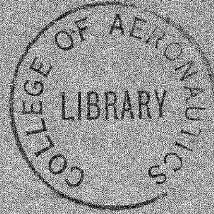


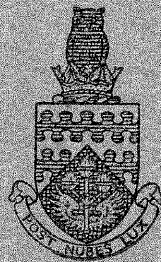
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AVOIDABLE DELAYS AMONG WOMEN WORKERS
ON LIGHT WORK

by

J. A. C. WILLIAMS, B.Sc.

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THE COLLEGE OF AERONAUTICS

C R A N F I E L D

Avoidable Delays Among Women Workers

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SUMMARY

Time Study makes use of certain allowances in correcting observed times to standard times. One allowance, the 'fatigue' allowance of F.W. Taylor, allocates a certain period of the working day to rest on a basis of conditions of work. The allowance is now termed Compensating Rest (C.R.) Allowance and is given for a variety of psycho-physiological conditions of work. A study of women workers in light industry is reported which measures the time spent not working, in talking etc. From this study causal factors effecting time not working are considered and certain recommendations are made as to values for C.R. Allowances covering certain factors in the work situation.

The method of study employed was that of ratio delay originated by L.H.C. Tippett and some comment is made on its application.

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INTRODUCTION.

Time Study is applied to industrial processes today in a manner which was described in all its essentials by F. W. Taylor in 'The Principles of Scientific Management' in 1911. There he outlined a programme which included

- (1) study of the method of work in order to simplify it,
- (2) timing elements of the job after standardisation of the method,
- (3) application of rest allowances to overcome physical fatigue,
- (4) standardisation and recording of element times so that synthetic times could be obtained for future use.

The only important addition to this practised today is 'rating' which was introduced by C. E. Bedaux.

The rest allowances (here discussed under the title of Compensating Rest (C.R.) Allowances) and rating form numerical corrections to the element times (Refs. 1 & 2) to give the time value in which it is expected that workers will accomplish specified work. Rating is applied generally to each observed element time and C.R. Allowances to the element time selected as being representative of those observed.

The industrial worker works under a wide variety of conditions, both physiological and psychological, for which the Time Study observer assigns a range of rest allowances which are conceived as being associated with the mental and physical strain of the work. They are intended to give the worker time free from work in which to recover from the deterioration which the process of work has caused.

The concept of the C. R. Allowances has changed since its use by F. W. Taylor. Originally it was a period of time in which the worker was made to sit down without working, but latterly the rest has developed into a permissive type following the practice of the Bedaux organisation expressed as 'the Company urge emphatically that these (allowances) are incorporated with the firm intention that advantage should be taken of them.... the manner of taking the rest allowances must generally be left to the workers and employers concerned' (Ref.3).

It is considered important that C. R. Allowances be allocated to industrial processes which are time studied in a manner which is equitable, using values whose magnitude has been assigned as a result of scientific investigation into the casual factors obtaining in the work process. The work described here was carried out as part of a programme to that end sponsored by the

Department of Scientific and Industrial Research and the Medical Research Council.

PRESENT POSITION OF C. R. ALLOWANCES.

Time Study is applied with the following aims

- (a) to provide efficient manning of jobs,
- (b) to provide data on which production planning can be based,
- (c) to provide for the efficient control of a planned programme,
- (d) to form a rational basis for wages.

Time standards for jobs are fixed following upon Time Study carried out in a manner described in (Refs. 1 & 2) using C. R. Allowances derived from standard tables. An examination of certain tables now in use in industry has been made in Ref. 4 as a result of which it is suggested that any tables should have allowances grouped under the following headings

- (a) physiological fatigue arising from imposing forces by the muscles and from posture,
- (b) heat stress,
- (c) perceptual strain,
- (d) social needs arising, for instance, from lonely or monotonous work,
- (e) personal hygienic needs.

The tables now in use in industry have allowances grouped under headings which are slightly different from these. The main defect of the present tables is that they do not follow a logical conceptual framework such as that given above. In some cases the description of the conditions for which allowances are given is ambiguous; in any given case this is probably not a defect as the table description is amplified verbally as part of the time study technicians training but in published tables this is a dangerous defect. The research unit has found that practitioners realise the limitations of tables now used and give help towards clarification in a most generous manner.

