the day shift groups will be referred to as Day and the three shift workers as Shift. The Survival curves for each of the seven establishments for both day and shift workers are shown on Graph 5 (i to vii) and Table 5.

T A B L E 5.

Survival Curves by Shift & Establishment.

(Entrants 1st. January 1952 - 30th. April 1956)

No.	1	2	3	4	8	13	26	39	52	weeks. e ₅₂
<hr/>										
Day. <u>Establishment 1.</u>										
21	21	21	21	21	21	21	20	19	17	43.9
$\frac{21}{100}$	100	100	100	100	100	100	95.2	90.5	82.8	
<hr/>										
Shift.										
23	23	23	23	23	23	23	23	23	23	52.
$\frac{23}{100}$	100	100	100	100	100	100	100	100	100	
<hr/>										
Day. <u>Establishment 2.</u>										
53	53	53	53	52	52	52	50	50	50	49.86
$\frac{53}{100}$	100	100	100	98.1	98.1	98.1	94.4	94.4	94.4	
<hr/>										
Shift.										
92	92	92	92	92	92	92	88	84	80	
$\frac{92}{100}$	100	100	100	100	100	100	95.6	91.3	87.0	
<hr/>										
Day <u>Establishment 3.</u>										
64	64	64	64	64	64	63	60	55	54	48.2
$\frac{64}{100}$	100	100	100	100	100	98.4	93.8	85.9	84.4	

No.	1	2	3	4	8	13	26	39	52	^e 52
<u>Shift.</u>				<u>Establishment 3.</u>						
81	80	79	79	79	79	76	70	60	55	43.99
$\frac{\%}{100}$	98.8	97.3	97.3	97.3	97.3, 93.8	86.4	74.1	67.9		
<u>Day.</u>				<u>Establishment 4.</u>						
154	154	152	149	148	140	138	128	119	113	43.63
$\frac{\%}{100}$	100	98.7	96.8	96.1	90.9	89.6	83.1	77.3	73.4	
<u>Shift.</u>				<u>Establishment 5.</u>						
106	106	106	105	104	100	100	88	83	74	44.21
$\frac{\%}{100}$	100	100	99.1	98.1	94.4	94.4	83.0	78.3	69.8	
<u>Day.</u>				<u>Establishment 6.</u>						
79	71	65	57	54	49	40	32	29	24	23.63
$\frac{\%}{100}$	90.7	82.3	72.2	68.4	62.0	50.4	40.5	36.7	30.4	
<u>Shift.</u>				<u>Establishment 7.</u>						
8	8	8	8	8	8	8	7	7	7	47.94
$\frac{\%}{100}$	100	100	100	100	100	100	87.5	87.5	87.5	
<u>Day.</u>				<u>Establishment 8.</u>						
57	56	54	53	52	48	47	45	43	42	41.71
$\frac{\%}{100}$	98.3	94.7	93.0	91.2	84.2	82.5	79.0	75.4	73.7	
<u>Shift.</u>				<u>Establishment 9.</u>						
50	49	48	47	47	47	45	40	36	33	42.11
$\frac{\%}{100}$	98.	96.	94.	94.	94.	90.	80.	72.	66.	

No.	1	2	3	4	8	13	26	39	52	e ₅₂
<u>Day.</u>										
		<u>Establishment 7.</u>								
37	37	36	36	35	34	34	34	33	32	47.38
$\frac{37}{100}$	100	97.9	97.9	94.6	91.9	91.9	91.9	89.2	86.5	
<u>Shift.</u>										
40	40	39	38	37	36	34	32	29	23	40.8
$\frac{40}{100}$	100	97.5	95.0	92.5	90.0	85.0	80.0	72.5	70.0	

As with the unskilled and skilled groups the whole of the entrants for whom the necessary information is available between January 1st. 1952, and April 30th. 1956 are included.

In four cases (establishments 2, 3, 6 and 7) the survival of the Day workers is markedly superior to that of the Shift workers, whilst in two cases (establishments 1 and 5) the reverse is the case. The fourth establishment shows no marked difference between the survival experience of the two classes of workers. Once again the most marked difference arises in the case of establishment 5. The number of entrants in the Shift category in this establishment is very small - only 8, compared with 79 day entrants. Consequently the greater apparent wastage for the day workers might not be significant. In the case of establishment 1, such an explanation is not so likely. The numbers of day and shift entrants are almost the same - 21 and 23 respectively. and though these numbers are not large the difference in service expectation is sufficiently

large for us to consider it as significant if we are prepared to take the cases of Establishments 2, 3, 6 and 7 as significant in the opposite direction.

Although unskilled workers had shown no greater tendency towards instability than skilled workers it was thought possible that a positive correlation between type of shift and skill might account for the inconsistency between type of shift and length of survival at different establishments. Information on the numbers of day and shift workers who were skilled and unskilled was available in the case of the establishments 1 to 5. The figures are given below in Table C.

T A B L E C

Establishment Number.		Numbers of skilled.	Unskilled.	Total.
1	Day.	10	11	21
	Shift.	<u>6</u>	<u>17</u>	<u>23</u>
	Total.	16	28	44
2	Day	22	31	53
	Shift	<u>16</u>	<u>76</u>	<u>92</u>
	Total	38	107	145
3	Day	24	40	64
	Shift	<u>28</u>	<u>53</u>	<u>81</u>
	Total	52	93	145
4	Day	34	120	154
	Shift	<u>18</u>	<u>83</u>	<u>106</u>
	Total	52	203	250
5	Day	2	77	79
	Shift	<u>2</u>	<u>6</u>	<u>8</u>
	Total	4	83	87

It will be noted that there is a relatively greater number of workers in the unskilled - day category at establishment 5 than at any other establishment. However, whilst this may have some significance for the particular establishment in question it cannot be extended to a general rule that day workers' stability is low in relation to the proportion of unskilled workers in this category, as establishment 4, which has the next highest proportion of day - unskilled workers shows favourable stability for day workers as a whole. Moreover establishment 1 where day stability is lower than shift stability shows a lower proportion of unskilled workers in the day group than any other establishment. It is recognised that this may not be the whole of the story. All unskilled workers, for example do not receive the same hourly rate, even when working on the same shift: There is some evidence, for which, unfortunately figures cannot be quoted, that the proportion of unskilled day workers who are employed on the minimum basic rate at establishment five is much greater than in the case of any other establishment considered but whether this is a cause or a consequence of the relatively higher wastage at establishment 5, or indeed if it has any influence at all, cannot be ascertained by any one outside the firm itself.

If we are prepared to ignore the case of establishment 5

and it certainly appears to be one subject to influences very different from those relevant to the other establishments, we can only say that whilst day workers appear to be slightly more stable than shift workers, this tendency is not sufficiently consistent to permit of the formation of definite conclusions.

Survival rates and e_{52} were calculated also for Married and Single entrants at each of the seven establishments, once again over the whole of the entrance period January 1st. 1952, to April 30th. 1956. In a small number of cases information on Civil Status could not be obtained and therefore the numbers involved are slightly less than 865. No workers were recorded as being divorced, but whether this was due to the inclusion of such persons other one, or other of the categories, single or married is not known. Widowed persons, who numbered 5 were included in the class Single.

As can be seen from Table 6 (see next, and following pages) the stability of the two groups though markedly different in the case of different establishments shows no consistent relationship over the establishments as a whole. In the case of three establishments single workers show greater stability than married ones, whilst the reverse

(continued on page 219)

T A B L E 6

(No Graph)

Survival curves by Civil Status & Establishments.
Entrants 1st. January 1952 - 30th. April, 1956.

No.1	1	2	3	4	8	13	26	39	52	weeks. e ₅₂
<u>Married.</u>		<u>Establishment 1.</u>								
37	37	37	37	37	37	37	37	36	35	51.3
% 100	100	100	100	100	100	100	100	97.3	94.6	
<u>Single.</u>										
7	7	7	7	7	7	7	7	6	6	49.21
% 100	100	100	100	100	100	100	100	85.7	85.7	
<u>Married.</u>		<u>Establishment 2.</u>								
119	119	119	119	119	119	119	113	109	106	49.54
% 100	100	100	100	100	100	100	95.0	91.6	89.1	
<u>Single.</u>										
26	26	26	26	25	25	25	25	25	24	49.8
% 100	100	100	100	96.2	96.2	96.2	96.2	96.2	92.3	
<u>Married.</u>		<u>Establishment 3.</u>								
101	101	100	100	100	100	98	89	79	74	45.53
% 100	100	99.	99.	99.	99.	97.	88.1	78.2	73.3	
<u>Single.</u>										
30	29	29	29	29	29	27	26	20	19	42.32
% 100	96.67	96.67	96.67	96.67	96.67	90.	86.7	66.7	63.3	

No.	1	2	3	4	8	13	26	39	52	weeks. e ₅₂
<u>Married.</u>										
<u>Establishment 4.</u>										
217	217	213	210	209	202	201	184	174	163	44.71
$\%$ 100	100	98.2	96.8	96.3	93.1	92.6	84.8	80.2	75.1	
<u>Single.</u>										
40	40	40	40	39	34	31	27	23	20	36.24
$\%$ 100	100	100	100	97.5	85.	77.5	67.5	57.5	50	
<u>Married.</u>										
<u>Establishment 5.</u>										
48	46	40	35	34	28	24	19	15	13	22.89
$\%$ 100	95.9	83.4	72.9	70.9	58.3	50.0	39.6	31.3	27.1	
<u>Single.</u>										
34	27	26	24	23	21	18	13	13	10	23.91
$\%$ 100	79.4	76.5	70.6	67.7	61.8	52.9	38.2	38.2	29.4	
<u>Married.</u>										
<u>Establishment 6.</u>										
89	88	85	83	82	79	77	71	66	62	42.0
$\%$ 100	98.9	95.5	93.3	92.1	88.8	86.5	79.9	74.2	69.7	
<u>Single.</u>										
18	18	18	18	17	16	16	14	13	13	42.05
$\%$ 100	100	100	100	94.4	88.9	88.9	77.8	72.2	72.2	
<u>Married.</u>										
<u>Establishment 7.</u>										
66	66	65	64	64	63	60	58	54	52	45.54
$\%$ 100	100	98.5	97.0	97.0	95.5	90.9	87.9	81.8	78.9	
<u>Single.</u>										
11	11	11	10	9	9	9	9	8	8	41.32
$\%$ 100	100	100	90.9	81.8	81.8	81.8	81.8	72.7	72.7	

is the case in the other four. The most likely explanation is that there is no difference in the stability of the two groups which cannot be accounted for, either by time of entrance, particular establishment, or other independent influence.

If the number of workers investigated had been larger it would, perhaps, have been instructive to analyse the data in finer groupings, making such cross classification as e.g. Married, unskilled day workers, contrasted with married unskilled shift workers, and so on, but with the numbers involved in the present case the size of many of the groups would have been so reduced as to be quite inadequate for even the most limited of conclusions to be drawn. There is on the face of it, indeed, no indication that such further analysis would give rise to markedly different results from the ones already obtained.

Two further analyses have been made, in both cases using the data for 1952 - 5 years and all establishments combined. The first concerns stability and length of service in previous occupation (excluding National Service, but including regular military engagements) whilst the second relates age on entry to stability. In both these cases interesting results have emerged.

Table 7 and Graph 7a and 7b. show details of survival

to one year in quinquennial age groups.

T A B L E 7.

Age on entry & survival (All 7 Units 1952-1955.

No.	1	2	3	4	8	13	26	39	52	years. e52
	21 and under 26 years.									
97	96	95	93	92	85	82	74	67	62	40.40
%	99.0	97.9	95.9	94.9	87.6	84.5	76.3	69.1	63.9	
	26 and under 31 years.									
175	173	173	169	168	163	158	149	141	128	44.46
%	98.9	98.9	96.6	96.0	93.2	90.3	85.2	80.6	73.2	
	31 and under 36 years.									
154	152	143	147	145	142	140	130	120	116	44.08
%	98.7	96.1	95.5	94.2	92.2	90.9	84.4	77.9	75.3	
	36 and under 41 years.									
109	107	105	104	104	101	100	96	89	88	45.52
%	98.2	96.4	95.4	95.4	92.7	91.3	88.1	81.7	80.7	
	41 and under 46 years.									
104	103	100	99	98	96	95	87	84	80	44.51
%	99.05	96.2	95.2	94.2	92.3	91.4	83.7	82.7	78.7	
	46 and under 51 years.									
64	64	64	61	61	60	57	51	51	50	43.87
%	100	100	95.3	95.3	93.3	89.1	79.7	79.7	78.1	
	51 and under 56 years.									
42	41	41	40	40	38	38	33	32	29	42.61
%	97.7	97.7	95.3	95.3	90.1	90.1	78.6	76.2	69.1	

Of the 776 entrants between 1952 and 1955, information as to age on entry was available for 765. 745 of these were between 21 and 56 on entrance, entrants at ages

outside these limits have not been included for the following reasons -

- a. The under 21 group consists mainly of apprentices, whose stability is governed by influences not present at other ages;
- b. it is unusual for workers of over sixty years of age to be appointed, and when this happens special influences are usually at work. The seven workers of age sixty or over were therefore excluded, and because of small numbers the six who entered between 50 and 60 years of age were also omitted.

Graph 7a shows clearly the progressive increase in stability with age at entrance until a maximum stability is reached in those who were 36 but under 41 on entrance. Thereafter stability declines with age. A significant point is the relatively greater instability of the 21 and under 26 year group. Less than 65 per cent survived the first 52 weeks and the expectation of service was correspondingly low. It is, of course, possible that this greater instability may be related to marital status, as it is to be expected that a large proportion of this age group are unmarried. Some writers (1,51.4; 1955.4;) have detected this kind of a relationship in the engineering and in the iron and steel industry. In one case the inconclusive results of the Single - Married

analysis would seem to indicate that single status of itself is not necessarily a cause of lower stability, though combined with youth, of course, it might be. In addition, unsettlement after the completion of National Service can be looked upon as a likely stability reducing influence, but the extent of this can only be guessed at as the records of Firm A. did not make reference to this unless the entrant had completed his National Service immediately prior to engagement. Allowing for these factors, however, as tending to accentuate the instability of the younger adults, the nature of the progression from one age group to another certainly indicates that age is an important influence in its own right.

Finally we examined the relationship between Length of Service in previous job and stability at Firm A. For this purpose the previous job was taken to be that immediately prior to the engagement at firm A, unless that prior job had been National Service in which case the employment prior to National service was taken. If a person had previously been self-employed he was included if the duration of his self employment was recorded. In a number of cases the duration of previous employment was omitted and these individuals were not included in the analysis. Of 776 entrants during 1952-1955, 761 provided informat for this analysis.

T A B L E 8 (No Graph)

Length of Service in previous job, and survival.

Previous Length of Service (1952-55 All entrants)

No.	1	2	3	4	8	13	26	39	52	e ₅₂
1 month or under.										
66	63	61	53	57	54	54	48	43	40	38.33
%	95.5	92.4	87.9	86.4	81.8	81.8	72.7	65.2	60.6	
over 1 month to 3 months.										
89	86	85	84	84	82	79	71	69	64	43.03
%	96.6	95.5	94.4	94.4	91.9	88.6	79.8	77.5	71.9	
over 3 months to 6 months.										
112	111	110	106	106	101	99	92	85	83	43.16
%	99.2	98.2	94.7	94.7	90.2	88.4	77.2	75.9	74.1	
over 6 months to 9 months.										
51	51	51	51	51	50	49	44	42	38	45.82
%	100	100	100	100	98.1	95.6	86.3	82.3	74.5	
over 9 months to 1 year.										
51	50	50	49	48	47	43	40	37	37	41.06
%	98.1	98.1	95.55	94.1	92.2	84.3	78.4	72.55	72.55	
over 1 year to 2 years.										
101	100	98	97	97	93	90	81	73	68	42.13
%	99.	97.0	96.1	96.1	92.1	89.1	80.2	72.3	67.3	
over 2 years to 5 years.										
93	93	91	91	90	86	83	78	72	67	43.72
%	100	97.9	97.9	96.8	92.5	89.3	83.9	77.3	72.1	
over 5 years to 10 years.										
89	89	89	88	88	85	84	80	77	69	46.59
%	100	100	98.9	98.9	95.5	94.4	89.9	86.5	77.5	
Over 10 years.										
73	73	73	72	72	72	72	70	70	69	50.34
%	100	100	98.6	98.6	98.6	98.6	95.9	95.9	94.5	

The results are not so clear cut as in the case of age on entry, dealt with above, but are, nevertheless suggestive. From Table 8, it can be seen that workers with very short (under one month) and very long (over 10 years) length of

service in previous jobs are performing consistently in their new posts. The under one month group have a very low survival level, whilst the over 10 year group are remarkably stable. This, it might be said, is what can be expected, but it calls for some comment in view of the survival curves of the other service groups.

It would appear, if our results are significant, that only those who have shown themselves very unstable in their previous jobs can be expected to repeat that instability in the new occupation. From the table we see that the stability of the over 3 month and up to and including 6 month group is considerably greater than that of the 1 year to 2 year group or indeed of the 2 year to five year group. Hence one cannot assume a close correlation between present stability and length of service in previous jobs. It is nevertheless possible that the engagements of persons of previous low stability are scrutinised more carefully than those where the stability has been fairly high. If such has been the case persons of previous low stability would have only been employed, let us say, if they had a good excuse, and hence they might be expected to have a higher expectation of service^{than} if they had been completely unselected. This would account for the entire absence of correlation between present stability and previous length of service but it would not explain distribution

of survival curves observed in this instance. It is unfortunate that information was available in respect of the immediately previous occupation only. If instead of details of length of service in the previous (say) three jobs had been recorded a more reliable relationship between present stability and average length of service in previous jobs might have been possible.

In concluding this survey, it must be stressed that the restrictions to the permanent workers at this particular firm may have led to results which are not typical over a wide field of industry. On the other hand if similar relationships are observed in a large variety of circumstances their validity will no longer be in doubt. In the succeeding chapters data from other firms will be analysed in a similar manner to that used in the present case, and the whole summarised in a later section.

CHAPTER NINE

CASE STUDY B.

LABOUR TURNOVER IN A PASSENGER TRANSPORT ORGANISATION.

This study covers the entrants to the traffic side of a large Passenger Transport Organisation in the North-East in the years 1953 to 1956 inclusive, and their survival experience up to the end of 1957. The organisation confines itself to the operation of urban services in a heavily populated area and does no private hire or contract work outside that area. The demand for its services though fluctuating a little at holiday time, is basically, stable. The entrants consisted of male drivers, and male and female conductors operating the Trolley Vehicles and Omnibus services of the organisation. Maintenance workers and supervisory staffs are excluded.

The strength of the traffic force over the period of the survey is shown in Table A.

The major part of the survey covers survival experience to one year, but, in a number of cases the period of service covered was greater than this.

TABLE A
NUMBERS EMPLOYED.

Job Category.

	1953		1954		1955		1956		1957		1958.
	Jan.	Ju.	Jan.	Ju.	Jan.	Ju.	Jan.	Ju.	Jan.	Ju.	Jan.
Male O.C.	240	211	191	167	195	171	179	174	180	158	190
F.O.C.	224	254	298	309	281	299	314	309	302	283	272
M.T.V.C.	212	200	192	175	174	173	185	179	174	188	22
F.T.V.C.	161	161	175	171	175	182	185	184	162	178	162
O.D.	453	452	465	451	448	434	469	429	459	398	417
T.V.D.	360	359	345	361	349	347	321	336	318	318	305

Key - M.O.C. - Male Omnibus Conductor.
 F.O.C. - Female Omnibus Conductor.
 M.T.V.C. - Male Trolley Vehicle Conductor.
 F.T.V.C. - Female Trolley Vehicle Conductor.
 O.D. - Omnibus Driver.
 T.V.D. - Trolley Vehicle Driver.

The organisation makes no distinction between temporary and permanent traffic employees. This is largely because during the period concerned the firm experienced a shortage of suitable operatives in all grades, and because there is no marked seasonal change in the demand for the services it provides. There was no redundancy during the period.

Considerable care is taken in the selection of employees. A personnel manager is employed, a large part of his time being taken up in interviewing applicants for jobs. Exit interviews are carried out by the Personnel Manager, but these consist mainly in ensuring that the employee fulfils

his contract of service and gives in his notice in the prescribed manner. It is not usual for detailed inquiries to be made about the employees reasons for leaving, nor of the job to which he or she is intending to proceed. Information may be proffered by the employee in some cases but unless this relates to health reasons or domestic problems it is not usually recorded.