It is considered important that the magnitude of values be realistic as in some cases in practice it is suspected that C. R. Allowances (which cover 'avoidable delays' in Time Study parlance) are used to cover delays due to machine stoppages, non-availability of materials, etc. ('unavoidable delays').

An example taken from American practice (Ref. 5, p.267) will illustrate the point: this resulted from a study undertaken to investigate what delays occurred and their source.

<u>Allowances before study</u>		<u>Study results</u>			
Unavoidable	All except	Unavoidable			
	lot change	Misc.	7.1	2.0	
	1.0				
	lot changes	Repairs	4.0	1.5	
	3.5	4.5			
Personal	5.0	Lot changes	3.5	1.4	14.3 2.7
		Personal			5.5 1.8
Fatigue	10.0				
Total	19.5				20.1 3.1

The presence of 14.3% 'unavoidable delays' in a process merits attention by management towards a reduction but this had been masked by the allocation of unrealistic 'fatigue' allowances.

No systematic work has been carried out in the field of C.R. Allowances although the pre-1939 investigators of the Industrial Health Research Board, notably S. Wyatt, had made very useful studies of various factors that entered into the work situation causing delays.

It was decided that, as part of the present investigation, examination should be made of the time spent by workers in not working when work was available to them and from this attempt to establish the causal systems obtaining. In the present report studies are reported which were made on women workers engaged on very light work in two factories, in one of which the work was on conveyor belt packing. These represented work in which one would anticipate finding the minimum rest taken in industrial processes.

METHOD OF OBSERVATION

The method of observation shapes the data obtained so that it is necessary to discuss the point. It was decided to observe what stoppages the workers made in circumstances when work was available to be done - the so called 'avoidable delay'. This means that one observes the rest actually taken and not what rest is needed, which is the concept now understood for C. R. Allowances. This position is difficult to resolve without 'rest actually taken' is equated with 'rest needed' as the work situation is associated with a psycho-physiological state into which motivation to work enters and motivation can only be inferred by study of the behaviour pattern so that the argument is circular in form.

In some cases involving high metabolic rates or heat stress one can use physiological measures as indices but even there the tolerance of a condition is individual so that care must be taken to ensure high motivation under such conditions. B. Muscio (Ref. 6) pointed out that 'fatigue' could not be measured but only certain effects from which fatigue could be inferred.

The method used was that of 'ratio delay' developed originally by L. H. C. Tippett (Ref. 7) and discussed with its statistical background by Abruzzi (Ref. 5). This method, which takes momentary samples of behaviour by visual observation, enables the observer to study a reasonable sample of people (in this case seven or eight). The behaviour sampled is placed in categories predetermined by the purpose of the study and from the results the percentage occurrence of each form of behaviour given by the category definition can be obtained. After examination of the statistical stability of the data one can allocate confidence limits to the percentages obtained after removing any assignable causes of variance. In the present studies the categories used were basically

- | | | | |
|-----------------|----------------|---------------------|------------|
| (A) Working | (1) standing | (2) sitting | (3) absent |
| (B) Not working | (1) standing | (2) sitting | (3) absent |
| (C) Talking | (1) about work | (2) not about work, | |

but for any given type of work these were modified to suit the conditions obtaining by use of F. W. Taylor's 'exception principle'.

Observations on any one worker were taken at intervals of approximately 15 - 20 seconds so that with seven workers being observed, approximately 1,250 observations were taken per hour. This rate of sampling allows sufficient values for a reasonable examination of the statistical stability of the data on each worker to be obtained for every 15 minutes working time. Periods during which special effects can be expected to occur, notably within 5 minutes of stopping and starting work, were occluded from the study: special effects did occur in some cases during the normal course of work in Factory 'A' but these were noted and treated specially in the statistical treatment.