The organisation puts its leavers into a number of categories, Discharges; Paid off; Health Reasons; Pregnancy; Domestic Reasons, and Own accord. However it was felt that these categories were neither sufficiently clearly defined, nor sufficiently vigorously applied to be of very much use for our purpose. In the category Health Reasons for example, those who voluntarily resigned - perhaps in some cases using this as an excuse, would jostle side by side with those who, owing to frequent absences on a Medical Certificate (in some cases possibly malingerers) had been asked to resign. In another case a worker will, quite frequently, be given the opportunity of resigning - if he has committed a not too serious offence, perhaps - rather than being discharged. Hence amongst those who leave of their own accord there may be a number whose departure is anything but voluntary in fact. Moreover, where the employee is leaving voluntarily the ostensible reason is quite frequently anything but the real reason. Indeed

he may not himself be conscious of his real motive or motives. With this firm reasons were rarely asked for - and never recorded. In view of such difficulties, it has been thought better in this survey to omit any classification by "reasons for leaving" * with two exceptions. The first is Death. There were two deaths amongst the entrants considered and the persons involved have been excluded from the analyses. Secondly, all departures for what may be called "employer's reasons", including all persons discharged, paid off, or asked to resign have been included in all the analyses, but they have also been treated separately for purposes of comparison.

* It must not be thought because the reasons given for voluntary resignation are often hopelessly incorrect that it is pointless taking any cognisance of them. From the point of view of our inquiry which is concerned with illustrating the usefulness of particular quantitative techniques this may be so. Nevertheless changes in the pattern of reasons shown in a particular firm can provide management with important information regarding the success of its employment policy. It is indeed when quantitative analysis has revealed, say, a deteriorating situation that the search for causes may usefully be assisted by observation of such changes. (See Report based on Labour Turnover in the Administrative County of Monmouthshire (ref. 1958.1) Chapter III.)

There is a strong insistence upon time - keeping, limitation of absenteeism, and honesty. The offences of the majority of employees who are discharged come under these headings.

Past employees applying for reinstatement are subject to careful scrutiny, but provided they have a clean record or can convince the responsible officers that they are likely to be satisfactory in future, re-employment may be offered. It is extremely rare for an employee to be re-engaged a second time unless special circumstances exist.

The majority of entrants for the jobs of conductor have had no previous experience and require training. During the fortnight's training period the worker may be discharged if he shows no aptitude but a simple educational test given before the worker is accepted for training has reduced such discharges to a low level. In addition vehicle sickness, particularly in women, brings about a number of resignations.

As is customary with passenger transport organisations, the operatives are employed on a shift basis. The major part of the work is carried on between 5.30 a.m. and 11.30 p.m., but as there is a great deal of round the clock shift working in the area, skeleton services on certain routes are maintained throughout the night. It might be expected that working schedules necessary under such circumstances

would make the job unattractive to some workers, and that the job would appear more onerous in the winter months. This, coupled with the fact that the wages paid are little influenced by length of service has undoubtedly had some influence on the ability of the organisation to recruit and retain workers. The differential between the pay of a driver and that of a conductor is small, though it might be thought that, particularly with a town service, the work of the former requires more skill and is more onerous. In fact there is - in times of full employment - a considerable wastage of skilled drivers into the Road goods transport industry, or open cast mining - where wages are higher and the driving not necessarily any more difficult. Moreover, the organisation which is the subject of this survey has hardly any country routes, and no long distance or tourist services which impose less strain on the driver and in certain cases are more remunerative.

Established women conductors received the same rate of pay as men. From the point of view of pay, therefore, women in this job are very much better off than in other occupations to which women of comparable attainments could aspire. They are also in a better position relative to men. It might be expected, therefore, that in this case we might observe a tendency to a reversal of the greater

wastage amongst women than amongst men observed in other industries by most investigators in the past. This will be commented upon further in a later part of the chapter.

The organisation employs a number of coloured workers, mainly as conductors, but a few have now been trained as drivers. Owing to the small numbers involved no attempt has been made to analyse these separately from the main body of workers. Omnibus Drivers are recruited from three sources. Firstly, there are those applicants who already hold a public service vehicle licence and who require nothing more than route training before they become fully efficient. In the second category come those already possessed of a heavy goods vehicle licence who may be accepted after varying amounts of training. In some cases such persons may take a Public Service Vehicle test on entry and if accepted go straight on to route training, in other cases a short period of training in the handling of a passenger vehicle may be required. Finally, there are those conductors who desire to be trained as drivers, and who become eligible after the completion of a period of satisfactory conducting service. The length of conducting service required varies in accordance with the need of the organisation for drivers. Only in the most exceptional cases are entrants without experience of large vehicles accepted directly for omnibus driver training. The sources

of Trolley Vehicle drivers are similar excepting that the great majority in this case come under the third category, being internally trained.

Bearing in mind the comments made earlier, on the essential stability of the demand for the transport service and the possible discouraging effect of winter conditions upon the workers an attempt has been made to discover whether workers entering at one time of the year are more or less stable than those entering at another time. If, for example, winter conditions had an adverse effect on new workers stability we should expect to find that workers recruited in spring tended to stay longer than those recruited in winter. For this purpose the one year expectations of service for male and female conductors entrants have been calculated for each quarter in the years 1953 to 1956 inclusive. Tables I and II give the necessary information, and Graph I and II illustrate the change in stability from quarters to quarters. The figures give no obvious indication of a consistent seasonal movement.

T A B L E I

All Male Conductors - Entrants by Quarters.

Year & Quarter.	No.	Leavers in (weeks.)					Expectation of Service to 1 year.					e ₅₂
		1	2	3	4	8	13	26	39	52	weeks.	
1953.												
1	38	1	3	-	1	4	1	11	6	-	26.96	
2	24	1	2	-	-	1	3	7	3	2	26.08	
3	15	1	-	-	-	3	-	4	4	-	25.50	
4	26	-	1	-	-	2	2	5	6	3	31.83	
1954												
1	27	1	1	1	-	3	3	5	3	1	28.24	
2	24	3	2	-	-	2	2	1	-	-	32.71	
3	39	2	1	-	-	7	3	7	7	5	26.63	
4	41	1	1	-	-	4	5	8	9	2	29.02	
1955												
1	56	5	1	1	-	7	6	14	11	1	23.35	
2	21	1	-	1	-	1	2	4	6	-	29.29	
3	38	3	2	-	1	3	2	8	3	3	29.29	
4	59	7	6	-	1	7	8	14	3	1	20.03	
1956												
1	49	1	2	-	-	5	6	9	5	3	30.75	
2	33	2	2	-	-	7	3	6	4	2	23.62	
3	38	3	1	-	-	3	8	11	3	2	22.95	
4	52	2	5	1	1	5	5	9	4	3	27.37	

T A B L E II

All Female Conductors - Entrants by Quarters.

Year & Quarter.	No.	Leavers in (weeks).							Expectation of Service to 1 year.		
		1	2	3	4	8	13	26	39	52 weeks. e52	
1953											
1	71	4	2	-	1	4	4	10	10	7	34.10
2	82	-	1	-	1	4	4	19	8	7	36.54
3	108	1	5	2	-	9	9	16	17	11	32.43
4	69	2	1	1	1	4	2	16	13	3	32.99
1954											
1	102	3	4	-	2	9	15	15	16	8	29.04
2	104	3	7	1	2	6	13	25	11	7	27.55
3	97	2	3	2	2	6	14	15	13	5	30.55
4	54	2	2	1	1	1	5	12	5	6	31.96
1955											
1	95	3	4	1	1	9	9	15	14	5	30.58
2	69	-	3	-	1	5	6	13	9	3	33.21
3	105	5	4	5	4	13	6	12	11	7	29.16
4	102	2	8	1	2	11	5	25	14	10	27.32
1956											
1	103	2	6	-	2	7	13	20	14	4	29.54
2	93	8	1	2	-	11	11	17	11	6	26.95
3	88	4	3	-	1	11	8	16	17	6	27.74
4	90	7	1	4	-	11	10	15	10	1	27.34

A four quarterly trend by the method of moving averages was calculated and the deviations from trend were obtained, with the results shown below.

TABLE B.

Male Conductors.

Year & Quarter.	Actual Expectation of Service.	Trend.	Deviations from trend.	
			-	+
<u>1953</u>				
1	26.96			
2	26.08			
3	25.50	27.75	2.25	
4	31.83	28.75		3.08
<u>1954</u>				
1	28.24	29.71	1.45	
2	32.71	29.50		3.21
3	26.63	28.54	1.91	
4	29.02	27.50		1.52
<u>1955</u>				
1	23.35	27.405	4.05	
2	29.29	26.61		2.68
3	29.29	26.415		2.68
4	20.05	26.63	6.60	
<u>1956</u>				
1	30.75	25.13		5.62
2	23.62	25.255	1.63	
3	22.95			
4	27.37			

<u>QUARTERS.</u>	1.	2.	3.	4.
1953	<u> </u>	<u> </u>	<u> </u>	<u> </u>
1954	- 1.45	+ 3.21	- 1.91	+ 1.52
1955	- 4.05	+ 2.68	+ 2.68	- 6.60
1956	+ 5.62	- 1.63	<u> </u>	<u> </u>

Sum of deviations from trend for each quarter. + 0.12 + 3.26 - 1.43 - 2.00

TABLE C.

Female Conductors.

Year & Quarter.	Actual Expectation of Service.	Trend.	Deviations from trend	
			-	+
1953				
1	34.10			
2	36.54			
3	32.43	33.38	0.95	
4	32.99	31.63		1.36
1954				
1	29.04	30.14	1.10	
2	27.55	29.78	2.23	
3	30.55	29.97	x	0.58
4	31.96	30.87		1.09
1955				
1	30.53	31.40	0.82	
2	33.21	30.65		2.56
3	29.16	29.94	0.78	
4	27.32	29.02	1.70	
1956				
1	29.54	28.06		1.43
2	26.95	27.89	0.94	
3	27.74			
4	27.34			

<u>QUARTERS.</u>	1.	2	3	4
1953	---	---	- 0.95	+ 1.36
1954	- 1.10	- 2.23	+ 0.58	+ 1.09
1955	- 0.82	+ 2.56	- 0.78	- 1.70
1956	+ 1.43	- 0.94	---	---
Sum of deviations from trend for each quarter.	+ <u>0.44</u>	- <u>0.61</u>	- <u>1.15</u>	+ <u>0.75</u>

For both males and females it will be seen that there was no consistent seasonal movement in service expectation. Though the totals for the variations in each quarter gave a very low residual in both cases when added, inspection of the individual deviation in each quarter show that they are as inconsistent as they possibly can be - two negative

deviations with one positive or vice versa.

Investigation over a longer period might possibly show a consistent movement but we must consider it to be unproved. It is true that the stability in the third quarter on an average is low for both males and females but this is made up of divergent components in the individual years. The most that we can say is that there is a possible indication of greater instability in entrants during the third quarter, but that this indication is not sufficiently strong for us to accept it without further evidence collected over a longer period.

An examination of the stability trend for males (Graph I) shows a slight decline over time with a peak with the entrants in the early part of 1954. The female stability trend, though it too shows a decline appears to have a peak early in 1953 and again in early 1955, whilst the first part of 1954 is a period of low stability. This suggests that some of the variable forces at work determining male and female stability over time are not necessarily the same. Though a downward trend in stability appears in both sexes, as can be observed from Graphs I and II, this movement is more noticeable in the case of females than of males. The female stability is however appreciably higher than that of the males. As these two tendencies

might be affected, particularly, by differences in the proportion of males and females taking up Trolley or Omnibus work, as well as by other factors to be noted later, a more detailed analysis is needed before any firm conclusion can be drawn.

The stability of Omnibus Driver entrants was analysed for possible seasonal movement (Trolley Vehicle Drivers were too few in number to be analysed separately) but none were observed. This is not altogether surprising as the transport firm has taken steps to minimise possible developments in this direction. It is well known that a number of drivers prefer to take up the more remunerative coach or taxi service during the summer months and to work on the town services during the winter. Hence if employment was offered to such persons, say during September they could be expected to remain no more than five or six months. One might, therefore, have expected the autumn and winter entrants to show a reduced stability for this reason. All applicants for driving vacancies who require any training whatsoever are required, however, to enter into a contract to remain with the company for at least one year and this coupled with careful selection has gone a considerable way to removing this difficulty.

Each class of worker was now analysed separately, with the results set out in Tables II, IV, V, VI, VII, and VIII.

T A B L E I V

Male Entrants - Omnibus Conductors.

Year of entrance.	Weeks,			Years and months.			3y	4y	e 52								
	1	2	3	4	8	13				26	39	1y 3m	1y 6m	1y 9m	2y		
1953	entrants																
q _x %	3.1	5.4	-	1.1	9.0	6.3	24.7	35.6	7.7	5.0	10.5	-	12.5	30.8	12.5	30.93	weeks.
t _x %	96.9	91.7	91.7	90.7	82.6	77.5	58.3	37.5	34.6	27.7	24.8	24.8	21.7	15.0	13.1		
102	entrants																
1954	entrants																
q _x %	2.9	4.	1.1	-	12.8	12.2	22.5	31.3	19.4	24.	5.3	29.4	8.3	45.5		29.06	weeks.
t _x %	97.0	93.1	92.2	92.2	80.4	70.6	54.7	37.6	30.3	23.0	21.8	15.4	14.1	7.7			
140	entrants																
1955	entrants																
q _x %	7.8	3.9	1.6	0.8	10.7	14.8	34.8	32.7	12.5	22.2	9.5	5.3	16.7			24.55	weeks.
t _x %	92.1	88.6	87.1	86.3	77.1	65.6	42.8	28.8	25.2	19.6	17.7	16.8	14.0				
128	entrants																
1956	entrants																
q _x %	5.5	5.8	0.9	0.9	9.9	11.1	32.0	20.0	16.2							28.48	weeks
t _x %	94.5	89.1	88.3	87.5	78.8	70.1	47.7	38.1	31.9								

T A B L E V

Female entrants - Trolley Vehicle Conductors.

No. of entrants.	Weeks and months and years.																
	1	2	3	4	8	13	19	26	39	1y	1y3m	1y6m	2y	3y	4y	5y	
1953	125	124	117	116	113	104	95	73	52	45	37	34	33	28	18	8	29.89
entrants	%	99.2	93.6	92.8	90.4	83.2	76.0	58.4	41.0	36.0	29.6	27.2	26.4	22.4	14.4	6.4	wks.
1954	123	120	113	111	108	96	82	62	47	38	33	27	23	18	16		28.53
entrants	%	97.6	91.9	90.2	87.8	78.1	66.7	50.4	38.2	30.9	26.8	21.9	18.7	14.6	13.0		wks.
1955	111	107	100	96	91	85	79	60	48	38	31	29	26	23			30.00
entrants	%	96.4	90.1	88.5	82.0	76.5	71.7	54.1	43.2	34.2	23.5	26.1	23.4	20.7			wks.
1956	111	101	97	95	95	87	79	57	42	38							29.03
entrants	%	91	87.4	85.6	85.6	78.4	71.2	51.4	37.8	34.2							wks.

242

T A B L E VI

Female Entrants- Omnibus Conductors.

No. of entrants.	Weeks, years and months.												e			
	1	2	3	4	8	13	20	32	1y	1y3m	1y6m	2y		3y	4y	
1953 205 entrants	200	198	196	196	183	173	134	107	86	73	63	56	44	28	18	35.85 weeks.
%	97.3	96.6	95.6	95.6	89.3	84.4	65.4	52.2	41.9	35.6	30.7	27.3	21.5	13.7	8.8	
1954 234 entrants	227	218	216	212	202	169	122	92	75	61	52	43	40	27	29.54 weeks.	
%	97.0	93.2	92.3	90.6	86.3	72.2	52.2	39.3	32.1	26.1	22.2	18.4	17.1	11.5		
1955 263 entrants	257	245	242	239	207	187	141	105	90	78	64	54	50	29.90 weeks.		
%	97.7	93.2	92.0	90.9	78.7	71.1	53.6	39.9	34.2	29.7	24.3	20.5	19.0			
1956 263 entrants	252	245	241	238	206	172	126	89	76	27.48 weeks.						
%	95.8	93.2	91.6	90.5	78.3	65.4	47.9	33.8	28.9							

T A B L E VII

Male Drivers

Period of Entrance	No. of Entrants.		Survival to weeks.				e			
	1	2	3	4	8	13		26	39	52
All Years.	43	43	42	42	42	37	33	28	24	40.13 weeks.
%	100	100	97.7	97.7	97.7	86.04	76.74	65.1	57.1	
<u>Trolley Vehicle Drivers.</u>										
All Years.	484	474	466	460	428	395	313	258	221	35.44 weeks
%	99.2	97.5	96.3	95.1	88.4	81.6	64.7	53.3	45.66	
<u>Omnibus Drivers.</u>										

T A B L E VIII

Omnibus Drivers..

No. of entrants.	weeks, years and months.										°52						
	1	2	3	4	8	13	26	39	1y	1y3m		1y6m	2y	3y	4y		
1953	96	96	95	94	86	82	62	53	44	34	27	24	21	10	7	°52	°104
%	100	100	98.95	97.9	89.6	85.4	64.58	55.21	45.8	35.4	28.1	25.0	21.9	10.4	7.3	36.21	52.12
																WKS	WKS.
1954-103	102	101	99	97	93	84	70	52	45	36	28	24	21	14		35.43	50.70
%	99.1	98.1	96.1	94.2	90.3	81.56	67.96	50.5	43.7	35.0	27.2	23.3	20.4	13.6		WKS	WKS
1955	153	152	150	147	146	136	127	94	79	68	50	43	35	29		34.67	49.88
%	99.4	98.1	96.1	95.5	88.9	83.0	61.4	51.6	44.4	32.7	23.1	22.9	18.95			WKS	WKS
1956	132	130	127	125	123	113	102	87	74	64						35.54	--
%	98.5	96.2	94.7	93.19	85.6	77.3	65.9	56.1	48.5							WKS.	--

A complication arose here in connection with male conductors. As has been previously remarked male conductors provide one source for the recruitment of drivers. Conductors who transferred to driving during their first year of service were excluded entirely from the seasonal analysis above, as it was felt that due to the relatively small number involved in each quarter any adjustment on the lines of the formulae of Chapter III would be unreliable. Moreover as our aim was not to compare stability between one class of worker and another the exclusion could only be of importance if those selected for driver training were subject to seasonal influences other than those applicable to the main body of male conductors. Of this we have no evidence either way, but in view of the negative results of the seasonal enquiry it is improbable that their inclusion would have appreciably altered the result. However, when we are seeking to compare the stability of the male conductors with female conductors and with drivers, we must be careful to retain entrants in our calculations until they leave the experience, (i.e. transfer to driving). This has been done in the figures for male conductors given in Table III. Because Conductors, desirous of being trained as drivers apply to have their names entered on a list, (which is done if their conductoring record is satisfactory) and they are always aware a few weeks before they are transferred when they will take up training. Once a man

TABLE III.

[The table content is extremely faint and illegible due to the quality of the scan. It appears to be a multi-column table with several rows of data.]

is aware that he has been selected, his stability is likely to increase, because the possession of a Public Service Vehicle of Trolley Vehicle licence is a great asset, not lightly to be rejected, once it appears to be within the man's grasp. Therefore, at whatever stage of his service a man transfers to driver training his stability characteristics are likely to have changed sometime before. The conventional method, therefore, of taking the time of transfer as the centre of the length of service period concerned is likely (assuming a symmetrical distribution of transferees within the period) to over estimate the stability of the conductor group. To offset this, therefore, the transferees have been excluded in each case from the beginning of the period in which they left. If, for example we commence with 42 male entrants in year 1 and during length of Service period above 13 and under 26 weeks, 9 are transferred to driver training we have excluded them from the conducting force during the whole of this period. The calculations to obtain q_x (see Chapter 2) for the male Trolley Vehicle Conductor entrants in 1953 are shown below.

	<u>Leaving with weeks.</u>								
Entrants up to	1.	2.	3.	4.	8.	13.	26.	39.	52
42	-	2	-	-	2	1	9	4	3
	<u>Transfers within.</u>								
	-	-	-	-	-	-	9	2	1
	-	2	-	-	2	1	9	4	3
q_x	42			40	38	(37-9)	(32)	(23-1)	

$$\therefore q_x = \frac{1. \quad 2. \quad 3. \quad 4. \quad 8. \quad 13. \quad 26. \quad 39. \quad 52}{4.762 \quad - \quad - \quad 4.999 \quad 2.632 \quad 32.14 \quad 23.53 \quad 25}$$

The survival curve (curve of t_x) and e_{52} is now obtained in the usual manner. Table III and IV shows only the original number of entrants, q_x and t_x

It will be observed that in one case, that of the female Omnibus Conductors there is evidence of a decline in stability. This is apparent both from the survival curves and the one year expectation of service. Of the 1953 entrants almost 42% remained for at least one year whilst of those entering in 1956 less than 29% remained. The corresponding e_{52} were 35.85 weeks and 27.48 weeks. It is true that the number of recruits taken in increased (see Table VI) and that poorer quality material might therefore have been accepted. Nevertheless, these additional recruits would not have been necessary if there had been no increase in wastage in the first place. Indeed the increased recruitment is just as likely to be one of the effects of increasing labour instability as its cause. Of the other group which showed some decline in stability - the Male Trolley Vehicle Conductors showed a peak of stability for the 1954 entrants, with over 50% remaining beyond one year. However if we trace the survival over a two year period it can be seen that the 1955 entrants with a survival of 36.86% to the end of their second year give the most favourable result. The low e_{52} for this group (31.83) weeks arises because of the unusually large wastage during the first four weeks of service. Fifteen

per cent of the entrants left during this period against a maximum of 7⁵ for the other years' entrants.

The value of employing both survival per centages and expectations of service is also brought out by the contrast between the survival of the 1953 entrants and the 1956 entrants in this group. The 1953 Male Trolley vehicle Conductor entrants show a one year survival per centage of 33.29 and an expectation of service of 33.67 weeks. The 1956 entrants show a higher survival per centage, 36.82 but a lower service expectation - 30.01 weeks. This arises because the tendency of the 1956 entrants to leave relatively early is more than offset by their greater stability later on. It is important to note how the two measures employed together summarise the survival curve more effectively than if either one was employed separately.

Amongst the Female Trolley Vehicle Conductors a fairly constant stability trend for each group of entrants is observed during the first year of service and the level of survival compares favourably with the Female Omnibus Conductors. During the second year of service however, no such differential can be observed. The contrast between the ~~small~~ variability in survival from year to year between Female Trolley Vehicle Conductors and Female Omnibus Conductors in the first year of service is most remarkable. Although, as has been mentioned in an earlier chapter the

usual tests of significance can not be employed with this type of data, there would appear to be little doubt that the differences, in stability trends are real.

It is true that the number of Female Trolley Vehicle Conductors recruited declined very slightly (from 125 in 1953 to 111 in 1956) with the years, whilst there was a marked increase (1953 - 205 and 1956 - 263) in Female Omnibus Conductor recruitment. This might have accounted for some of the observed differences - but whether this is a major factor or not the analysis indicates that a thorough investigation into possible causes might be useful in helping in the formation of future policy.

An inspection of the Male Omnibus Conductor survival figure reveals a decline at first, but with the stability for the most recent year, showing a marked improvement.

The stability of the groups once again are inversely correlated with the number of entrants as might be expected from what was said earlier in connection with the Female Omnibus Conductors.

A comparison of the stability of the four categories of conductor reveals a number of interesting points. Male Trolley Vehicle Conductors show the greatest stability with the possible exception of the 1953 entrants. Here the numbers were so small as to give rise to figures subject

to rather more error than in other cases. There were only 42 in this category, of which 12 transferred to driving during the latter part of the first year of service. Moreover the method of exclusion adopted, is, as explained possibly slightly biased so as to decrease the survival percentages of the remaining conductors. The lowest stability is shown by the Male Omnibus Conductors, with the female Conductors of both types in between. So far, then, as Trolley Vehicle conductors are concerned the males are by far the most stable and for Omnibus conductors the females have the best record. Though we must not fall into the trap of assuming a relationship of cause and effect where none exists it might nevertheless be worthwhile to step up recruitment of Trolley Vehicle Conductors from amongst males and that of Omnibus conductors from amongst females on an experimental basis and observe whether or not overall stability increased. It might be stressed here that this should only be done if steps can also be taken to discover the cause of the decline in female omnibus conductor stability which has previously been commented upon. We would add that the type of pointer given by the figures just referred to is frequently the best that we can expect from our statistics, because of the very large number of variables which may be involved, and their non-random nature. It is the best that we can do, but nevertheless it can be remarkably useful at times, as indeed it has been in this

case to the firm involved.

An examination of the stability of drivers gives us the opportunity to assess the efficiency of the contract scheme in retaining drivers for a year or more, as well as enabling us to compare the stability of Omnibus drivers with those driving Trolley Vehicles. Whilst it proved possible to analyse the direct entrant Omnibus drivers into yearly entrance groups, Trolley Vehicle drivers could not be so divided as there were only 43 direct entrants during the whole four years. This in itself is significant when we compare it with the numbers of employees in the two driver categories given in Table A. It certainly appears from this that Trolley vehicle drivers are much more stable than Omnibus drivers. A comparison of the survival curves and the expectations of service to one year confirms this. Whereas over 57% of Trolley Vehicle Drivers remained after one year, of the Omnibus driver entrants only 45% survived the same period (Table VII, Graph VII) and this in spite of the fact that a greater proportion of the Omnibus drivers were subject to the yearly contract. Employees who enter directly as Trolley Vehicle drivers are nearly always experienced in handling such vehicles, being either ex-employees of the company or of a similar organisation in another area. Few heavy goods drivers for example choose to take up Trolley Vehicle driving in preference to Omnibus driving. In the first place there are far more opportunities for employment

elsewhere in Omnibus driving than in Trolley Vehicle driving. A trained Omnibus driver is thus more mobile than his Trolley Vehicle driving counterpart. Secondly remunerative coach tour work is often easily available for the trained Omnibus driver. Lastly, the possession of a P.S.V. licence held by the Omnibus driver is recognised as a valuable qualification by employers requiring goods drivers outside passenger transport.

Quite apart from the reasons advanced above for a high stability amongst Trolley Vehicle driver entrants another reason exists why these workers can be expected to form a more stable group than Omnibus Drivers. The number of Trolley vehicle drivers directly engaged from outside the firm, given above was 43 whilst those accepted for training from conductors already employed numbered 62. Of the Omnibus drivers during the same period there were 484 engagements from outside the firm and only 50 transferred from conducting. The differences in the proportion of internal transfers would account for large differences in stability between the two classes of workers. Conductors are not accepted for training if their work has not been satisfactory, and, hence, if we accept that there is likely to be some relationship between performance in ones job and stability, drivers recruited from such a source will tend to be more stable than new entrants. Furthermore, conductors who are transferred are already accepted members of the working

force of the firm and will not be subject to many of the disturbing forces which affect persons when they first enter the company's service. The latter must be borne in mind when we come a little later on, to compare the stability of new entrants drivers with ^{that of} transferred conductors.

For the moment, however, we will consider the stability of Omnibus Drivers in a little more detail. Reference to Table VIII reveals very small variability in the stability of Omnibus Drivers over the first year of service. The Omnibus drivers are more stable over the period than the two groups of male conductors. The proportion of Omnibus drivers surviving to the end of the second year of service compares unfavourably with the stability of Male Trolley Vehicle Conductors and is only slightly better than that of the Male Omnibus Conductors. Whilst it is not suggested by this comparison that conductors and drivers should show similar survival curves the observed results are compatible with the conclusion that many of the contract drivers (who make up the majority of the entrants concerned) tend to leave within a short time of their contract being completed. Indeed the results suggest that the contract, whilst retaining the relatively unstable drivers for the period of one year has only a small effect in improving the long term stability of the Omnibus drivers as a whole. (If we had been able to distinguish in our analysis between non-contract drivers

entering as fully trained and contract entrants, a more definite statement could be made. Unfortunately this has not proved to be possible)

A comparison was now made between Omnibus driver entrants and conductors transferred to Omnibus driving (Table IX, and Graphs IXa and IXb). (see page 256 for Table IX.)

Of conductor transfers to Omnibus drivers who had the opportunity to complete one year's service, 36% remained after one year. The expectation of service 48.27 weeks was very high. Some of these, transferred in 1956 had no opportunity to complete two years of service during the period of our inquiry so they have been excluded from the survival curve which was extended to the end of the second year of service. It will be seen that this survival curve is not very different from the first one over the first year of service. It would seem to be legitimate to assume that the exclusion of the 1956 entrants is not, therefore, likely to bias our results. A remarkable decline in stability in the second year of service is to be noted. By the end of the second year only 29.03% of the transferees remain. The expectation of service to two years is high, but this reflects the stability of the first year as well as the relatively unstable period following. This group of men, who according to our previous comments might be

T A B L E IX

A Comparison of Transfers to Omnibus Drivers with Omnibus Driver Entrants.

Period/No. of Entrants.	1	2	3	4	5	Survival to weeks, years and months.	1y 1y3m 1y6m 1y9m 2y	e52	e104
						8 13 26 39			

Omnibus Driver Entrants.

All Years (1953-1956 inclu)	484	480	474	466	460	428	395	313	258	221	35.44
%	99.2	97.85	96.3	95.1	88.4	81.6	64.7	53.3	45.7		
	50	50	50	50	49	49	47	43	43		
%	100	100	100	100	98.	98.	94.	86.	86.		48.22

Omnibus Driver Entrants.

Years 1953-1955 (Incl)	352	350	347	341	337	315	293	226	184	157	120	98	83	71	50.73
%	99.5	98.6	96.9	95.5	89.5	83.3	64.2	52.3	44.6	34.1	27.9	23.6	20.2		

Omnibus Driver Trainees (From Time of Transfer)

31	31	31	31	30	30	29	27	27	14	13	11	9	60.37
%	100	100	100	96.8	96.8	93.6	87.1	87.1	45.2	41.9	35.5	29.03	

expected to be of greater stability than direct entrants to driving shows a decline of over 57% in the second year of service. The result reinforces our earlier suggestion that the effect of the contract of service is minimal in encouraging long period stability. In other words the successful retention during the first year does not succeed in identifying workers (who would otherwise have left) with the working force to such an extent that they remain when the element of compulsion is removed. This is an important point as it indicates that the mere passage of time as such does not make a worker more stable in a job to any appreciable extent. It would be interesting to discover if any other cases where contract service is the rule, display similar features.

Table X and Graph X (Table X page 258) give data for conductors transferred to Trolley Vehicle drivers similar to that discussed above for transfers to Omnibus Drivers. The pattern in the first year of service, shows a greater stability in this group than in the corresponding omnibus drivers, but (perhaps owing to the small numbers involved) the two year survival curve follows more closely the omnibus driver transfer curve, though with a much smaller decline in survival during the second year of service.

(contd. on page 259)

T A B L E K

A Comparison of Transfers to Trolley Vehicle Drivers with T.V. Driver Entrants.

Period/No. of Entrants.	Survival to weeks				years and months.				°			
	1	2	3	4	8	13	26	39		1y3m	1y9m	2y
<u>Trolley Vehicle Driver Entrants.</u>												
All Years (1953-1956 incl)	43	43	42	42	42	37	33	28	24	40.13	52	104
%	100	100	97.6	97.6	97.6	86.0	76.7	65.1	57.1	weeks		
<u>Transfers to T.V. Driver (from time of Transfer)</u>												
62	62	62	62	62	60	55	50	48		46.26		
%	100	100	100	100	96.8	88.7	80.7	77.4		weeks		
<u>Transfer to T.V. Driver (from time of Transfer)</u>												
37	37	37	37	37	36	34	32	26	21	81.62		
%	100	100	100	100	97.3	91.9	86.5	70.3	56.8	weeks.		

258

Taking into consideration the lack of opportunity for mobility in Trolley vehicle drivers this shallower decline is probably of real significance despite the small numbers involved. Unfortunately owing to the direct Trolley Vehicle driver entrants (Table VII) being concentrated mainly in 1956 a satisfactory curve over the second year of service cannot be constructed for this group. The indications are, however, that between 30% and 40% of workers in this category survive to the end of the second year of service. Thus, apart from the higher overall stability of Trolley vehicle drivers generally our remarks regarding the retention of omnibus drivers during their second year could equally apply to those employed on Trolley vehicles.

As was mentioned in the introductory remarks to this chapter persons leaving at the request of the employer (discharge for misconduct or unsatisfactory performance of duties - but not those who resigned for health or other reasons on the employers suggestion) have been analysed separately (Table XL)(page 260) . We refer to such leavers as 'discharges'. The percentage of entrants discharged within one year was high amongst conductors (range 10.58% ^{21.3-47%}) almost twice as high as amongst entrant omnibus drivers.

This can be attributed to at least two main causes -

(contd. page 261)

T A B L E XI

Discharged Employees
All Years - Entrants.
(1953 - 56 incl.)

Total of 1953/56
entrants discharged
during 1953 - 57
inclusive.

	Entrants discharged within 1 yr.	Survival in weeks.				26	39	52w. entrants discharged within 1yr	% of entrants discharged within 1yr
		1	2	3	4				
56	50 %	<u>Female Entrants (T.V. Conductors) Discharged.</u>							
		49	44	43	40	37	29	17	8
		98.	88.	86.	80.	74.	58.	34.	16.
30	27 %	<u>Male Entrants (T.V. Conductors) Discharged.</u>							
		26	23	23	22	16	10	6	4
		96.3	85.2	85.2	81.5	59.3	37.03	22.2	14.8
107	102 %	<u>Female Entrants (Omnibus Conductors) Discharged.</u>							
		99	95	94	91	78	55	30	9
		97.1	93.2	92.2	89.2	76.5	53.9	29.5	8.82
72	65 %	<u>Male Entrants (Omnibus Conductors) Discharged.</u>							
		64	57	56	54	42	32	10	2
		96.2	87.7	86.2	83.1	64.7	49.2	15.4	3.08

1. Drivers were at least partly experienced when engaged directly and would not have been employed at all if their record had not shown good driving ability,
2. Drivers do not handle cash and thus have less opportunity than conductors to be discharged for dishonesty.

Of the conductors, females show a somewhat lower record for discharges than males - amongst the latter a peak of almost 14% of male omnibus conductors were discharged within a year of entry. This excess of discharges amongst males cannot account for the differences in general stability between male and female conductors noted on an earlier page, as the discharge percentage for Trolley vehicle male conductors than that for Female Trolley vehicle conductors although Male workers in this category are as a whole more stable than the female ones.

Percentages of discharges in the first year of service have been given because all entrants considered (1953-1956) had the opportunity to complete one year of service at least. To use the total number of discharges from the entrants for all years combined could be misleading as not all entrants have been observed ~~over~~ for the same length of time. For example an entrant in 1953 could be observed to leave in his 1st., 2nd. 3rd., or 4th. year of service, one entering in 1954 would only be observed for his 1st., 2nd., and 3rd. years, and so on. It is, nevertheless,

instructive to compare for the whole group in each category, the number of workers discharged in the first year of service with all discharges from that group. The figures are given in Table XI (page 260). It will be seen that very few entrants are recorded as being discharged after one year's service has been completed, and although some allowance must be made for unequal duration of exposure to risk referred to above, it is evident that the great bulk of those discharged leave within one year.

If we take four weeks as the length of time a new entrant requires to attain a reasonable standard of efficiency we can say that for all job categories 80% of the discharges represent a loss of trained men and women within one year - men and women who, in the main, it has proved unprofitable to engage. An investigation into possible differences in characteristics and background of such discharged persons from those of other entrants might be useful in pointing the way towards more efficient selection and training.

Another sub-group of interest for which information is available is that made up of those re-engaged (Table XII page 263). As mentioned earlier, eligibility of a worker for re-engagement depends upon his or her record when originally employed by the firm and upon the personnel officer's assessment at the interview. Not all persons,

T A B L E XII.

Survival of Re-engaged Workers (All years)(Conductors.)

No. of persons re-engaged.	52 weeks.									
	1	2	3	4	8	13	26	39	52.	
Female Omnibus Conductors.	99	98	97	96	89	78	60	38	35	32.17
	%	99.0	98.0	95.9	95.9	89.9	78.8	60.6	38.4	35.4
Male Omnibus Conductors.	30	30	30	30	29	27	21	13	9	35.13
	%	100	100	100	100	96	70	43	30	
Female T.V. Conductors.	54	53	52	52	47	40	31	24	22	32.31
	%	98.2	98.2	96.3	96.3	87.1	74.1	57.4	44.4	40.74
Male T.V. Conductors.	23	22	22	22	22	21	14	12	10	35.8
	%	95.7	95.7	95.7	95.7	91.3	60.9	52.2	43.48	

PAGE 263

by any means, who apply are re-engaged and obviously the aim is to ensure as far as possible that those who are re-engaged are at least as likely to stay as new entrants. A comparison of the Survival curves and one year expectations of service is made between re-engagements and new entrants in Graphs XIIa, b, c, and d. It will be seen that nowhere does the stability of re-engaged workers compare unfavourably with that of the new entrants. Bearing in mind that the number of re-engagements in some categories is small and not necessarily distributed in each entrance year in the same proportions as the new entrants, it has been thought advisable to compare each re-engagement survival curve (for all years' entrants) with the survival curves for each of the four years in the corresponding job, rather than with an average of the four years. In the case of omnibus drivers (Table XIII 265) and trolley vehicle drivers the re-engaged workers showed a much greater stability. Both the survival curves to one and two years, and the service expectations indicate a consistently higher trend - and this despite the fact that re-engaged drivers will hardly ever be contract men (the only exception to this being where a previous employee had allowed his P.S.V., licence to lapse in the period between first leaving and his re-engagement and could not obtain immediate renewal). The greater stability is not

(contd. page 266)

T A B L E XIII.

Survival of Re-engaged Workers (Drivers).

Mo. of persons re-engaged.	Survival to weeks.				1y 1y 3m 6m 9m 2y.
	2	4	8	13	
Omnibus Drivers Re-entrants. (1953-56) incl.	104	104	103	103	39 52
	%	100	99.1	99.1	62.5 53.9
			94.2	85.6	72.1 62.5 53.9
					52 weeks. - 38.9.
Omnibus Drivers (re-entrants) 1953-55.	73	73	73	73	47 40
	%	100	100	100	64.4 54.8 49.3
			95.9	90.4	75.5 64.4 54.8 49.3
					41.1 39.7 34.3
Trolley Vehicle Drivers Re-entrants (1953-56)	18	18	18	18	15 13
	%	100	100	100	83.3 72.2
			100	100	94.4 83.3 72.2
					52 47.31.

altogether surprising when we consider that only in very special circumstances will men have broken their contract originally be re-engaged. Secondly drivers who return will not normally do so merely because they cannot get another job (good drivers are not plentiful in relation to the demand for their services at current wages) but because they have some positive reason for returning. They may thus be expected to have weighed the advantages and disadvantages of their return, with a consequent bias in favour of stability.

We can conclude this section by suggesting that re-engagement policies for drivers appear to be sound but that there is some room for improvement in other categories. Comparisons of the type we have been making afford a useful means of measuring the efficacy of re-engagement policies.

Unfortunately the firm keeps no full record of the civil status of its male employees. Records are kept for females in this respect however, and it has been possible to make a comparison between the stability of married and single females. Widowed and divorced females are classed as single, but the numbers of persons in these two categories was so small (11) that they are not likely to have any appreciable influence on our results. All females who were married during their period of service were

excluded entirely as it was felt that their inclusion might introduce a bias into the results which was not desired. The number of females so excluded was 98. In addition for a small number of females no information was available.* (Table XIV gives the survival figure for each entrance year.) (see page 268)

Superficially, unmarried females are slightly more stable in each entrance year. This superior stability is only evidenced during the first year of service, thereafter married women show more stability than the unmarried. (Graph XIVa, b, c, and d.) The single females who were married during the course of their service were added to the unmarried females to see if the above movement was altered in any way. A slight accentuation of the instability of the group after the first year of service was noted, but otherwise no appreciable change was observed. It was also found that the unmarried and married female were fairly evenly distributed amongst the two job categories. Bias from this source seems to be unlikely in any case.

* It was impossible to apply the methods of partial exposure (even if they had been considered suitable in this case), as often no date of marriage was given for those females changing status.

T A B L E XIV

Married and Single Females.