It is important in this method of observation to make a correct judgment of the behaviour of the worker and some observer effect is expected to be present from this source although an estimate of its magnitude cannot be given. It is not always possible to interpret behaviour at the momentary observation point so that the procedure was adopted of noting mentally the behaviour at the observation point and then awaiting the outcome of the behaviour in order to interpret it.

The operational description of categories is important and must be predetermined to suit the end purpose of study: the descriptions employed were determined after preliminary studies of the operations and will be described later.

DESCRIPTION OF JOBS STUDIED

Women workers were studied in two factories approximately 50 miles to the north of London. In both cases two groups were studied on each operation, each group consisting of seven or eight workers. The work will now be described in greater detail.

Factory A.

This was situated in a small country town and the labour force was mainly of single girls from 16 - 28 years old. The hours of work were

Mon. to Thurs. 7.30 a.m. - 1.00 p.m. & 1.30 p.m. - 5.00 p.m.
with 15 min. breaks at 10.15 - 10.30 a.m.
and 3.15 - 3.30 p.m.

Friday 7.30 a.m. - 1.00 p.m. & 1.30 p.m. - 3.45 p.m.
with one 15 min. break at 10.15 - 10.30 a.m.

The time worked was $41\frac{1}{2}$ hours per week.

Two groups were studied at this factory on an operation joining light, thin material in a foot operated press requiring only light foot pressure. The supervision over both groups was small as the management pursued a policy of letting the group discipline members by group opinion: the payment was by group bonus with a guaranteed minimum wage. Certain working conditions differed for the groups which will be commented on below.

Group 1.

This group numbering ten people worked in a small room on the ground floor through which members of Group 2 passed frequently. The presses were an old type which, although still technically effective were conducive to postural fatigue in the worker. The lighting level could have been improved at the machine position with advantage. Group 2 had improved type presses and this brought about charges of favouritism from Group 1 girls although they preferred working with their own group to moving into Group 2. The work room gave sight of the work yard and this proved a distracting influence. The group worked under a leader and certain experienced members moved from machine to machine, each machine performing specialised jobs, as the course of work dictated. The work progressed from member to member of the group each performing a specialised operation on it.

Group 2.

This group numbered some 30 people of whom seven were studied. The members of the whole group worked as one team and were paid by group bonus based on the production of the team. The workroom was on the first floor of the factory, was well lighted both from the windows and fluorescent lighting and the presses were easier to operate than those used by Group 1. In this group each worker performed one specialised operation on the material which passed progressively from member to member of the team and in general no worker left her own machine to help clear production bottlenecks by working on another operation: this differed from the practice in Group 1. No distracting views were obtainable from the windows.

Most of the girls in the two groups cycled to work distances up to 11 miles per day over undulating roads. 'Music while you work' was broadcast in both rooms and the radio was left on beyond the official B.B.C. programme times so that other types of music and talks were available if required by the groups who had the loudspeaker on-off switch under their control.

The type of work was very light. It required some dexterity in lining up the seams of the material to be joined but this could be done often without looking at the material. The positioning of the material in the press required visual attention and in no case was it observed that an operator positioned material without giving it visual attention. The work required the worker to be seated for the joining operation but the operators had opportunity to stand up and move about in collecting batches of material from their neighbours and bringing faults to the attention of inspectors. The work position in Group 1 was cramped and in both groups enquiries elicited complaints of back and arm aches; the work positions, however, were not unusual for industry and those for Group 2 were superior to many positions seen in other factories.

Factory B.

This was situated in a town in which there were a large number of other factories. Two groups were studied on the same operation, that of packing food products in cartons on a conveyor belt. The workers were older than those in Factory A, being mostly married, the age range being from 27 to 55 years old. They worked as teams in fixed positions on the belt, packing one or two units in each carton as predetermined by time study. The work was done seated but could be done standing: in the writer's opinion the work position could have been improved to reduce arm stretching and the neck and back muscles to be more relaxed. Enquiries elicited remarks about pains in the neck and back muscles to support this view.

The seating position was not the best possible but again was normal for seating seen in most factories. The hours of work varied between workers, some performing a 7.30 a.m. - 5.30 p.m. day down to others with a 1 p.m. - 5 p.m. day: the operators with the shorter hours generally had certain home commitments which precluded them from working longer hours. The general tendency was that the longer day was worked when the children were off hand or the husband dead. 'Music while you work' was broadcast only at the official B.B.C. programme times.

In both factories the managements were extremely co-operative in providing facilities for study. It was understood by both managements and workers that in all cases data obtained remained confidential to the investigator unless the workers had no objections to points raised being discussed. The workers studied were very co-operative and discussed relevant points freely.

RESULTS OBTAINED.

Factory A.

Group 1.

Observations were made throughout the day on Tuesday, Wednesday and Friday of one week. It was not possible, owing to the nature of the work, to obtain production rates for the individual or the group which would afford useful data. This is naturally regretted but is commonly found in industrial operations as variations occur in the product design produced, in machine breakdowns, in material variations, etc; the work rate for the days studied appeared to the observer to be consistent and on a level with the rate of Group 2.

In recording behaviour, 'working' was understood to comprise that time during which the worker was waiting for, lifting or otherwise arranging material, joining the material by machine and inspecting or discussing faults. 'Not working' was understood to comprise that time which, when material was available to be worked on, the worker was not 'working'. If the worker were waiting for material then the behaviour was classed as 'working'. Initially 'walking' was included as a separate category to 'standing' but finally these categories were combined as 'standing'. Certain other subcategories were obtained but are not discussed. In recording 'talking', workers in Group 1 were included in this category if they were physically talking but not if they were listening: the reason for this was that it was possible for many of the workers in this small room to hear a conversation so that observation of 'listening' was rendered impossible and behaviour was consistent with this point. A different definition was possible with Group 2, and to compare 'talking' in the two groups the percentages found in Group 1 should be doubled at least to compare with Group 2.

As an example of the differences found between individuals on the first day of observation the percentage of working spent in (a) not working, either sitting or standing but not absent at toilet, (b) in standing, working or not working, (c) in not working but talking about a non work subject, (d) in talking about a work or non work subject, are given in Table 1.

Table 1.

Operator	1	2	3	4	5	6	7
(a)	2.1	13.8	5.3	10.4	4.8	10.5	7.1
(b)	5.3	27.0	5.9	17.2	43.3	14.6	15.7
(c)	1.0	5.2	2.4	5.9	2.6	4.6	4.1
(d)	7.0	10.1	9.0	19.8	13.2	8.0	11.0

It is not intended to publish the results on individual but only the group means. Each of the individuals' results was analysed however to determine whether each sub period result (43 readings on each individual taken in approximately 15 minutes) was consistent with the assumption of statistical stability and could therefore be assigned confidence limits from binomial distribution theory. This assumption was justified in almost every case; in the exceptions, notes had been made during the observation period as to what seemed to be abnormal behaviour and these sources of variance were removed.

The group percentage means for the three days are given in Table II.

Table II
Group I Factory A

Behaviour category	Tues.	Weds.	Fri.
Not working either sitting or standing excluding toilet	7.8	7.0	9.7
Absent at toilet	.4	.2	.4
Standing	14.2	9.0	7.1
Talking about work or non work subject	11.1	7.1	6.9
Not working and talking	3.7	2.5	2.4
No. of readings	5929	6237	3801

The higher percentage of standing on the Tuesday was mainly occasioned by the absence of the leader of the team on that day which resulted in her work being taken over members of the team studied: she was present on the Wednesday and Friday. The differences between the days in the time spent not working are not significant for the Tuesday and Wednesday readings but significant for the Friday compared with the other days.

Group 2.

The results from this group showed that two of the seven members studied intensely were employed on the same type of operation which was not 'in balance' with the rest of the team. This resulted in them having approximately 30% of their time available for non work activities. As a consequence of this the results are given excluding the values obtained for these operators except for 'standing' and 'absent at toilet' values. The values were obtained on the Thursday of one week and the Tuesday and Friday of the next week.