Year of No. of Entrants.	Survival to weeks, years and months.												e 52 wks.				
	1	2	3	4	8	13	26	39	1y	3m	6m	1y		1y 9m	2y	3y	4y
1953	75	75	73	71	63	58	40	35	28	23	19	19	19	17	13	9	32.24
%	100	97.3	97.3	94.7	84.0	77.3	53.3	46.6	37.3	30.7	35.3	35.3	35.3	22.7	17.3	12.0	
1954	131	121	121	117	108	106	60	45	36	35	28	27	27	24	20		27.36
%	95.4	92.4	92.4	89.3	82.4	82.4	65.7	45.8	34.4	27.5	26.7	21.4	20.6	18.3	15.3		
1955	181	175	163	159	157	140	125	84	68	55	48	45	40	39			28.00
%	96.7	90.1	87.9	86.7	77.3	69.1	46.4	37.6	30.4	26.5	24.9	22.1	21.6				
1956	132	125	118	114	113	101	85	56	37	33							25.37
%	94.7	89.4	86.4	85.6	76.5	64.4	42.4	28.0	25.0								
1953	220	214	207	204	203	190	176	135	97	77	61	54	47	37	22	15	32.72
%	97.3	94.1	92.7	92.3	92.3	86.4	80.0	61.4	44.1	35.0	27.7	24.6	21.4	16.8	10.0	6.8	
1954	198	194	182	178	175	162	140	107	82	68	52	43	35	32	22		30.19
%	97.9	91.9	89.4	88.4	88.4	81.8	70.7	54.0	41.4	34.3	26.3	21.7	17.7	16.2	11.1		
1955	168	164	157	154	148	128	118	95	73	61	52	41	34	29			30.64
%	97.6	93.5	91.7	91.7	88.1	76.2	70.3	56.6	43.5	36.3	30.9	24.4	20.3	17.3			
1956.	232	218	214	212	210	183	158	120	89	78							29.11
%	94.0	92.3	91.4	90.5	78.9	68.1	51.1	38.4	33.6								

(Females changing civil status whilst in service are excluded completely.)

Unmarried females were, on the whole, younger than married ones, but whilst this might be expected to make them somewhat less stable (as we show a little further on) it would not provide an explanation of the reversal in stability observed. If the observed reversal is statistically significant (and a decision on this awaits further inquiries) it might be accounted for in the following manner. The forces specially affecting the stability of married women (with the exception of pregnancy) may be expected to show themselves at an early stage in her service. The arrangements for the care of children, the conflict of shift work with the arrangements of meals for the family, the influence of the husband make themselves felt acutely at an early stage. We must add to this the possibility that the married women may take a job merely to earn sufficient for a particular piece of expenditure e.g. holidays. If the difficulties mentioned can be overcome in the early months they are less likely to be disturbing factors later; if they prove insuperable the married women will not delay her resignation for long. One factor promoting instability in young married women is, however, likely to grow as time passes. The longer she stays in employment - up to a certain age (and we must not forget that over 50% of all female entrants are under 21) the more likely she is to leave in order to get married. Though from our figures we have eliminated those who

married and remained with the firm, information on the numbers leaving in order to get married were unfortunately not available. It is known, however, to be large. Many women marry their male co-workers. Indeed, the possibility of male company is one attraction of the job to females.

It would be unsafe to generalise from experience in one firm, and confirmation or otherwise of this tendency must await further investigations. It is, perhaps, not entirely unnecessary for us to point out that only by methods of analysis similar to the ones used here would movements of this kind be revealed.

The next analysis was performed with the intention of discovering if there was any relationship between age and length of service achieved. Tables XV and XVI (pages 271 and 272) show the survival experience, for the four years combined of Male Omnibus Conductors and Male Trolley Vehicle Conductors in convenient groups showing age on entrance (separately) from 18 years to 51 years. Owing to the small numbers involved a 10 year interval has been selected for the last group, - aged 41 and under 51 on entry. It is unusual to engage (or even to receive applications from) persons above this age. There were two Male Trolley Vehicle Conductors and two Male Omnibus Conductors engaged above 51 years of age but as their inclusion would have necessitated a class interval of

T A B L E IV.

Age of entrance, and Length of Service of Male Conductors. (see Graph XVI)

Age Group.	No. of Entrants.	Male Omnibus Conductors.										52 weeks.			
		1	2	3	4	8	13	26	39	52.					
under 21	63 95.5	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	61 92.4	29.27
21 & under 26.	151 96.0	139 92.1	139 92.1	137 90.7	111 73.5	91 60.3	51 33.9	28 18.5	26 17.2						22.22
26 & under 31	60 90.0	51 85.0	50 83.3	49 81.7	46 76.7	41 68.3	22 36.7	17 28.3	12 20.0						24.48
31 & under 36	48 95.8	42 87.5	41 85.4	41 85.4	36 75.0	31 64.6	21 43.8	15 31.3	12 25.0						25.89
36 & under 41	28 100	27 96.4	27 96.4	27 96.4	24 85.7	22 78.6	14 50.0	11 39.3	9 32.1						30.46
41 & under 51	25 86.2	22 75.9	22 75.9	22 75.9	18 62.1	16 55.2	15 51.7	8 31.0	8 27.58						25.09

Excludes completely conductors transferred to driving in first year of service.

T A B L E XVI

Age of entrance, and Length of Service of Male T.V. Conductors.

Age Group.	No. of Entrants.	1	2	3	4	8	13	26	39	52	52 weeks.
under 21	26 %	23 88.5	23 88.5	23 88.5	22 84.6	21 82.6	18 69.2	12 46.2	7 26.9	7 26.9	26.31
21 & under 26	51 %	50 98.1	44 86.3	44 86.3	44 86.3	34 66.7	27 52.9	15 29.0	10 23.0	8 15.69	20.20
26 & under 31	35 %	35 100	33 94.3	33 94.3	33 94.3	29 82.9	26 74.3	23 65.7	20 57.1	17 48.57	35.28
31 & under 36	29 %	28 96.6	28 96.6	28 96.6	28 96.6	24 82.76	20 79.3	20 68.97	15 51.72	15 51.72	35.73
36 & under 41	13 %	12 92.3	12 92.3	12 92.3	12 92.3	11 84.6	9 69.2	8 61.5	7 53.9	5 38.47	33.12
41 & under 51	23 %	19 82.6	18 78.3	18 78.3	18 78.3	18 78.3	17 73.92	13 56.5	11 47.8	9 39.13	31.13

Excludes completely conductors transferred to driving in first year of service.

41 - 61 in both cases these persons were excluded from the data:

From Graph XVI showing the service expectations (e_{52}) we see that in both categories the lowest stability is shown in the 21 under 26 age group, the under 21 group showing considerably greater stability. Beyond the age 26 the experience of the two groups differ - Male Trolley Vehicle Conductors showing high stability at the age between 26 and under 41 with a slight decline thereafter, whilst Male Omnibus Conductors show a marked increase in stability only in the 36 - 41 age group. The numbers involved are sometimes, particularly in the case of the Male Trolley Vehicle Conductors rather small and hence we must accept some of these conclusions with reserve. We are probably justified in assuming that the following common factors emerge, a relatively favourable stability record of the under 21s., a marked instability of the 21 and under 26s., and some indication of increasing stability into the early 40s., with a decline thereafter.

The results obtained from a similar analysis of the female conductors are given in Tables XVII and XVIIIa, and Graphs XVII and XVIII. As the number of females engaged over the age of 46 is negligible the analysis covers only females below that age, and 18 or above.

T A B L E XVIII
(No Graph)

Age and Length of Service of Female
Omnibus Conductors.

Age on entrance.	No. of entrants.										52 weeks.
	1	2	3	4	8	13	26	39	52		
a. Entrants in all years (1953-56 incl.)											
under 21.	502	493	480	476	471	426	374	275	196	158	30.5
	%	98.2	95.6	94.8	93.3	84.9	74.5	54.8	39.0	31.48	
21 and under 26.	229	224	215	214	213	189	158	117	89	77	29.48
	%	97.8	93.9	93.5	93.0	82.5	69.0	51.1	38.9	33.6	
26 and under 31.	101	99	95	92	90	85	77	60	48	42	32.81
	%	98.0	94.1	91.1	89.1	84.2	76.2	59.4	47.5	41.6	
31 and under 36.	74	68	66	65	64	55	53	44	37	32	32.18
	%	91.9	89.2	87.9	86.5	74.3	71.6	59.5	50.0	43.2	
36 and under 46.	42	38	34	34	34	32	30	22	19	16	31.88
	%	90.5	80.98	80.98	80.98	76.2	71.4	52.4	45.2	38.1	

Information on 17 entrants not available.

T A B L E A VIII a (No Graph)

Age and Length of Service of Female T.V. Conductors.

Age on Entrance	No. of Entrants.	1	2	3	4	8.	13	26	39	52.	52 week..
under 21	203	194 95.6	182 89.7	178 87.7	175 86.2	161 79.3	146 71.9	105 51.7	77 37.97	61 30.05	29.03.
21 and under 26.	124	121 97.6	116 93.6	115 92.8	112 90.3	99 79.8	88 70.93	65 52.4	48 33.7	42 32.25	29.61
26 and under 31.	61	59 96.8	54 88.6	53 86.9	50 82.0	47 77.1	40 65.7	25 41.0	17 21.9	15 24.59	25.19
31 and under 36	46	45 99.8	43 93.5	43 93.5	42 91.3	39 84.8	37 80.4	34 73.9	30 65.2	27 53.7	38.59
36 and under 46	24	22 91.7	22 91.7	21 87.5	20 83.3	19 79.2	19 79.2	18 75.0	12 50.0	11 45.83	33.80

a. Entrants in all years.

T A B L E XVIII b

Age and Length of Service of Female T.V. Conductors.

Age on Entrance	No. of Entrants	Entrants in Years 1953-55 incl.												
		1	2	3	4	8	13	26	39					
under 21	153	149	138	135	132	121	111	82	62	49	36	33	23	23
		97.4	90.2	88.2	86.3	79.1	72.6	53.6	40.5	30.2	23.5	21.6	18.3	15.03
21 and under 26	93	92	90	89	86	77	67	49	36	30	25	21	19	14
		98.9	90.6	95.7	92.5	82.8	72.7	52.7	38.7	32.3	24.9	22.6	20.4	15.0
26 and under 31	49	48	43	43	40	38	33	21	15	13	11	11	11	9
		97.95	87.7	87.7	81.6	77.6	67.4	42.9	30.6	20.5	22.5	22.5	22.5	18.37
31 and under 36	37	36	34	34	33	30	28	26	22	19	18	15	14	12
		99.6	91.9	91.9	89.2	81.1	75.7	70.5	59.5	51.4	48.7	40.5	37.6	32.4
36 and under 46	19	17	17	16	15	14	14	14	9	8	7	5	5	5
		89.5	89.5	84.2	78.9	73.7	73.7	73.7	47.35	42.1	36.84	26.3	26.3	26.3

Information on age of 8 entrants not available.

244

The stability of the Female Omnibus Contractors appears to increase with age between 18 and 36, whilst in the final group 36 and 46 stability seems to decline. Because of the conflict between the trend shown by the expectation of service and the percentage surviving to one year, and the three entrance groups 1953 to 1955 were combined to give a survival curve to the end of the second year of service. (Table XVII b, Graph XVII) This confirms our original impressions. *

* It is realised that the longer the period of service over which we trace the age groups, the greater the proportion of an age group which will have passed into the next higher group, but as the boundaries of the groups, have no special significance it is not considered that this is sufficiently serious to invalidate the argument. An alternative approach might have been to analyse according to age on leaving, but apart from the difficulty involved here in allocating those who do not leave in the period under consideration, such an analysis would not be so useful for policy decisions. What firms want to know when they engage persons of a given age is, how long can we expect persons of this age to stay?

The results of the analysis of the Female Trolley Vehicle Conductors show a divergence from the pattern shown by the Female Omnibus Conductors. The general upward trend in the stability from entrance age 18 to age 36 is broken by the very low stability of the 26 and under 31 age group. (Table XVIII a)

The writer has been unable to discover the cause of this apparent discrepancy. A breakdown of the 26 and under 31 group, by year of entrance revealed that in all four years stability was below that of any other entrance age group. In three out of the four years the difference was very marked. Moreover the proportion of married to single persons in the 26 and under 31 group, did not differ markedly from that in the 31 and under 36 group, although the stability of the two groups was so very different. There were 61 persons in the 26 and under 31 age group and thus the numbers were not so small as to be unreliable.

As with the Female Omnibus Conductors a survival curve for the first three entrance years of the Female Trolley Vehicle Conductors was obtained in order to compare survival in each age group over two years of service. The results appear in Table XVIII b and Graph XVIII. It will be seen that the pattern has changed and is now

and is not similar to that of the Female Omnibus Conductors - steadily increasing stability to age 30. The early instability of the Female Trolley Bus Conductors 20 and under 31 age group is compensated for by increased stability in the longer period.

In commenting on the situation for all conductors it can be said that the thirties - particularly the early thirties stand out as being especially stable for both male and females - whilst the most unstable groups are those below 20, though the pattern for the two sexes differs here.

Trolley Vehicle Drivers were too small a group to permit age grouping, so the Omnibus Drivers were analysed alone by age. (Table XIX a and b) (pages 281 and 282) Bearing in mind the possible effect of the contract of service a two year period of service seems the most suitable basis for comparison.

Taking into consideration both the service expectations (e_{104}) and the percentage surviving to two years, there is evidence of a general upward trend in stability - broken by the 31 and under 36 group who present a much less stable picture than the 20 and under 31 group. Nevertheless beyond that age stability increases sharply showing no definite tendency to fall off even at the greatest age - 56.

T A B L E XIX a (No Graph)

Age and Length of Service
of Omnibus Drivers.

Age at Entrance. No. of Entrants. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 weeks.

a. Entrants in all years.

21 and under 26. 136 % 135 99.3 133 97.8 131 96.4 130 95.6 118 86.8 108 79.4 90 66.2 65 47.8 61 34.61

26 and under 31. 134 % 134 100 132 98.5 131 97.8 130 97.0 121 90.3 113 84.3 88 65.7 72 53.7 61 36.02

31 and under 36 89 % 89 100 88 98.9 86 96.6 84 94.4 78 87.7 70 78.7 54 60.7 46 51.7 40 34.03

36 and under 41 55 % 54 98.2 53 96.4 53 96.4 52 94.6 51 92.7 50 90.0 37 67.3 34 61.8 28 50.91 38.22

41 and under 46 48 % 47 97.9 47 97.9 46 95.85 45 93.77 42 87.5 38 79.18 32 66.66 29 60.43 25 52.09 36.95

46 and under 56 22 % 21 95.47 21 95.41 19 86.38 19 86.38 18 81.82 16 72.74 12 54.55 12 54.55 10 45.45 32.80

Page

21

T A B L E XIX b. (No Graph)

Age and Length of Service of Omnibus Drivers.

Age at Entrance	No. of Entrants.			Survival to weeks, years and months.			ly 3m	ly 6m	ly 9m	2y			
	1	2	3	4	8	13					26	39	52
21 and under 26	82 % 41.24	81 98.79	79 96.35	78 95.13	70 85.38	64 78.06	53 64.65	36 43.9	40.25	24.39	12 14.6	10 12.2	7 8.54
								e104	e104				
26 and under 31.	105 %	104 99.05	103 98.09	102 97.15	98 93.33	93 88.59	69 65.70	56 53.34	46 43.81	38 36.19	28 26.67	22 20.95	19 18.10
										e104	e104		
31 and under 36	68 %	67 98.55	67 98.55	66 97.05	60 88.25	54 79.42	40 58.83	34 50.0	28 41.19	20 29.41	20 29.41	15 22.06	14 20.58
										e104	e104		
36 and under 41	44 %	43 97.73	43 97.73	43 97.73	42 95.45	29 95.45	26 65.9	26 59.08	22 49.99	19 43.18	17 38.63	15 34.09	14 31.81
										e104	e104		
41 and under 46	37 %	37 100	36 97.3	35 94.6	32 86.48	29 78.38	26 70.28	23 62.16	19 51.36	16 43.24	14 37.8	14 37.8	11 29.73
										e104	e104		
46 and under 56	16 %	16 100	14 87.5	14 87.5	13 81.4	11 68.75	9 56.25	8 56.25	8 50.0	7 43.75	7 43.75	7 43.75	6 37.51
										e104	e104		

12

This may be due largely to the fact that alternative driving occupations are frequently young men's jobs e.g. open cast mining, long distance lorry driving, and so on. Consequently older entrants are not only less attracted to alternative occupations, but also include a substantial number of men from those jobs which they can no longer perform comfortably. An analysis of the whole four years entrants over one year's service was also carried out and surprisingly enough the results were broadly in agreement with the more logically based two year service analysis.

Finally an attempt was made to measure the influence of previous job stability or length of service. It proved possible to obtain information on the length of time the majority of entrants in 1953 had spent in their previous job. Where an entrant had just been demobilised (10 males) after the National Service, the job held immediately prior to National Service was taken whilst in other cases the job held immediately prior to entering this company was used. The total number of Male entrants (Drivers and Conductors) in 1953 was 237 and of these information on the previous service of 216 was obtainable, whilst the corresponding figures for females were 330 and 316. Where information was not available the reason was that the records could not be located. There is no reason to suppose that their omission

has given rise to any substantial bias.

In Table XX and XXI, the information for males and females (treated separately) are shown. A four year length of Service period was taken and a four year expectation of service calculated in each case. For males, those who had spent upwards of nine months in their previous job showed markedly greater stability than those who had spent a shorter period. There was, apart from this however no clear trend. For example the men staying less than one month in their previous job showed greater stability than those who had spent between six and nine months. Amongst the longer service groups there was little difference between the stability of the nine month to one year group and the over 5 year group.

Females with less than one months' service previously shows a markedly lower stability than all other groups, but apart from that there is no clearly discernible trend. The 1 to 3 month group appears rather more stable than the 1 to 2 year group. Stability on the whole does increase with length of service in previous jobs but not very markedly.

As only one entrance year has been used in this analysis some of the classes contain small numbers. The

contd. page 289.

Length of Service in Previous Job, and Stability (Miles)

Length of service in previous job.	No. of Entrants.	Survival to weeks, years and months.			Stability (Miles)						
		2	4	8	1y	3m	1y	3y			
up to 1 month.	14	14	14	13	3	6	5	5	2y	3y	4y
	100	100	100	92.9	92.9	64.3	42.9	35.7	35.7	28.6	14.29
				<u>52</u>	<u>34.72</u>	e104	<u>67.75</u>				

over 1 month under 3 months,	43	43	43	39	34	22	18	16	15	14	13	9	6	3
	100	100	100	90.7	79.6	51.2	41.9	37.2	34.3	32.6	30.2	20.9	13.95	6.97
				<u>52</u>	<u>21.71</u>	e104	<u>62.70</u>							

over 3mths. under 6mths,	37	36	35	30	28	16	13	11	10	7	7	5	3	3
	100	97.3	94.6	81.1	75.7	43.3	35.1	29.7	27.0	18.9	18.9	13.5	8.1	8.1
				<u>52</u>	<u>28.39</u>	e104	<u>49.47</u>							

over 6 mths. under 9mths,	12	12	12	10	8	8	6	5	4	3	3	2	1	0
	100	100	100	83.3	66.7	66.7	50.0	41.6	33.3	25.0	25.0	16.7	8.3	0
				<u>52</u>	<u>33.63</u>	e104	<u>56.92</u>							

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Table XX continued.

Length of Service in prev-ious job.	No. of Entrants.	Survival to weeks, years and months.															
		1	2	3	4	8	13	26	39	1y	3m	6m	1y	9m	1y	2y	3y
over 9mths.	16	15	14	14	14	12	12	10	8	8	7	7	7	7	6	4	3
under 1 yr.	%	93.8	87.5	87.5	87.5	75.0	75.0	62.5	50.	50.	43.8	43.8	43.8	43.8	37.5	25.0	18.75
		^e 52	<u>33.38</u>	^e 104	<u>66</u>	<u>83.75</u>											
1 year & under 2yrs	29	28	28	28	28	27	20	19	15	12	12	11	10	8	4	2	
	%	96.6	96.6	96.6	96.6	93.1	68.9	65.5	51.7	41.4	37.9	34.5	27.6	13.8	6.99		
		^e 52	<u>39.38</u>	^e 104	<u>75.47</u>												
2 years & under 5yrs.	34	34	33	32	30	25	19	19	16	14	14	14	13	9	8		
	%	100	97.1	97.1	94.1	88.2	73.5	55.9	47.1	41.8	41.8	38.2	26.5	23.9			
		^e 52	<u>38.43</u>	^e 104	<u>91.19</u>												
5 years & above	31	30	28	27	27	26	21	18	16	14	12	11	10	8	6		
	%	96.8	90.2	87.1	87.1	87.1	83.9	67.7	58.1	45.2	38.7	35.5	32.3	25.8	19.4		
		^e 52	<u>36.60</u>	^e 104	<u>84.40</u>												

Length of Service in Previous Job, and Stability (Females)

Length of Service in previous job.	No. of Entrants.	Survival to weeks, years and mths.									ly									
		1	2	3	4	8	13	16	21	26	39	ly	3m	6m	9m	1y	2y	3y	4y	
1 month or less.	24	22	21	21	21	16	16	10	6	3	3	3	2	2	2	2	2	2	2	1
	%	91.7	87.5	87.5	87.5	66.7	66.7	41.7	25.0	12.5	12.5	12.5	8.3	8.3	8.3	8.3	8.3	8.3	4.17	
						^e 52	23.83		8104	37.52										
over 1mth, under 3 mths	44	44	42	41	40	38	37	26	18	15	13	13	12	8	7	7	7	7	4	
	%	100	95.5	93.2	90.9	86.4	84.1	59.1	40.9	34.1	29.5	29.5	27.3	18.2	15.7	15.7	15.7	15.7	9.1	
						^e 52	32.33		104	62.32										
over 3mths, under 6mths.	52	52	50	50	49	46	42	32	25	22	15	10	9	8	2	2	2	2	1	
	%	100	96.2	96.2	94.2	88.5	80.8	61.5	48.1	42.3	28.8	19.2	17.3	15.7	3.9	3.9	3.9	3.9	1.9	
						^e 52	34.03		104	52.78										
over 6mths, under 9mths.	22	21	21	21	21	18	16	11	11	10	8	6	6	3	3	3	3	3	1	
	%	95.5	95.5	95.5	95.5	81.8	72.7	50.0	50.0	45.5	36.4	27.3	27.3	13.6	13.6	13.6	13.6	13.6	4.6	
						^e 52	31.91		104	59.84										

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287

Length of Service in previous job.	No. of Entrants.		1		2		3		4		8		13		26		39		1y		3y		4y			
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.		
over 9mths under 1 yr	25	25	100	25	100	25	100	25	100	25	100	25	100	21	17	11	10	44.0	40.0	32.0	32.0	6	5	24.0	12.0	
		e52		35.22		e104	72.66																			
over 1y. under 2yrs.	55	54	98.2	54	98.2	54	96.4	49	91.8	45	84.0	33	60.0	23	41.8	14	25.5	23	40.0	11	20.0	11	10	18.2	16.4	
		e52		32.12		e104	49.97																			
over 2yrs. under 5yrs.	65	62	95.4	57	92.3	57	87.7	54	83.1	51	78.5	44	67.7	32	49.2	31	47.7	27	41.6	23	35.4	21	17	26.2	20.0	
		e52		32.5		e104	71.1																			
over 5yrs & above	24	24	100	24	100	24	100	22	91.7	21	87.5	19	71.2	17	70.8	13	54.2	11	45.8	11	45.8	9	7	29.2	12.5	
		e52		43.19		e104	76.182																			

reliability of the results, therefore, is not as great as could be desired. Nevertheless, bearing in mind that a similar picture is repeated for male and female it is perhaps unlikely that greater numbers would lead to a major change in the picture presented.

As implied in Chapter 8 the figures do not reveal the extent of any differential selection which may be practised by the firm. One would expect, for example that the personnel officer would go most deeply into the cases of those individuals who have a previous history of instability. Hence it is possible that a smaller proportion of applicants with under one month's service in previous jobs are engaged than those with, say one year's previous service. Therefore, we cannot say, even assuming our figures to have a sufficiently small sampling error, that males with one month or less service in the previous job are no less stable in the Company's employment than those with nine months similar service, unless we add the words - "Taking into consideration the effect of selection policy". This serves as one illustration of the complexity of the problem involved and of the need for careful interpretation throughout.

CHAPTER TEN

Case Study C.

LABOUR WASTAGE AMONGST ENTRANTS TO THREE PRODUCTION UNITS IN THE FUEL AND POWER SECTOR.

Three large production units of an organisation in the fuel and power sector of industry were the subject of our third inquiry.

The work carried out in these undertakings is of such a nature that only a very small number of skilled manual workers is required. Far and away the greater part of the labour force is made up of labourers, who, though classed as unskilled, nevertheless in many cases require some training on the job and hence, if lacking previous experience take some time after engagement before they are fully efficient. Indeed one of the difficulties experienced in the collection of the data was that no separate figures were available for the really unskilled labourer on the one hand and the plant attendant and tradesman's mate on the other. It is, obviously, in the latter group that a high labour turnover will be most costly, if inexperienced workers have to be taken on as replacements for leavers in these classes of work. Moreover, whilst a fitter or bricklayer's mate does much the same job in whatever industry, or for whatever firm he works, the skill of the plant attendant is usually more

specific to the industry or the firm in question. Other things being equal, the instability amongst plant attendants (with whom can be compared semi-skilled machinists in manufacturing industry) is likely to be more costly than wastage in really unskilled grades, or in grades where the skill is general rather than specific in the sense in which we have been using. This is one of the cases where attention to the Cost of Labour Turnover is particularly important and where the method of approach outlined in Chapter VI might be of considerable value.

As will be seen later, a high rate of wastage is present amongst unskilled workers in this particular inquiry. If, however, as there is some reason to believe in this case the high rate of wastage is concentrated amongst those who are really unskilled labourers rather than in the group of plant attendants such wastage may be rather less serious than it appears to be. There are, of course, many other considerations to be taken into account in a comparison of the stability of workers in this organisation with that found in other concerns. The demand for the services of this concern is seasonal, being concentrated during the winter months and there is usually a building up of the labour force in the fourth and the early part of the first quarter with a tendency to a corresponding low level of recruitment in the second quarter. Later on, we shall examine what evidence there

is for seasonal differences in labour stability, but one important point can be noted now. It is said by the management of each of the three units that many workers who enter the organisation in the fourth and first quarters look upon their employment as seasonal. Few, if any, are discharged as redundant when the spring period of low demand commences. There is sufficiently voluntary wastage at this time to absorb any possible redundancies. The writer was informed that much of this wastage represents a movement into the building trade which expands seasonally at this time of the year. With the onset of winter there is a movement back to employment with the organisation which is the subject of the inquiry. To some extent, therefore, it was suggested by the management the wastage and recruitment is mutually advantageous to the man and to the employer. The worker is assured of employment throughout the year, whilst the employer avoids the costs which he would otherwise incur if he had to maintain a reserve of unnecessary labour throughout the summer or the bad labour relations which might arise out of frequent redundancy. In addition the employer feels that he can count upon a substantial number of trained men applying for re-engagement when they are most needed - at the onset of winter. Though this was commented upon at all the units which the writer visited the analysis which is presented later does not entirely confirm this latter impression. It is possible

that whilst the seasonal movement does take place at all units the return of workers previously employed has been exaggerated, and that the influx of workers from the building trade in autumn, for example largely consists of new entrants and not re-engagements. Further comment upon this will be deferred until later.

The labour force of the three units (apart from canteen workers, cleaners and staff, who are not considered) is entirely male and varied between 900 and 1200 during the period 1953 to 1958 (January). Some of this variation was due to seasonal changes in intake, but one branch, Unit III increased its labour force during 1955-56 at a considerably greater rate than the other units. Since that time the number of workers at Unit III has declined to its previous level. Table A shows the manning of each unit in the first week of January and June for each year, from January 1953 to January 1958.

TABLE A

Numbers employed in years.

	1953.		1954		1955		1956		1957		1958
	Jan.	June	Jan.	June	Jan.	June	Jan.	June	Jan.	June.	Jan.
1.	272	248	273	250	276	258	280	260	275	253	278
2.	310	274	320	275	315	280	310	276	314	275	313
3.	455	408	424	410	462	480	559	414	468	420	443

No distinction was made at the units between temporary and permanent workers.

The working environment can hardly be said to be pleasant - though the organisation is doing its best to mitigate this by improvements in plant and in operational methods. Provision of welfare services, pension schemes, canteen facilities, and so on are not appreciably less satisfactory than those which the writer has found in other organisations investigated. However, whilst the established worker * may have adapted himself to the environmental conditions to such an extent that they are not a major determining factor in his wastage there is little doubt that the comparatively high instability experienced during the early weeks of service in this concern is due in part to the adverse effect of the working conditions on the new entrant. This influence is probably accentuated because the more intelligent unskilled workers may prefer to seek employment elsewhere and therefore the quality of unskilled labour available will tend to be rather low. A high degree of instability in employment is frequently associated with workers in this latter category.

Such factors as those indicated in the previous paragraph, which in the short and medium term must be taken as given

*See 1951.7 ref. for comments on the influence of working conditions on the established worker.

and outside the control of the firm, will tend to lead to a higher level of wastage even if personnel policies attain the standard of efficiency found in the best firms. Too much must not be read into the last sentence, and it should certainly not be assumed that the external factors are such that it is hopeless to do anything about a high level of wastage. If wastage must be high in an organisation where uncontrollable factors are at work, it will certainly be higher if control is not applied where it can be effective. In other words an efficient personnel policy, particularly in selection and induction, will go some way towards mitigating an otherwise unfavourable works situation, whilst unsound or bad policies, or no policy at all, will make a bad situation worse. It is conceivable of course, to take an extreme example, that situations exist where the saving due to increased worker stability resulting from the introduction of the most elementary selection policies may be more than offset by the costs incurred in implementing those policies. In any given situation there is always (as is considered in more detail in Chapter VI) a 'break even point' beyond which it is unprofitable to reduce labour wastage any further. The writer suspects, however, that few firms have reached that point, and the case envisaged above where practically all workers applying for a job would be accepted is so

exceptional that it should never be accepted as a result of negative criteria.

A firm which has, for any reason, drifted into a policy of wholesale engagement without adequate selection may offer as an excuse that it cannot afford to select, because it must take all available workers in order to maintain its labour force at some desired level. It may be, however, that the lack of adequate selection is a causal factor in its high rate of wastage. A more selective policy, whilst it cuts down the number recruited also aims at reducing the number who leave prematurely as well as at increasing the efficiency of the labour force. In this case, any firm which does not, at least, give a more selective policy on recruitment a trial may be increasing the difficulties under which it is working, for there is nothing like an unstable labour force for breeding further instability, quite apart from the influence of any other factors.

The foregoing argument has been introduced at this stage, because the selection policies employed at the three units we are considering appear to be of a very rudimentary nature, and some of the arguments which we have just been criticising have been used to justify the lack of selectivity in the face of high wastage in one of the units. Recruitment and selection in all units is the responsibility of each works manager and this function is generally delegated to

the foreman or the departmental head into whose hands the recruited worker will pass. In the case of unskilled workers reference to previous employers is hardly ever made - indeed in all three units the writer found it impossible to trace any record of the previous employer, or the length of service in previous employment for the majority of the workers. In two cases, Unit I and Unit II record cards for each employee were kept and there was some evidence that in one of the Units some interest had recently been shown in the previous history of the worker. In Unit III no record cards were kept at all - chiefly because, in view of the high rate of wastage it was supposed to be a waste of time. Exit interviews were not normally practised in any unit - indeed in a considerable number of cases men left without proper notice, and in some cases without informing the employer.

Though, undoubtedly any person who is frequently occupied in engaging workers gains some skill in the task, those so occupied at the three units in question had had no special training for the work and were essentially technical men whose main interests were the controlling of the process with which they were concerned. From a close examination of what information was available the writer gained the impression that provided a person was physically suited to the job at Unit III he would be engaged, and that engagement was only slightly more

selective at Unit II. Only at Unit I, did the writer find, in discussion, that more specific consideration of stability was given and that efforts were made to be rather more selective in making engagements. This increased selectivity was of only recent development and appears to have arisen since 1951 - 52 when the modernisation of the unit led to circumstances more favourable to the retention of labour. We have here evidence of an all too common tendency. Where stability is low, due partly to external factors, adequate selection is abandoned because of the need to maintain a labour force of a given size 'at all costs', and this, of course leads ultimately to higher wastage. Should an improvement in stability occur, due to a change in some external factor, this may encourage the employer to be more selective because his recruitment needs have fallen below the level at which they previously stood. It is particularly important to note in this connection that the abandonment of selection in an endeavour to maintain a labour force is not irrational, it is merely short sighted. Improvements in selection are only likely to increase the stability of new entrants, and not (at first in any case) to any appreciable extent that of existing workers. Hence it is only after improved selection measures have been in force for some time that a pronounced decrease in overall wastage is likely to be noticed. Long before this the

selection policy may be dropped as not having fulfilled its purpose. It is also true that inadequate selection policies will effect an immediate improvement in the number of workers available only at the expense of an increasing rate of wastage. However if attention is paid chiefly to the availability of workers and not to their quality or stability the decline in efficiency and increase in costs may be accepted as something which cannot be avoided.

Once again it is necessary to stress that the effects of changes in selection policy are likely to become evident at an early stage only if we use entrants data as the basis of our wastage records and the effect upon costs will only be apparent if an efficient costing scheme such as the one outlined in Chapter VI is in use. This is not to suggest that we can safely ignore the effects of our policies upon established workers, but adequate information on their stability can be obtained quite simply using the methods of Chapter III Appendix A. In any case it is not these workers, but the new entrants whose stability is most usually a problem to the firm.

A majority of the unskilled workers employed in the three units are engaged on shift work, or likely to be called upon to do such work. The skilled workers are almost entirely day workers. Owing to the fact that transfer

from day to shift work and back again may occur to almost any unskilled worker it has not been possible to analyse the day and shift workers separately, but the association of shift work with unskilled employees and of day work with skilled ones should nevertheless be noted.

The first step in the analysis of data was to discover if there was any seasonal relationship between time of entry and length of service achieved. All entrants in each of the years 1953 to 1956 for the three establishments together were analysed on a seasonal basis and their service expectations to one year obtained. The results are given in Table I, Graph I. No very pronounced trend can be noticed, but as there is an indication that entrants in the first quarter might be of consistently low stability a moving average trend was obtained and deviations taken in the usual manner. It will be seen from Table B (below) that the first quarter shows low stability throughout, but that the other three quarters present no decisive tendency either way. Close investigation reveals that the consistent negative seasonal movement for the first quarter arises only because of the abnormally high stability of the entrants in the last quarter of 1954. If this were due to causes peculiar to that particular group of entrants then our negative deviation obtained for the first quarter of 1955 would vanish and we should have an

TABLE I

All Entrants - By Quarters.

Year & Quarter	No. of Entrants.	Leavers within-										
		1	2	3	4	8	13	26	39	52	^e 52	
1953												
1	150	18	9	13	6	19	19	25	8	7	18.71	
2	117	21	13	8	5	20	6	19	-	2	16.31	
3	112	23	9	5	3	14	12	13	11	1	17.92	
4	221	50	24	14	10	27	15	31	12	5	15.4	
1954												
1	173	23	21	11	6	22	27	22	6	5	16.87	
2	59	9	3	8	1	3	4	11	3	2	21.62	
3	185	32	23	10	7	21	12	15	16	9	19.75	
4	172	13	6	5	12	18	9	31	9	6	27.43	
1955												
1	188	27	15	9	3	25	23	24	14	6	20.43	
2	127	29	9	12	7	19	12	10	3	6	15.18	
3	136	18	15	9	9	18	12	12	18	4	17.78	
4	327	79	29	17	15	46	29	58	14	4	13.15	
1956												
1	219	37	20	12	9	42	34	26	4	7	14.35	
2	38	11	2	1	2	4	2	4	1	3	19.11	
3	124	22	20	8	3	8	7	8	14	8	20.32	
4	138	12	6	10	6	13	17	33	10	3	20.86	

indeterminate result as in the case of the other three quarters. Moreover in the same circumstances the positive excess of the fourth quarter would be eliminated and we should have estimates of seasonal variation in each of the four quarters not significantly different from zero.

TABLE B

Year.	Qtr.	e ₅₂	TREND.	Deviation from trend.	
				-	+
1953	1	18.71			
	2	16.31			
	3	17.92	16.84		1.08
	4	15.40	17.28	1.88	
1954	1	16.87	18.18	1.31	
	2	21.62	19.91		1.71
	3	19.75	21.86	2.11	
	4	27.43	21.50		5.93
1955	1				
	1	20.43	20.45	.02	
	2	15.18	18.42	3.24	
	3	17.78	15.875		1.905
1956	4	13.15	15.61	2.46	
	1	14.35	16.415	2.065	
	2	19.11	17.70		1.41
	3	20.32			
	4	20.86			

Year.	<u>quarters.</u>			
	<u>1.</u>	<u>2</u>	<u>3</u>	<u>4</u>
1953	---	---	+ 1.08	- 1.88
1954	- 1.31	+ 1.73	- 2.11	+ 5.93
1955	- .02	- 3.24	+ 1.91	- 2.46
1956	- 2.07	+ 1.41	---	---
	---	---	---	---
	- 3.40	- 0.10	+ 0.88	+ 1.49
	---	---	---	---

Our conclusions are, then, that there is no evidence of seasonal variations in stability related to time of entry, and whilst this is not necessarily inconsistent with a seasonal variation in the normal Labour Turnover Rate (B.I.M.) it provides some support for the opinion that adjustments in the size of the labour force in accordance with seasonal demand for the product can be effected by varying recruitment alone.

It will be observed from Graph I that the stability of entrance groups rose from early 1953 to the end of 1954, fell to the end of 1955 and since then has risen. The low figures for the end of 1955 and early 1956 can be accounted for in part by the high recruitment at that time (almost entirely in Unit III which bore much of the burden of the increased output called for due to the severe winter) but such an explanation cannot be offered for the remainder of the trend. However, as the figures relate to the three units combined it is possible that the observed trend might conceal divergent movements in the individual units. In our investigation into seasonal movements we were concerned with influences affecting the firm as a whole, and hence we were concerned to eliminate divergent movements if any existed from unit to unit. Now however, an analysis of the stability of entrants to each unit is a natural step to take and the relevant data is given in Tables II to IV and Graphs II to IV. (pages 303, 304 and 305, 306)

TABLE 11

Entrants to Unit I

Year. Number. Entrants.	Survival to --			Entrants to Unit I								e 52 wks.					
	1	2	3	4	8	13	26	39	1y	3m	1y		6m	1y	9m	2y	3y
1953	140	112	103	101	85	75	56	42	37	34	32	30	30	26	24	24	23.07
	%	85.7	80.	73.6	72.2	60.7	53.6	40.	30.	28.4	24.3	21.4	21.4	18.6	17.2		
1954	109	90	85	78	62	54	42	39	35	33	32	31	29	26			23.54
	%	88.1	82.6	78.	71.6	56.9	49.6	38.5	35.8	32.1	30.3	29.4	28.5	26.6	23.9		
1955	93	79	76	72	61	54	47	43	39	37	34	34	32	32			28.15
	%	92.5	84.9	81.7	77.4	65.6	58.1	50.5	46.2	41.9	39.8	36.6	36.6	34.4			
1956	75	67	65	60	56	52	41	33	27								29.97
	%	94.7	89.3	86.7	80.	74.7	69.3	54.7	44.	36.							

TABLE III.

Entrants to Unit II

Year Number	Entrants to Unit II												e 52 wks.				
	1	2	3	4	8	13	26	39	52w	1y 3m	1y 6m	1y 9m		2y	3y	4y	
1953	163	144	127	119	111	92	72	50	39	36	34	30	26	25	20	18	19.64
%	88.4	77.9	73.0	68.1	56.4	44.2	30.7	23.9	22.1	20.9	18.4	16.0	15.3	12.3	11.0		
1954	145	128	115	109	107	95	79	57	47	43	41	38	31	25	21		23.88
%	88.3	79.3	75.2	73.8	65.5	54.5	39.3	32.4	29.7	28.3	26.2	21.4	17.2	14.5			
1955	76	69	65	61	54	46	35	30	26	22	18	15	13	13			23.17
%	90.8	85.5	80.3	71.1	60.5	46.1	39.5	34.2	29.	23.7	19.7	17.1	17.1				
1956	93	84	77	72	69	59	49	37	30	26							23.56
%	90.3	82.8	77.4	74.2	63.5	52.7	39.8	32.3	28.								