Table III
Group 2 Factory A

Behaviour category	Thurs.	Tues.	Fri.
Not working either sitting or standing excluding toilet	2.1	4.9 (5.4)	8.2 (10.0)
Absent at toilet	1.6	2.0	2.4
Standing	4.2	6.0	6.6
Talking about work or non work subject	2.4	4.4	11.4
Not working and talking	1.2	2.7	4.0
No. of readings	3055	2855	3010

The figures in brackets are those raw figures actually obtained before removal of special occasions remarked upon previously.

The results for 'not working' are significantly different for all the days. A reason for the low figure on the Thursday was that one of the operators was new to the particular operation and paid more than normal attention to the work in order to preserve balanced production in the team: she affected the operator to her left slightly in a downward direction.

The criterion used for 'talking' in this group was different to that in Group 1. If an operator were physically talking or could be observed to be listening to another operator talking then the behaviour was classed as talking. In order to compare Table II with Table III values for 'talking' one should at least double the former.

The toilet position was next door to the Group 1 workroom so that members of Group 2 had to walk approximately 40 yards and down a flight of stairs to reach it. This would account to some extent for the higher percentage given.

Factory B.

In this factory it was decided to take only half day duration studies owing to presence of part time workers. The studies made were on groups whose members remained sensibly constant when studied on different days.

The first group, consisting of eight persons, was studied in the morning of one day, Thursday. The second group, also of eight persons, was studied on the same Thursday as the first group but in the afternoon, and then on the Friday afternoon of the week following.

Observation was made from a gallery overlooking the work position and it is considered that, as a consequence, the percentage of talking recorded for certain individuals is lower than actually obtained: it was not possible to apportion talking into 'working' or 'non working' categories. Records for any one individual were examined, as noted previously, for statistical stability and found to be consistent with the assumption of a binomial distribution of data obtaining. The grouped means are given in Table IV below

Table IV

Groups I & II Factory B.

Behaviour Category	Group 1		Group 2.
	Thurs. morn.	Thurs. aft.	Fri. aft.
Not working either sitting or standing	1.9	3.1	3.7
Standing	1.8	.6	2.3
Talking	(23.4)	25.2	17.4
Not working and talking	.9 (1.2)	2.0	1.2
No. of readings	3784	2056	1376

The figures in brackets apply when the observations on two of this group who were Italians (with little knowledge of English) were excluded. This group also included two British women over 50 and a Yugoslav: if their values were excluded the group value for 'not working' rose to 3.0%.

There is no significant difference between the 'non work' time of Group 2 on the two days studied but the difference between Group 2 and the whole of Group 1 is significant at the 0.01 level.

In neither group did any member absent herself for toilet purposes during the time of study.

The comparative hourly production of Groups 1 and 2 on the Thursday studied showed that Group 1 were 3 - 5% above Group 2 who were slightly below their average performance.

DISCUSSION OF RESULTS

There are known to be a large number of factors both local and global which effect the conduct of the worker at his job. The type of work which was studied and reported here had a metabolic rate of approximately 1.5 Kilocalories/min at which it could be expected that normally understood physiological fatigue would not occur. No heat stress was present and the work did not involve any perceptual strain sufficient to merit special study. Factors other than these become more important in light work as determinants of rest pauses taken in the course of work and the results obtained illustrate this to a limited extent. It is considered that the restrictions of the limits of the studies must be stressed otherwise the values may be assumed too hastily to be applicable to other groups in other districts without consideration of the differences in social norms obtaining. It is to be anticipated that in some districts less pauses would be taken by members of groups similar to that in Factory A especially if supervision were increased and talking discouraged. Nevertheless in both factories the workers seemed to be on good terms with supervisory grades of management and the rest pauses taken, except in certain cases in Factory A, were associated in the writer's judgment with general feelings of tiredness at the end of the day. There was no apparent conscious withdrawal of work effort by the workers.