TABLE IV

Entrants to Unit III

Year	Number of Entrants.	Entrants to Unit III												e 52 wks.			
		1	2	3	4	8	13	26	39	1y	3m	6m	1y		2y	3y	4y
1953	297 %	224 75.4	194 65.3	171 57.6	157 52.9	112 37.7	90 30.3	43 14.5	37 12.5	30 10.1	27 9.1	24 8.1	19 6.1	16 5.4	14 4.7	13 4.4	12.31
1954	335 %	288 86%	254 75.8	231 69.	214 63.9	178 53.1	150 44.8	103 31.5	84 25.1	70 20.9	67 20.	64 19.1	53 15.8	52 15.5	48 14.7		19.44
1955	609 %	470 77.2	413 67.8	373 61.2	350 57.5	261 42.9	203 33.3	111 15.1	70 11.5	58 9.5	53 8.7	50 9.6	49 8.	47 7.7			13.42
1956	351 %	282 80.3	245 69.8	220 62.7	208 59.3	155 44.2	109 31.1	61 17.4	47 13.4	37 10.3							13.58

In units I and II the recruitment has declined over the four years. Unit I shows a progressive increase in stability over time whilst for Unit II a marked increase in stability in 1954 is followed by little or no change in the ensuing years. To some extent the increase in stability, - noticeable in Unit I particularly from 1954 to 1955 entrants and in Unit II from 1953 entrants to those in 1954 - might have been due to the recruitment of a smaller yet more reliable labour force, but it is also possible that the decreased recruitment only occurred because of an increase in the stability of the labour force. Moreover such an explanation of the observed movements does not account for the slight decline in entrants stability noticed in Unit II from 1954 to 1955 entrants, nor the increase in stability in Unit I from 1953 to 1954 entrants. The upward trend in Unit I has been associated as was mentioned earlier with more favourable working conditions (a modern plant) and with increased awareness of the requirements of a sound personnel policy amongst the members of the management. It is true that there is some slight evidence of a decline in stability amongst the 1956 entrants at Unit I, but taking into consideration both the one year survival percentage - 36% in 1956 compared with 42% in 1955, and the service expectation to one year - 29.97 weeks in 1956 and 28.57 weeks in 1955, it is doubtful if the decline is

significant. An inspection of the survival curve for 1956 shown in Graph II reinforces this opinion.

Unit III presents a rather different picture from those exhibited by Units I and II. In Unit III there is a marked increase in stability of the entrance groups from 1953 to 1954 and then a relapse to the earlier level.. No significant facts have emerged to indicate the reasons for the early increase in stability. A possible pointer for management's consideration however, is the parallelism here between Units II and III. Both show an apparently significant increase in stability at this time, both are situated in a similar area - so close in fact to one another that there is some overlap in their sources of labour supply and both are considerably less modern than Unit I. As has been mentioned before, Unit III bore the brunt of the increased demand for the product in 1955-1956. Table A (page 293) shows that its labour force increased very greatly at this time and hence it can be argued that the increased recruitment in late 1955, by leading to a scraping of the barrel for labour could be expected to result in decreased stability. However the lower stability persists right through the 1956 entrants at a period when the above consideration did not apply - when, indeed the labour force was being allowed to decline. It is, perhaps, best to look upon the low stability of the

latter years as being a reassertion of a normal trend after an abnormally favourable situation rather than anything else.

We can sum up by saying that no consistent trend with time is observable for the firm as a whole.

No graph is needed to compare the stability of the three units with one another. Unit I has a very favourable record throughout. Unit II is somewhat less stable on the whole, although its 1954 entrants with a survival percentage of 29% and an expectation of service of 23.88 weeks compares well with the figures for Unit I - one yearly survival of 32% and an expectation of service of 23.54 weeks. Unit III, the larger establishment has a much lower stability than the others in all years.

It is hard to tell to what extent the instability of workers at Unit II is due to the difficulties of getting a sufficient supply of suitable labour because of the size of the unit. Unit III is situated in a very densely populated area. It has to face some competition for labour by other factories in the district, but to no greater extent than has Unit II which faces the added disadvantage of being in the centre of a slum clearance area so that its recruits must come from a greater distance. In any case a concern which employs no more than 500 people in normal times is not usually considered so large as to be subject to recruitment difficulties except in special circumstances.

The very high proportion of wastage in the first week of service in Unit III compared with the other organisations is indicative of a possible significant difference in recruitment selection or induction policy. This is reinforced by the observation made by an official at Unit III who said "We have quite a substantial number - particularly in winter - who ask for their cards almost before they have started work". At Unit I and Unit II wastage of this latter type was very much the exception so far as the writer could ascertain. Other reasons than those already offered are needed to explain the excessively high wastage in Unit III. To tolerate as something uncontrollable and irremediable such excessive wastage without a thorough investigation is as unwise as it is costly.

The figures considered in the foregoing cover all entrants, leaving for whatever reason. The numbers stated as leaving for health reasons or death (15 in all) were so small as not to merit either exclusion or special consideration. The only other reasons for leaving referred to were "Paid Off" and "Own Request" though in Unit III a very high proportion of leavers had no reason specified at all. It is assumed in this inquiry that the latter were voluntary leavers.

It is interesting to look at the figures for those Paid Off, separately from the whole group. Table V. gives the
310.

number of persons paid off at each Unit in the period, with the proportion Paid Off in the first year of their service. Even allowing for different exposures to risk (1953 group were observed over four years whilst the 1957 group were only followed for one year) of the entrance groups it is obvious that by far the greater number of workers who leave at the Employer's request do so within a year of engagement. In two cases the proportion of those engaged who are paid off within a year is about 10% (see table) but in the least stable branch, Unit III the proportion paid off is less than 4%. This latter could be attributed to the greater voluntary wastage giving a lower average exposure to this risk for each entrance group, but a more likely explanation in this case is the inadequacy of the records, noted in an earlier paragraph which give no reason for leaving in over 40% of the cases.

TABLE V

Discharged Employees. (No graph)
Entrants all years
(1953-56 inclusive.)

Unit.	Total No. discharged 1953-56 Entrants.	No. Discharged from 1953-56 entrants within one year.	% of Entrants - 1953 -56 incl. Discharged within one year.
I	43	42	10.07 %
II	63	53	11.11 %
III	64	63	3.96 %

In our introductory remarks the seasonal transfer in Spring to the building industry ~~and~~ followed by a return to the firm in the autumn was commented upon. The opinion given by members of the management at each unit was that a substantial movement of this type occurred. The figures of re-entrants (persons taken on by the unit who had served at that unit within the previous 5 years) obtainable only from Unit I and Unit II give little support to this view. In Table VI the survival experience of persons re-engaged in Unit I and II are given.

TABLE VI

(No graph)

Workers (Re-engaged).
(All Years)

Unit. No.	1	2	3	4	8	13	26	39	52	^e 52	
I	19	17	16	16	15	15	14	11	10	9	32.68
	%	89.5	84.2	84.2	78.9	78.9	73.7	57.9	52.6	47.36	weeks.
II	73	63	58	58	56	49	37	27	15	10	20.82
	%	86.3	79.5	79.5	76.7	67.1	50.7	36.99	20.5	13.7	weeks

If a movement of the type suggested were present one would expect to find a high concentration of leavers with Length of Service between 13 and 39 weeks. In Unit I about 20% of those re-engaged left in this period; in Unit II the figure was about 30%. This of course suggests that at least 70% of the re-engagements were not influenced by seasonal factors of the type suggested. Moreover the

number of re-entrants to Unit I is small and therefore seasonal recruitment of this type cannot be considered to be of importance here.

Our interest does not cease here because if the re-engagements are not mainly seasonal it would be possible to justify them on the grounds that those re-engaged are either trained men and therefore more efficient than new entrants or they are more stable than the new entrants. The figures for Unit I show a high degree of stability with a one year expectation of service of 32.68 weeks, and a survival percentage to one year of 47.36. These compare favourably with the corresponding figures for all entrants to Unit I in any year. Obviously the main consideration here has been to limit the re-engagement of workers to those whose past records and present circumstances are most favourable. The stability of re-entrants to Unit II is slightly unfavourable when compared with all entrants in every year except 1953. However, the majority (65 out of 73) of the re-entrants were classed as unskilled, it is more suitable to compare them with unskilled entrants as a whole.

Table VII and Graph VII b. show the unskilled entrants to Unit II and it will be seen that all entrants, and re-entrants in this category differ little in stability. (see page 314) The service expectations are the same,

TABLE VII

Entrants Skilled & Unskilled
All years.

No. of Entrants.	1	2	3	4	8	13	26	39	52 ^a	52 weeks.
---------------------	---	---	---	---	---	----	----	----	-----------------	-----------

Unit I. Skilled.

46	44	43	42	39	32	28	21	17	14	26.74
%	95.7	93.5	91.3	84.8	69.6	60.9	45.6	36.9	30.4	

Unit I Unskilled.

371	329	305	287	272	232	207	165	140	124	25.51
%	88.7	82.2	77.4	73.3	62.5	55.8	44.5	37.7	33.4	

Unit II Skilled.

62	60	57	54	49	43	37	31	28	26	28.5
%	96.8	92.	87.1	79.	69.4	59.7	50.	45.2	41.9	

Unit II Unskilled.

364	323	289	270	258	217	171	121	94	83	20.77
%	88.8	79.4	74.2	70.9	59.6	47.3	33.3	25.8	22.8	

Unit II Lorry Drivers.

51	42	38	37	34	32	27	22	20	18	25.05
%	82.3	74.5	72.6	66.7	62.7	52.9	43.1	39.2	35.3	

Unit III Skilled.

101	67	61	51	49	34	29	14	12	10	11.58
%	66.4	60.4	50.5	48.5	33.7	28.7	13.9	11.9	9.9	

Unit III Unskilled.

1491	1197	1045	944	880	672	523	304	226	185	15.4
%	80.	70.1	63.3	59.	45.1	35.1	20.4	15.2	12.4	

the survival percentage being more favourable for all unskilled entrants. On balance therefore, the re-entrant policy pursued by Unit II can be justified, but a more selective approach, might be worth trying if it could eliminate some of the early leavers, as the employment of the 20% of re-entrants who leave in the first two weeks can hardly be economic.

All three units kept separate records of skilled and unskilled entrants (Table VII and Graph VII a - c.) At Unit II is based a substantial body of transport drivers serving all three units. Entrants to this category of work have been analysed separately. A comparison of Unit I and II shows that the skilled workers are more stable than the unskilled, the differential being greater in the case of Unit II than of Unit I. Lorry drivers occupy, as might be expected, an intermediate position. Skilled workers at Unit II are the most stable group of all.

As Unit II retains its skilled workers so effectively it is not easy to see why its unskilled workers have such a relatively high level of wastage. Certainly a comparative study of policies relating to skilled and unskilled workers at the two units would be valuable.

It is difficult to account for the situation at Unit III, where the unskilled group though showing high wastage when

compared with units I and II, is much more stable than the skilled group. Once again inadequacies of, or mistakes in, recording may have played some part, but the greater instability of skilled men seems an unmistakable fact. Redundancy can hardly have played a significant part in the large decline that took place in the first week of service, though it is possible that there was a small amount of redundancy later amongst bricklayers who are sometimes engaged for a particular job and then paid off, when no longer required. Though the writer has not been in a position to ascertain probable causes of this unusual development the figures once more show the value of this type of analysis in locating trouble spots.

Units I and II, only, recorded the civil status of male entrants and therefore our next step was to compare the stability of married and single entrants to these branches. The records took no account of any change of status during the service period, but it is not thought that this would substantially affect the analysis. In both units married entrants were very much more stable than single ones. (Table VIII and Graph VIII a and b)

TABLE VIII

Survival of Single and Married
Entrants. (All years 1953-6 incl)

Unit.	No. of Entrants.	1	2	3	4	8	13	26	39	52	^e 52	
				<u>Single.</u>								
I	151 %	131 86.8	121 80.1	110 74.5	102 67.6	86 56.9	76 50.3	59 39.1	46 30.5	40 26.5	22.44 weeks	
				<u>Married.</u>								
I	256 %	233 91.1	218 85.2	210 82.0	200 78.1	170 66.4	152 59.4	120 46.9	104 40.6	92 35.9	27.10 weeks	
				<u>Single.</u>								
II	135 %	112 83.0	99 73.3	93 68.9	86 63.7	73 54.1	52 38.5	28 20.7	24 17.8	21 15.6	16.26 weeks	
				<u>Married.</u>								
II	342 %	313 91.5	285 83.3	258 78.4	253 74.0	217 63.5	181 52.9	144 42.1	116 33.9	104 30.4	24.36 weeks	

We shall later show that in all three units there is some tendency for stability to increase with age. As single men are likely, on average, to be younger than married ones it was thought desirable to test whether the age factor accounted for the difference in single - married stability. Table IX shows the stability of the entrants to Unit I and II in two age groups 26 - 31 and 36 - 46.

TABLE IX

Survival of Single and Married
Entrants (All years 1953-6 incl)
In specified age groups.

Unit.	Civil Status.	Age Group	% Surviving to one year.
I	Single	26 u. 31	19.23
		36 u. 46	26.68
I	Married.	26 u. 31	28.00
		36 u. 46	53.00
II	Single	26 u. 31	23.56
		36 u. 46	22.32
II	Married.	26 u. 31	32.05
		36 u. 46	34.16

It will be seen that the married workers are more stable than the single ones at these units even when the age factor is eliminated.

The relationship between age and length of service was the subject of the final analysis, details of which are given in Tables X, XI and XII. In two of the units a tendency for an increase in stability with age can be observed. In Unit III there is a progressive increase in stability from the lowest age groups to the highest. Both the survival percentage and the service expectation follow the same trend, with the exception of the under 21 group and the 56+ group. In these two cases the two measures show divergent movements. The numbers concerned (14 in under 21 group and 37 in 56+ group) are however fairly small and the under 21 figures particularly, must be considered unreliable.

Units I and II do not show the same trend of steadily increasing stability with age. Nevertheless for Unit I the 36 and over groups show a considerably higher stability than the younger groups, though the under 21 entrants stand out as being more stable than those between 21 and 36.

No definite trend is observable in the case of Unit II. The linear correlation coefficient between age and stability (as measured by the expectation of service) is + 0.165

which is not significant even at the 20% level and we must conclude that there is no evidence of an association between age on entry and length of service in Unit II.

TABLE X a.

Age on Entry and Length of Service
 All years 1953 - 56 incl)
 Unit I

No. of Entrants	Survival to weeks —									e ₅₂ wks.
	1	2	3	4	5	13	26	39	52	
	<u>Age on Entry - under 21</u>									
33	31	29	29	29	24	22	14	10	10	26.01
%	94.	87.9	87.9	87.9	72.7	66.7	42.4	30.3	30.3	
	<u>21 and under 26.</u>									
96	88	80	71	64	58	50	39	30	27	23.22
%	91.7	83.3	74.	66.7	60.4	52.1	40.6	31.2	28.1	
	<u>26 and under 31.</u>									
87	71	67	66	63	50	41	34	28	23	21.31
%	81.6	77.	75.9	72.4	57.5	47.1	39.1	32.2	26.4	
	<u>31 and under 36.</u>									
73	66	60	56	54	43	40	28	23	19	23.1
%	90.4	82.2	76.7	74.	59.9	54.8	38.4	31.5	26.0	
	<u>36 and under 41.</u>									
37	30	30	29	26	22	21	13	13	15	27.78
%	81.1	81.1	80.2	70.3	59.5	56.8	43.7	43.7	40.5	
	<u>41 and under 46</u>									
44	42	38	37	36	34	32	29	27	24	35.32
%	95.5	86.4	84.1	81.8	77.3	72.7	65.9	61.4	54.5	
	<u>46 and under 51</u>									
33	30	30	28	26	20	18	13	13	12	25.38
%	90.9	90.9	84.9	78.8	60.6	54.6	39.4	39.4	36.4	
	<u>51 and above.</u>									
20	19	18	18	17	16	14	13	10	9	33.15
%	95.	90.	90.	85.	80.	70.	65.	50.	45	

This table includes six entrants still in service for whom age was available but no year of entry given.

TABLE K b.

Age on Entry and Length of Service
(All years 1953 -56 incl)
Unit II

No. of Entrants.	1	2	3	4	5	13	26	39	52	^e 52 wks.
<u>Age on entry 21 and under 26</u>										
128	115	103	98	92	79	63	38	29	26	19.95
%	89.2	79.5	76.	71.3	61.2	48.8	29.5	22.5	20.2	
<u>26 and under 31.</u>										
109	99	90	88	84	75	57	48	39	34	25.5
%	90.	81.8	80.	76.4	68.2	51.8	43.6	35.5	30.9	
<u>31 and under 36</u>										
91	76	69	64	62	48	36	23	20	17	17.79
%	83.5	75.8	70.3	69.7	52.8	40.5	25.3	22.	18.0	
<u>36 and under 41.</u>										
45	41	36	33	29	24	20	17	14	12	21.64
%	91.1	80.	73.3	64.5	53.3	44.4	37.8	31.1	26.7	
<u>41 and under 46</u>										
57	51	49	47	44	38	32	26	23	21	26.63
%	89.5	86.	82.5	77,	66.7	56.1	45.6	40.4	36.8	
<u>46 and under 51.</u>										
27	26	23	20	18	16	13	11	8	7	22.56
%	96.3	85.2	74.1	66.7	59.3	48.2	40.7	29.6	25.9	
<u>51 and over.</u>										
20	13	17	14	14	13	13	10	9	9	28.75
%	90.	85.	70.	70.	65	65	50	45	45	

TABLE I c.

Age on Entry and Length of Service
(All years 1953 - 56 incl.)
Unit III

No of Entrants.	Survival to weeks -									9 ⁵² wks.
	1	2	3	4	8	13	26	39	52	
	<u>Age on Entry - under 21</u>									
14	9	7	7	6	5	3	2	2	2	11.39
%	64.3	50.	50.	42.9	35.7	21.4	14.3	14.3	14.3	
	<u>21 and under 26</u>									
404	320	275	240	220	155	117	60	37	28	11.83
%	79.2	68.1	59.4	54.5	38.4	29.	14.9	9.2	6.9	
	<u>26 and under 31.</u>									
365	293	251	228	211	154	114	63	43	30	13.09
%	80.3	68.8	62.5	57.8	42.2	31.2	17.3	11.8	8.2	
	<u>31 and under 36</u>									
268	213	183	165	153	121	93	42	31	30	13.44
%	79.5	68.3	61.6	57.1	45.2	34.7	15.7	11.6	11.2	
	<u>36 and under 41.</u>									
152	127	112	102	99	78	65	36	29	23	17.11
%	83.6	73.7	67.1	65.1	51.3	42.8	23.7	18.2	15.1	
	<u>41 and under 46.</u>									
152	131	115	109	107	90	74	45	38	29	18.91
%	86.1	75.7	71.7	70.4	59.2	48.7	29.6	25.9	18.2	
	<u>46 and under 51.</u>									
115	96	91	84	80	67	56	41	35	31	21.94
%	83.5	79.1	73.1	69.6	58.3	48.7	35.7	30.4	27.	
	<u>51 and under 56</u>									
61	56	54	48	46	34	29	23	18	18	22.42
%	91.8	88.6	78.7	75.4	55.7	47.5	37.7	29.5	29.5	
	<u>56 and over.</u>									
37	28	25	19	17	13	12	12	11	11	18.11
%	75.7	67.6	51.4	45.9	35.1	32.4	32.4	29.7.	29.7	

Information on 24 entrants not available.

CHAPTER ELEVEN

Case Study D.

LABOUR TURNOVER IN THE DISTRIBUTION SECTION OF A LARGE PUBLIC UTILITY

This organisation distributes its products through a unit which has two departments employing male workers only. One of the departments is concerned with work in the open, attending to the company's installations whilst the other deals with all work carried on customers' premises, as well as a certain amount of workshop servicing work for Department I. The work of the first department includes a very great deal of heavy labouring work which is not present to any extent in the work of Department II.

The writer was informed that the total numbers employed in this unit have not varied considerably during the period covered by the inquiry - 1951 to 1957, though actual figures of manual workers (with whom we shall be solely concerned) employed could only be given from July 1954 onwards. Table A below gives the figures that were available showing numbers employed in the first week of January and of June in each year.

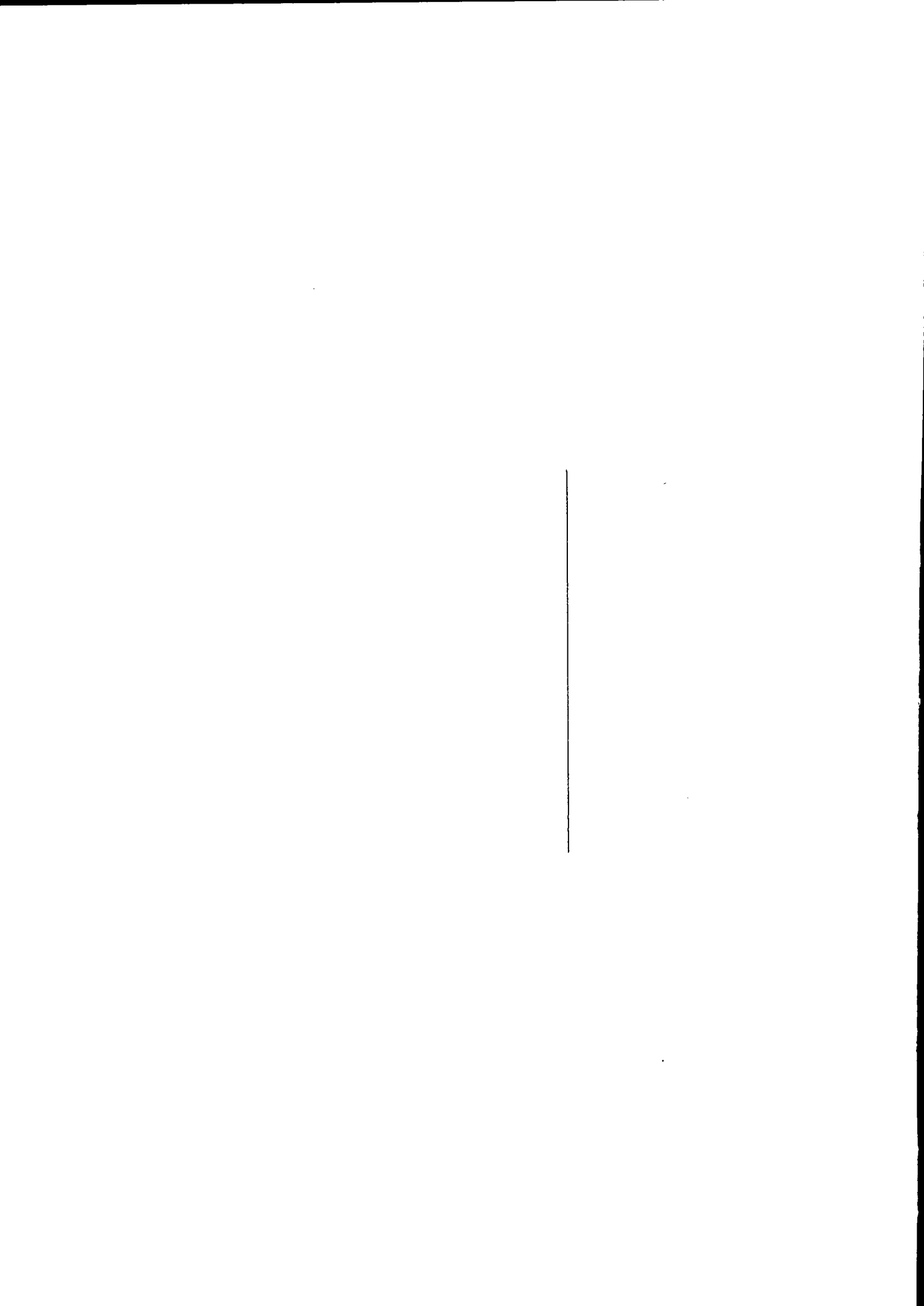


TABLE A.

Numbers Employed.

	1954.		1955.		1956.		1957		1958.
	Jan.	June	Jan.	June	Jan.	June	Jan.	June	Jan.
Dept. I	((((357	318	322	345	341
Dept. II	730	730	728	740	430	370	366	379	365

From these figures it will be seen that, with the exception of a period in 1956 a manual staff of something over 700 has been employed. Separate figures for employment in the two departments were not recorded before January 1956, but the writer was informed that the staff of Department I had always been slightly smaller than that of Department II.

Department I employs a much larger number of unskilled labourers than skilled workers. On the other hand over fifty per cent of the labour force of Department II are skilled tradesmen. This difference arises out of the nature of the work involved - Department I requiring a large force of labourers for excavation work, whilst the unskilled force employed in Department II consists largely of tradesmen's mates. There is, therefore a difference between the two departments not only in the proportions of unskilled workers employed, but also in the type of unskilled work undertaken.

Apart from the inconvenience caused by inclement

weather, particularly in winter, to the workers in Department I, the working conditions can not be considered to be unpleasant in either department.

No distinction is drawn between temporary and permanent workers, although in some circumstances workers engaged in Department I may not be required permanently. Thus the labour force will be augmented when repairs to installations need to be performed urgently, and these workers will be paid off if there are no vacancies available on the completion of the urgent work. However, in practice such redundancy is very small as the level of voluntary wastage is usually such that a temporary reduction in recruitment at these times is all that is necessary. Unfortunately redundancies are not recorded separately from other workers who leave the firm on the initiative of the employer. In our investigation therefore the workers classed as Paid off may be redundant, dismissed for misconduct or discharged as unsuitable, the latter category being it is understood the largest in number. The main tables of our inquiry do not exclude paid off workers, but these workers are shown separately, as in our previous analyses.

Department II had a number of apprentices, who have been excluded for reasons similar to those advanced in the

comments on Case Study A. Other workers than apprentices who commenced under the age of 21 have, however been included. Obviously these latter workers will be unskilled.

Transfers from one department to another are rare, and occur, if at all, amongst skilled workers. It has not been thought necessary in view of the small number of persons involved to treat such workers separately, nor to adopt the exclusion methods outlined in previous chapters. Any transferred worker who left has been included in the department from which he left and any worker still remaining in the labour force on January 1st. 1958 has been included in the figures for the department in which he was employed on that date. This procedure is similar to that adopted in Chapter 8.

Reasons for leaving other than 'own accord' and 'paid off' were not normally recorded by the departments and, though, undoubtedly these terms will cover many cases which could more properly be included in other categories e.g. health, it has been remarked before ^{it is} doubtful how far a more detailed classification would be useful. In any case the alternative was not open to us.

In both departments selection of workers is the responsibility of the departmental managers who may delegate it to their foremen. No specialist personnel

officer is employed for the selection of manual workers although specialist officers are engaged on some of the work usually covered by personnel departments, e.g. industrial relations and welfare. There is also a training officer but his main concern ~~are~~ the apprentices. Much more attention appears to be paid by the departments to the selection of skilled workers than to the unskilled ones. In department I, particularly, the engagement of unskilled workers is very much a matter of course. Little or no real selection is practised in this case. We must refer the reader to our comments in Case Study C regarding the inadequacy of such a procedure.

Quarterly recruitment figures were not available for either department and therefore it has not been possible as with the earlier case studies to examine the extent of seasonal variations in stability.

Table I and II show the survival performance of yearly entrance groups to the two departments separately for the years 1951 to 1956. The survival curves corresponding to the tables are given in Graphs I and II. As will have been noticed a rather longer period of time is covered by this inquiry than in the case of the previous studies.

Bearing in mind the relative size of the labour force

TABLE I.

Entrants to Department I (Years 1951-56 incl.)

Year	Ento. No.	1	2	3	4	8	13	26	39	1y	3m	6m	1y	1y 9m	2y.	3y	4y	5y	e 52 wks.
1951	92	81	73	68	65	57	46	35	28	27	25	25	25	24	24	19	15	13	22.78
	%	83.1	79.3	73.9	70.7	62.5	50.3	38.3	30.4	29.4	27.2	27.2	27.2	26.1	26.1	20.6	16.3	14.1	
1952	110	853	81	74	69	58	50	34	29	28	25	25	25	25	25	21	18	16	19.81
	%	77.3	73.6	67.3	62.7	52.7	45.5	30.9	26.4	25.5	22.7	22.7	22.7	22.7	22.7	19.1	16.4	14.5	
1953	173	148	136	127	115	90	71	53	40	35	31	28	28	26	24	16	14		20.69
	%	87.6	78.6	73.4	68.5	52.4	41.3	31.4	23.1	20.2	18.3	16.2	15.3	14.3	9.3	8.3			
1954	128	124	118	112	108	102	78	45	36	31	28	27	26	26	26	22			24.25
	%	96.9	92.2	87.5	84.4	79.7	60.9	35.2	28.1	24.2	21.9	21.1	20.3	20.3	20.3	17.2			
1955	213	180	167	163	151	138	109	84	72	65	61	58	55	52	52				23.69
	%	84.5	78.4	76.5	70.9	64.8	51.2	39.4	33.8	30.5	28.6	27.2	25.8	24.4					
1956	120	102	97	91	88	65	57	40	37	31									21.48
	%	85.0	80.8	75.8	73.3	54.2	47.5	33.3	30.8	35.8									

TABLE II

Entrants to Department II - (Years 1951 - 56 incl)

Year	1	2	3	4	8	13	26	39	1y	3m	1y	6m	1y	9m	2y	3y	4y	5y	e	
Entc. No.	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	wks.
1951	17	16	15	14	12	11	11	9	8	8	7	7	7	7	7	7	6	5	5	33.15
	%	94.1	88.3	82.4	70.5	64.7	64.7	52.9	47.1	47.1	41.2	41.2	41.2	41.2	41.2	41.2	35.3	29.4		
1952	25	25	25	25	24	24	19	19	19	16	16	16	16	16	14	13	10	9	9	43.66
	%	100	100	100	95	96	76	76	76	64	64	64	64	64	56	52	40	36		
1953	24	23	22	22	22	20	18	18	18	16	15	15	15	15	15	11	8			41.63
	%	95.8	91.7	91.7	91.7	83.3	75	75	75	66.7	62.5	62.5	62.5	62.5	62.5	45.8	33.3			
1954	50	50	48	46	39	38	33	29	26	24	21	21	21	21	19	18				35.61
	%	100	100	96	92	78	66	58	52	48	42	42	42	42	38	36				
1955	19	19	19	19	18	11	11	8	6	6	6	6	6	6	5					34.08
	%	100	100	100	100	94.7	57.9	42.1	31.6	31.6	31.6	31.6	31.6	31.6	26.4					
1956	20	19	19	19	18	17	15	13	13	13	13	13	13	13						39.9
	%	100	95	95	95	85	75	65	65	65	65	65	65	65						

in the two departments the most striking fact which emerges is the low annual recruitment levels in Department II. This presupposes a high degree of stability amongst the workers already employed in this department. It is true that the entrance groups are so small as to lead to considerable variability in the survival percentages and service expectations from one entrance year to another. However, with a minimum expectation of service to one year of 33.15 weeks (range 33.15 to 43.66) and a minimum survival percentage of 31.58 (range 31.53% to 76%) it is obvious that the stability of new entrants is high. A variation (not so pronounced) in entrants to Department I is also observed, but in all years the stability is much lower than that found in the second department. A further point to be noted is the different leaving pattern shown by the two departments. For 5% of the workers engaged in Department II to leave in the first fortnight is exceptional, whilst, except for the 1954 entrance group which was exceptionally stable, Department I customarily lost more than 20% of its workers during this period.

In both departments the proportion of men paid off out of the entrance groups considered was substantially the same as has been observed in earlier studies (Chapters 9 and 10). From Table III it can be seen that just under 11% of the entrants to Department I were paid off within

one year of entrance, as were a slightly smaller proportion of the entrants to Department II. Further examination reveals the interesting fact that whilst nearly all those paid off from Department I left within a year, over half of the Department II workers paid off left after that period. In other words the proportion of workers paid off in Department II tended to be much higher than that observed in Department I and indeed than that found in the other inquiries. This may be indicative of a substantial difference in the reasons for pay offs in the two departments. It is true that the total number of workers paid off from the groups entering Department II was only 29 and had the discrepancy between the two departments been smaller we might have attributed it to the small numbers in Department II, but as it is such an explanation seems unlikely.

TABLE III (no Graph)

Entrants (1951-56 incl).
Paid Off.

Dept.	Total No. PAID OFF from entrance Groups 1953- 1956.	PAID OFF within one year.	Percentage of Entrants Paid off within one year.
I	96	91	10.89 %
II	29	14	9.03 %

In view of the difference in the proportions of skilled and unskilled workers in the two departments, coupled with

the commonly held opinion that unskilled workers tend to be less stable than skilled ones it might be thought that the differences in the stability of entrants to the two departments could be accounted for by the higher level of unskilled recruitment in Department I. Table IV and Graph IV a and b. indicate that this is by no means the case.

TABLE IV

Entrants in All Years (1951-56 incl.) by Category of Skill.

No. of Entrants.	1	2	3	4	8	13	26	39	52	52 weeks.
<u>Department I Skilled.</u>										
52	51	50	49	48	44	43	30	25	22	33.44
%	98.1	96.2	94.2	92.4	86.6	82.7	57.7	48.1	42.3	
<u>Department I Labourers and Mates.</u>										
751	637	590	554	518	438	340	238	198	176	20.36
%	84.8	78.6	73.8	69.0	58.3	45.3	31.7	25.4	23.4	
<u>Department I Unskilled unsupervised.</u>										
33	32	32	32	30	28	28	23	19	19	37.42
%	97.	97.	97.	90.9	84.9	84.9	69.7	57.6	57.6	
<u>Department II Skilled.</u>										
77	77	75	74	73	67	65	58	54	48	40.28
%	100.	97.4	96.1	94.8	87.	84.4	75.3	70.1	62.3	
<u>Department II Unskilled (Labourers and Mates)</u>										
78	76	76	74	72	67	64	49	42	42	35.62
%	97.4	97.4	94.9	92.3	85.9	82.1	62.8	53.8	53.8	

It is true that unskilled workers (with the exception of one particular group found only in Department I, who worked

largely unsupervised) were less stable than skilled ones in both departments. The stability of both classes of workers was higher in Department II than in Department I however and this is particularly noticeable in the case of the unskilled workers. Indeed with an expectation of service to one year of over 35 weeks the unskilled workers in Department II were substantially more stable than the skilled workers in Department I. This is the more remarkable when one remembers the higher proportion of workers paid-off from Department II. The stability of the skilled workers in Department II is very high indeed - over 62% of the entrants remaining more than one year with an expectation of service to one year of over 40 weeks.

A contrast with the low stability of entrants to Department I generally is provided by one small group of entrants, not labourers or tradesmen's mates, which shows a very high stability, almost as high, in fact as that of the skilled entrants to Department II. This group is small, only 33 in number, but the stability is consistently high in each entrance year, therefore it is likely to be of significance. These workers are engaged chiefly in attending to equipment installed in the open. Each worker operates in a certain area and though he has to report daily to the main works of his department he is not subject

to constant supervision when doing his job. Possibly this contributes not a little to his stability. It is perhaps significant that of the other workers the skilled tradesman of Department II are left more on their own than any other group, whilst the unskilled workers of Department I are subject to the most supervision, being constantly in contact with their foreman. Of course, it might be argued that in the selection of the unsupervised unskilled group special attention is paid to obtaining men who have some ability to work on their own and who are perhaps more intelligent than the average unskilled labourer. In view of the small numbers of such workers required, there is obviously more scope for such selectivity than in some other cases.

During the six entrance years Department I had 89 re-engagements of whom twenty were skilled and sixty nine unskilled. The overall survival percentage to one year was approximately 34% with a one year service expectation of 27 weeks (Table V).

TABLE V (No graph)

Re-entrants during 1951-56 inclusive.

No.	1	2	3	4	8	13	26	39	52	^e 52
<u>Department I</u>										
89	84	80	76	69	67	59	38	33	30	27.05
%	94.4	89.9	85.4	77.5	75.9	66.3	42.7	37.1	33.7	
<u>Department II</u>										
15	15	15	15	15	14	13	11	10	9	40.10
%	100	100	100	100	93.3	86.7	73.3	66.7	60.0	

In the same period only 15 re-engagements (of whom twelve were skilled workers) were made in Department II. The survival percentage to one year for the latter department was 60% with an expectation of service of about 40 weeks. In both cases the re-engaged workers showed no greater instability than the new entrants, but on the other hand they showed no significant superiority. The number of re-entrants to Department II is not large enough to permit us to use the results with any confidence; this does not apply to Department I. It is suggested that the Department I figures indicate that greater care in selection for re-employment might be profitable. After all, out of the 89 re-engaged workers, twenty left within a month, which suggests that they could hardly have had a very strong desire to return to the company. It is most unlikely that the majority of these early leavers would have passed through the net spread by an experienced personnel officer. As it happened, however, these twenty workers were re-engaged but for a period which was hardly likely to be profitable to their employers.

The general picture given by our analysis by Civil Status is one of greater stability amongst the married men in both departments. Table VI and Graph VI a. and b. show that the lower wastage is very much more pronounced in single men in department I than in department II.

TABLE VI

Survival of Entrants in
All Years by Civil Status.

No. of Entrants.	Survival to - weeks-									52 ^{wks.}
	1	2	3	4	8	13	26	39	52 ^{w.}	
<u>Department I. Single.</u>										
341	300	272	254	236	201	160	106	86	76	20.3
%	88.	79.8	74.5	69.2	58.9	46.9	31.1	25.2	22.8	
<u>Department I Married.</u>										
417	382	369	352	335	296	245	184	157	142	26.48
%	91.6	88.5	84.4	80.3	71.	58.8	44.1	37.7	34.1	
<u>Department II Single.</u>										
59	58	56	55	54	50	48	40	33	31	36.29
%	98.13	94.9	93.2	91.5	84.7	81.3	67.8	55.9	52.5	
<u>Department II Married</u>										
96	95	95	93	91	84	81	67	63	59	38.95
%	99.	99.	96.9	94.8	87.5	84.4	69.8	65.6	61.5	

No information on the Civil Status of 78 Entrants to Department I.

This very low stability of single (including widowers and divorced persons) men in Department I arises mainly out of wastage during the first eight weeks which is much higher than in the married group. This is undoubtedly due to the presence amongst this group of a number of unskilled workers of a particularly unstable type (those living in the local Salvation Army Hostel, who usually give their status as single or widowed. These workers are not usually acceptable for anything but the most unskilled work and

hence find their way to the less skilled road work in Department I. Many of these workers do not want work and in fact that they are engaged does not necessarily mean that they are prepared to do a fair days work. Very often such applicants have been persuaded by the National Assistance authorities that suitable vacancies exist for them at Company D. The 'workers' come along, in the sincere hope that the personnel officer will be sufficiently mindful of his firm's efficiency to reject them out of hand. Where they find a firm that is prepared to accept practically all applicants including themselves, these persons cannot refuse to be engaged, but they can, and frequently do, retain the job for as short a time as possible. As a personnel officer in another firm remarked to the writer, 'If I do nothing else at least I make sure that I do not engage those who do not want the job'. Where there is no personnel specialist such persons are frequently engaged - to the detriment of the employer.

A comparison of the relationship between age and length of service remains to be made. In Table VII a. the figures for Department I are given, and Table VII b. supplies those for Department II. A comparison of age and length of service between the two departments is made in Graph VII. There is no general increase in stability with age in either

TABLE VII a.

Survival of Entrants (All years 1951-56 incl)
and Age on entry. Dept. I.

No, of Entrants.	Survival to weeks. -									e ^a 52 ^{wks}
	1	2	3	4	8	13	26	39	52	
<u>Age on Entry - Under 21.</u>										
10	7	6	6	6	5	3	3	1	1	14.7
%	70	60	60	60	50	30	30	10		
<u>21 and under 26.</u>										
190	178	168	154	143	122	101	69	57	49	22.98
%	93.7	88.4	81.0	75.3	62.4	53.2	36.3	30.	25.7	
<u>26 and under 31.</u>										
134	113	103	98	94	84	74	50	39	33	22.62
%	84.3	76.9	73.1	70.1	62.7	55.2	37.2	29.1	24.6	
<u>31 and under 36</u>										
87	72	65	63	58	48	37	24	17	16	18.1
%	82.8	74.7	72.4	66.7	55.2	42.5	27.6	19.5	18.4	
<u>36 and under 41</u>										
75	66	59	58	52	48	34	29	28	25	23.63
%	88.	78.7	77.3	69.3	64	45.3	38.7	37.3	33.3	
<u>41 and under 46.</u>										
80	72	67	66	64	51	39	28	23	21	22.38
%	90.	83.8	82.5	80.	63.8	48.8	35.	23.8	26.3	
<u>46 and under 51.</u>										
68	60	57	51	51	47	38	27	23	21	24.55
%	88.3	83.8	75.	75.	69.1	55.9	39.7	33.8	30.9	
<u>51 and over.</u>										
100	98	93	88	80	69	60	41	36	32	25.9
%	98	93	88	80	69	60	41	36	32	

No information on the age of 94 entrants
to Department I.

TABLE VII b.

Survival of Entrants (All years 1951-56 incl)
and Age on entry. Dept. II.

No. of Entrants.	Survival to weeks.										e ₅₂ wks.
	1	2	3	4	8	13	26	39	52.		
<u>Age on Entry - 21 and under 26.</u>											
34	33	32	30	29	25	23	16	12	11		27.62
%	97.1	94.1	88.2	85.3	73.5	67.7	47.1	35.3	32.4		
<u>26 and under 31.</u>											
23	23	23	23	22	19	17	15	14	13		36.33
%	100	100	100	95.7	82.6	73.9	65.2	60.9	56.5		
<u>31 and under 36.</u>											
22	22	22	21	21	21	20	19	18	13		45.41
%	100	100	95.5	95.5	95.5	90.9	86.3	81.8	81.8		
<u>36 and under 41.</u>											
13	13	13	13	13	12	12	11	10	9		43.69
%	100	100	100	100	92.3	92.3	84.6	76.9	69.2		
<u>41 and under 46.</u>											
10	10	10	10	9	9	9	7	5	4		36.1
%	100	100	100	90	90	90	70	50	40		
<u>46 and over.</u>											
10	10	10	10	10	10	10	8	8	8		45.5
%	100	100	100	100	100	100	80	80	80		

No information on 43 entrants.

department. The most stable entrance age group in Department I is that of 51 years and over, whilst the least stable group (excluding those under 21 who number ten and who were all unskilled workers) is that covering ages 31 and under 36 years. In Department II all the entrance groups are too small to be entirely reliable but the lowest stability is found amongst the 21 and under 26 group, with the 31 and under 36 years group and the 46 and over group showing the greatest stability. The linear correlation coefficient in the case of both departments is positive, but it is below + 0.5 and hence with the number of degrees of freedom available cannot be treated as significant.

Graph VII enables us to compare the stability at various ages in the two departments. At every age Department II is more stable than Department I.

Our analysis of the various sub-groups within each department confirms our impression that the difference in stability between the two departments cannot be accounted for solely in terms of differences in the structure of the working group as distinct from the quality and the general environmental situation. It would appear, therefore, that differences in stability of entrants to the two departments, may be due to:-

- a. The quality (as distinct from the job category) of the

workers who are attracted to the two departments.

b. The working environment.

c. The selection policies pursued (including method of induction)

(Note.- Most other personnel services e.g. welfare, industrial relations, etc., are identical for both departments.)

d. The number of workers required.

The extent to which these factors are capable of modification will vary from one particular case to another, but the results of our inquiry suggest that a detailed comparative study paying special attention to the influence of the four factors should be made before management reconciles itself to the continuance of the present great disparity in labour stability in the two departments.

CHAPTER TWELVE

THE CHARACTERISTICS OF LABOUR WASTAGE - A SUMMARY.

In his article on Labour Turnover in the Royal Statistical Society's Journal, H. Silcock (1954.1) summarises briefly the characteristics of Labour Turnover which have been observed by recent investigation.

Though our own enquiry has been on different lines from those of some other investigators (e.g. refs.1951.4; 1951.11; 1958.1) and though it has not covered such a broad canvas as some of them, it should, nevertheless, be both instructive and useful to compare the extent to which our findings support those of previous workers in the field.

Silcock (1954.1) groups the observed characteristics of Labour Turnover under three headings:

- a. strongly marked characteristics;
- b. less strongly marked characteristics;
- c. characteristics for which only fragmentary evidence is available.

His classifications within these groupings are not always those to which the present writer would subscribe and in view of the differences of opinion which are bound to arise on the allocation of the various observed characteristics to the three categories it has been thought more satisfactory

from our point of view to list individually each item, indicating the degree of importance in the comments which follow.

Each of the characteristics listed below is followed by a summary of the evidence to date, and in a later section the extent to which our results add support to previous work is considered.

Characteristics observed in previous investigations.

1) The Annual Rate of Labour Turnover (we shall assume the use of the B.I.M. formula unless specific indications are given to the contrary) shows a wide variation between jobs, departments, firms and industries.

The survey of Labour wastage carried out by the Institute of Personnel Management and the British Institute of Management (1951.8) shows annual rates which vary between 5% and 143%. The Birmingham (1951.4) inquiry showed rates for females varying from 17% to 133% per annum and for males from 5% to 95%. Behrend (1953.2) in an article in Occupational Research (1953.2) gives annual rates for men of from 6% to 107%. Baldamus (1951.9) quoting avoidable labour turnover gives figures for eleven factories varying between 5% and 105%. The recent Monmouthshire survey (1958.1) shows a variation in annual Labour Turnover from 13% to 76% amongst ten firms. These observations are from factory to factory but large differences also, persist from one

industry to another as can be seen from an inspection of the figures published regularly by the Ministry of Labour and National Service in the Ministry of Labour Gazette.

Departmental differences in turnover within certain firms were found to be substantial by Baldamus (1951.9), Rice (1952.1;2.), and in the Monmouthshire (1958.1) inquiry.

2) Most terminations are at the request of the employee.

In the Monmouthshire (1958.1) survey voluntary resignations (excluding those for health reasons) for males represented about 70% of all leavers whilst for females it was around about 55%, but this latter figure excluded pregnancies (4.6%) and a high illness wastage (20.1%). The Sheffield survey (1951.11) showed resignations as upwards of 75% of all terminations, whilst the inquiry conducted by Long for the University of Birmingham (1951.4) showed resignations as between 83% and 93% of all leavers. Figures of upwards of 70% are also shown by the survey of the British Institute of Management (1951.8) Rice (1950.5) shows that even in 1949 - a year of redundancies for the Glacier Metal Company - the proportion of voluntary resignations was 45% and in several other years figures of 65% to 90% were observed.

In periods of recession, both because of a large number of redundancies and the difficulty experienced by employees

in getting work elsewhere the proportion of voluntary resignations can presumably be expected to fall.

3) The amount of Labour Turnover decreases as length of service increases.

Captain Major Greenwood (1919.3) in his paper to the Royal Statistical Society - "Problems of Industrial Organisation" was one of the first persons in this country to observe and comment upon this tendency. The more recent studies of Rice, Trist and Hill (1950.5) with the Glacier Metal Company show a decline in Labour Turnover as length of service increased, whilst both Long (1951.4) and Greystoke (1951.11) reach the same conclusions as a result of their enquiries. The Monmouthshire survey (1958.1) shows a specific turnover of 44% for male workers in their first year of service, declining to 4% amongst those workers with 10 or more years of service with a firm. For females the comparable rates are 70% and 8%.

No investigations, so far as the writer's knowledge extends, have led to results in opposition to these conclusions.

4) Females tend to have a higher wastage than males.

Few writers have suggested that this is a universal tendency, but most inquiries show no more than a few exceptions. The B.I.A., (1951.8) surveys show only a few

cases where females working in the same factory have a lower rate of wastage than the males, the reverse usually being the case. Females wastage rates are generally high in both the Sheffield (1951.11) and Birmingham (1951.4) inquiries. Behrend (1953.2) out of nine firms finds six with substantially higher wastage rates for females.

Many reasons have been advanced to account for this tendency - domestic responsibilities, disinclination to look upon a job as a permanent feature of a woman's life, lack of interest in a career, the greater proportion of women than men in unskilled occupations, and so on - but the indications are that whatever the causal factors may be, in certain cases they can be offset by other influences.

5) Married women have higher wastage rates than single women.

It is not possible from the methods of analysis adopted in most inquiries to discover the extent to which this tendency is the determining factor in (4) above. Long (1951.4) suggests that a large part of the greater wastage shown by females is due to the instability of married women and that a comparison of single women and males would reveal no significant difference between the wastage of the two groups. The Monmouthshire (1958.1) inquiry, however, compares the average length of service of men and women leavers both in the married and single categories. The

figures from this inquiry, given below, show the stability of married women to be lower than that of single women in two age groups, but the male workers with which they are compared are considerably more stable than women of either status.

Average length of service of single and
Married men and women. (Table 35 p.61 ref.1958.1)

Age group.	<u>MEN</u>		<u>WOMEN.</u>	
	Single	Married.	Single.	Married.
30 - 40 years.	6.4yrs.	9.0 yrs.	5.1yrs.	3.9yrs.
40 - 50 years	12.5yrs	11.25yrs	6.0yrs,	5.0yrs.

Whilst these figures are not conclusive (we do not know the length of service or occupational structure of the labour force considered) they nevertheless supply strong evidence for the conclusion that although marriage is a factor which increases female wastage it is not the only one and that single women compare unfavourably with males in stability.

6) Married men tend to be more stable than single men. This has been commented upon by a number of writers and is certainly the opinion of many employers and personnel managers, though the evidence available is scanty. The above table prepared for the Monmouthshire survey (1958.1) shows married males to be more stable than single ones between the ages of 30 and 40 whilst the age group 40 - 50 the tendency is reversed.

7) Wastage decreased as skill increases.

Long (1951.4) gives figures of Labour Turnover rates for skilled workers which do not exceed 11%, whilst unskilled wastages quoted by her are in excess of 24%. The article by Baldamus (1951.9) already quoted, also gives turnover rates for unskilled workers much in excess of those for skilled employees. These figures are supported by the impressions of many personnel officers whom the writer has consulted.

A lack of precise definition of the terms skilled and unskilled leads to difficulties of interpretation for purposes of comparison. In our inquiry we have equated 'skilled' to apprentice trained and have classified all other workers for whom we do not give a specific job category as unskilled. Other writers have adopted different classifications - in some cases threefold, skilled, semi-skilled, and unskilled.

8) Increased recruitment leads to greater wastage.

This has been commented upon in the Monmouthshire survey (1953.1) where the expansion of a firm's labour force from 2703 to 3406 was accompanied by an increase in the turnover rate (presumably annual) from 11% to 22%. Few would disagree with the claim that this tendency exists, but whether it can be accounted for solely because of the characteristics discussed in (3) above, or if there are other reasons, has

not apparently been investigated in any published work.

- 9) The rate of wastage varies in direct relationship with the general level of employment.

Inquiries in 1919 (1919.3) and 1921 (1921.1) were stimulated by wartime and early post war difficulties in the replacement of labour. Interest in labour wastage declined thereafter as the labour market became easier for employers, and has only been revived with coming of the full employment condition experienced since 1939. These facts in themselves give significant support to the tendency noted above.

Additional support for the existence of this characteristic is given by Woytinsky(1942.1) and by Long's survey (1951.4) of the general trend of labour wastage over a thirty year period prior to 1951, whilst Behrend (1953.2) brings forward some recent evidence in support of the proposition.

- 10) The rate of Turnover tends to decline as age increases. Long (1951.4) experienced some difficulty in deciding to what extent her observations giving support to this view were invalidated by the fact that to some extent age and length of service increase together. Though she did not succeed entirely in eliminating the influence of length of service, she finally concluded that age could be regarded as a separate although minor factor. In the Monmouthshire inquiry (1958.1) no attempt was made to eliminate the

possibly disturbing influence of length of service on labour wastage at different ages, but evidence was offered of a significant decrease in turnover with age in males, which was not observable amongst females.

11) Seasonal variations in Labour Turnover are perceptible. Apart from those occupations where there are seasonal changes in the demand for labour, e.g., in building, the Ministry of Labour and National Service's figures of labour wastage show a marked increase in the months of January and September preceded by periods of low turnover in December and July. The Birmingham (1951.4) and the Monmouthshire (1958.1) inquiry give information supporting the existence of a tendency such as this in individual firms.

Generally the writer found that it was the opinion of personnel officers that a holiday period is usually preceded by low wastage and followed by a much greater loss of labour.

12) The level of earnings is directly related to the amount of Labour Wastage,

Few would deny the force of the economic factor in influencing labour stability. Long and Bowyer (1953.1) have found a positive correlation between high earnings and low turnover, whilst the Monmouth enquiry (1958.1) also adduces evidence in this direction. These writers, however,

agree that this is an influence which it is particularly difficult to isolate from other factors, such as length of service, skill, sex and job category.

13) The size of the firm and the distance travelled to work have both been put forward as possible influences on the level of wastage.

The evidence in the latter case is very inconclusive, but a slight tendency for the larger units to have lower turnover rates has been found by Long (1951.4), and also in the Monmouthshire inquiry.

Some investigators would introduce the age of the firm as an additional relevant factor. No research worker has, however, attempted to isolate this factor from the possible influences of firm size and length of service structure, and therefore what evidence there is, is of doubtful value.

The extent to which some of these characteristics have been observed in the present inquiry is outlined in what follows.

1. The annual rate of turnover is, as has been pointed out in Chapter II, an unreliable measure of the stability of the labour force. Silcock (1954.1) says - "This notion (that leaving rates can 'vary up and down comparatively widely and rapidly') has been stated so often in the literature that it has become an article of faith. Yet nowhere

have I been able to find adequate evidence to support it. It is true that crude rates of turnover may exhibit wide variation but this seems to me quite compatible with relative stability in rates specific by length of service".

Our own investigation, which seeks to eliminate the length of service effect shows a wide range in stability from unit to unit. A survival percentage of 80 at the end of the first year of service is at one extreme, whilst a unit having only 10% survival over the same period is at the other. Within the same unit much less variability is observed, differences in the one year survival percentages of entrants from one entrance year to the next rarely exceeding 10% and frequently being less than 5%. Where differences in excess of this occur they can sometimes but not always, be accounted for as due to errors arising out of the small numbers of workers involved. The service expectations likewise vary considerably from firm to firm but are more stable within each unit.

Some support is afforded by our results for the view that stability varies greatly from one concern to another, and that such variability is much less pronounced within the firm from one year to another.

2. Our examination of the proportion of discharged (or paid off) workers to all leavers in each unit yields

figures not greatly differing from 10% in nearly all cases. Though the remaining 90% will not be composed entirely of voluntary leavers there is little doubt that the great majority could be so classed. These results are in agreement with the observations of previous investigators.

3. The greater instability of short service workers is, of course, the main assumption of our inquiry. With the exception of some groups in Case Study A (Chapter 8) our results are in conformity with this assumption. The results in Case Study A are subject to special qualifications outlined in Chapter 8 and cannot be said to vitiate our argument, nor our main conclusions which are in line with previous observations.

4. Females were not employed in the firms dealt with, in Case Studies A, C and D. In Case Study B, Chapter 9, however, the firm concerned employed many female workers who showed no greater instability on the whole than male workers in a similar job category. Our investigation, therefore, provides no support for the suggestion that female workers are necessarily less stable than males.

The existence of equal pay in this firm is undoubtedly an important factor in retaining female labour which suggests that part at least of what is gained by paying females at lower rates for similar jobs is lost in the

greater costs of labour wastage for that sex. On the other hand if equal pay were universal there is no guarantee that female stability would be the same as that of males, as the favourable experience for females may arise here not out of equal pay itself, but because of the greater differential existing between female pay in this and in other occupations compared with that between the pay of male conductors and that of males in comparable occupations.

5. In our inquiry married women were, on the whole, less stable than single ones during the first year of service. Thereafter the trend reversed itself and married women became the more stable. Such a tendency would not, of course, be revealed by the ordinary Labour Turnover Rate, and as by far the most wastage usually occurs during the first year of service our observations are not necessarily incompatible with a greater overall stability amongst single women. Nevertheless our results serve to indicate that the length of service structure of the labour force might have much to do with the relative stability of the two groups in any particular situation.

6. Case studies C and D show a greater stability for married than for single men - a difference which appears to be independent of the age factor. On balance the firm

in Case Study A shows a slightly greater stability in married men compared with single ones, although three units actually show a very slightly and probably not significantly, greater stability in single males.

Our results are therefore moderately well in accord with those obtained by others, though undoubtedly further research is indicated here.

7. A definite tendency for a greater stability of skilled workers over the unskilled is observable in our results, but it is a tendency only. Where special selective processes have been at work (as in Case Study A) or in particular categories (Case Study C) unskilled workers may attain a high degree of stability, in some cases exceeding that of skilled workers.

8. A large increase in recruitment took place in Unit III (Case Study C) during 1955, more than twice as many workers being engaged during this period as in any of the other years considered. Graph IV, Chapter 10 shows a much less stable picture for 1955 entrants than for those in 1954. However, entrants in 1953 and in 1956, normal recruitment years, show stability not appreciably different from that experienced by the 1955 entrants. We can offer no support therefore from our results for the assumption that increased recruitment necessarily means a decline in

stability.

Increased recruitment might lead to an increase in the Labour Turnover Rate for a variety of reasons, not all of which mean increased instability in the labour force as a whole. Three reasons in particular may be distinguished in order to illustrate our point:-

- a. When recruitment is increased there will be a greater proportion of short service workers in the total labour force. This would give rise to a higher turnover rate, which was not a reflection of any real decline in stability at all.
- b. A large influx of new workers may have an adverse effect on the stability of the existing workers.
- c. The increased recruitment may lead to a reduction in entrance standards, and hence to the introduction into the firm of workers of lower stability than those hitherto recruited.

It is desirable that we should be able to distinguish between these causes, because they call for ^{different} remedies.

Unfortunately previous investigators who have demonstrated the effect of recruitment on wastage have used the ordinary labour turnover rate and hence their results do not provide us with ^{the} necessary basis for such discrimination.

9. Our inquiry has covered a period during which there was

no marked change in the general economic situation, therefore, we have no information on the relationship between wastage and overall levels of employment. If the present decline in employment levels persist the opportunity to investigate this relationship will present itself.

10. The evidence we have accumulated on the relationship between age and length of service is conflicting. The most that we can say is that there is some evidence of instability of entrants between the ages of 21 and 31, whilst the following decade is one of high stability in the majority of cases. In some units a definite falling off of stability in entrants is observed beyond the age of 46 years.

A word of warning is appropriate here. The increased stability with age which some previous inquiries have revealed, even if independent of length of service is sometimes used as a guide to policy in the sense that firms are more anxious to appoint workers in what are suggested to be the more stable age groups, other things being equal. We must, however, distinguish between changes in stability with age, in existing workers and such changes amongst new entrants.

There is no reason why a firm might not find its existing workers in the 30 to 35 age group to be highly stable (as evidenced by a low turnover rate) whilst at

the same time its new entrants in that age group might be very unstable. In other words the workers who change their jobs say between 30 and 35 may be more unstable than those who change their jobs between 20 and 25 years, although there may be a greater proportion of the latter age group actually changing jobs. It is thus important here, as in all cases where selection policy might be modified as the result of labour wastage investigations, to employ statistics based upon entrants data rather than, or in addition to, those based upon the labour force as a whole.

11. No attempt has been made in this inquiry to detect seasonal movements in leaving rates, as what suggestions have been made are supported by a large and convincing amount of data. We have, however, investigated the extent to which the season of entrance might influence the stability of the worker, and have found no consistent relationship in any case. Whatever, then, the seasonal changes which may occur in crude turnover rates our investigations do not suggest that, in the firms we have covered, workers engaged at one particular time of the year are likely to be more stable than those engaged at any other time.

12. Though a number of comments upon selection procedures and working conditions have been made en passant our inquiry has not covered the characteristics referred to in the

previous section of this chapter under paragraphs 12,13 and 14 and we can therefore make no further comments thereon.

The main results of our inquiry are in broad agreement with the outstanding observations of other workers in the field. Where our conclusions differ from those of other workers, the relatively small scale of our inquiry may be responsible to some extent. However, it is more likely, in some cases at least, that the differences arise out of the different methods of analysis employed. Indeed if our method of analysis gave the same results as those which are not based on length of service there would be no justification for its use. We have tried to show in the previous chapters that for the individual firm, analysis by length of service is more informative than the use of crude turnover rates. It is hoped that some of the points brought out in this chapter show equally the superiority of the stability approach over the wastage rate method in the investigation of the more general characteristics of our problem.

In conclusion the writer would like to stress his belief that whilst some investigation of the general characteristics of labour wastage is valuable, it is no substitute for the critical observation and interpretation of the firm's own statistics. The characteristics referred to in this chapter are, in the main, only

tendencies, and are likely to be considerably modified in any individual firm or industry by the existence of factors peculiar to that firm or industry.

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