In observing workers in a variety of activities whose work rates are within the control of the workers it is noticeable that occasions arise when the worker is making movements which appear to be "working" but which on closer examination shew that a rest pause is being taken as no productive work is done. The workers movements are, consciously or unconsciously, hiding the fact that a rest is being taken. This occurred in Factory A with both groups: to overcome this rationalisation of rest pauses in order to record behaviour better the practice was followed of noting the behaviour at the momentary observation point and then noting the outcome of the behaviour before the recording of "working" or "not working" were made. This value judgment was found to be necessary generally for only one work movement: this movement was that of straightening out material before or after removal from the press at which time the worker might be talking whilst not looking at the work.

If she finally stopped straightening the material to do nothing except talk then the behaviour was classed "not working". The fact that such conditions arise has been agreed by technicians with whom the point was discussed; it forms a rationalisation of a rest pause which is acceptable to supervision. Observational methods such as that employed could detect such rationalised rest pauses and assess them quantitatively but it involves value judgments which are sometimes difficult to make.

The method of observation employed involves the presence of the investigator near to the group so that it is necessary to attempt an assessment of the observer effect on the group behaviour. It has been commented by a pioneer of Time Study, Charles Babbage, that workers under observation speeded up rate of working and I.H.R.B. investigators enquiring into variety in repetitive work (Ref. 8) have noted similar findings. The consensus of opinion of Time Study practitioners is that some workers speed up and others slacken pace if observed. In the present case the opinion of the writer is that with Group 1 Factory A and both groups of Factory B the observer effect was small: in the case of one operator in Group 2 Factory A the observer effect on the first day of observation may have been to speed up production but this had become small by the second day. The increase of "non work" periods with both groups of Factory A associated with Friday is considered to be a real phenomena unassociated with the presence of the observer.

The bases for these judgments on observer effect are

- (1) inspection of production records for the days before and after the observation days, compared with those for the days of observation
- (2) observation and evaluation of the general behaviour of individuals.

Production records do not furnish infallible evidence as to observer effect as machine stoppages, material variation and non-availability of work can vary greatly from day to day causing changes which are not within the control of the individual worker and evidence is offered later to illustrate these points. Ratio delay technique does not involve the use of a stop watch so that any attitudes hostile to timing are not engendered.

The factors which appeared to effect the rest pauses taken by members of both groups in both factories may be summarised as

- (1) postural strain resulting from seating and position of the machine and the work
- (2) social life of the workers as individuals and groups.
- (3) attention required to be given to the work which interacts with (1) and (2).

Much industrial work requires the worker to occupy one posture from which relief can only be obtained by breaking off from work. Such breaks may be consciously controlled and may involve some rationalisation of the nature of the break as commented above. Enquiry from workers in both factories elicited information that muscle aches occurred in the back, neck and shoulder muscles: in some cases behaviour of workers was consistent with this statement. In Factory A the actuation of the press could not be carried out standing up: in Factory B the carton filling could be done standing up and this eased the action of reaching for the units packed but was liable to increase the strain on the neck muscles in that the head had to be tilted further forward. It was recommended in I.H.R.B. Rep. No. 26 (Ref. 8) that ideal work positions should allow a variety of postures to be adopted whilst working and that, specifically, standing should be alternated with sitting. Supporting findings were reported in I.H.R.B. Rep. No. 28 (Ref. 9). The comment of women in an attitude survey conducted by the N.I.I.P. (Ref. 10) shewed the largest number of comments on physical conditions of work to be concerned with seating and alternation of work position and the present study provides experimental evidence to support a point that for work of a light nature this factor is one for which some allowance should be made.

There is no evidence from the present studies to shew that production rate is affected directly by postural fatigue other than that a small percentage of rest is taken. It may happen however that feelings of postural strain are an underlying cause of social friction arising amongst workers but it is not considered profitable to discuss this point further. There has been legislation to require industrial firms to furnish seats for workers (Factory Act 1948 Section 66) and a pamphlet (Welfare Pamphlet No. 6. 5th. ed. H.M.S.O.) has set out recommendations for seating. It does not follow that the seats provided will be suitable for the work positions as in many cases seen in practice (not necessarily in the factories studied and reported upon here) no adjustment of the seating is possible to suit individuals and postural strain takes place. It is considered to be of mutual benefit to managements and workers alike that attention be given to the design of suitable work positions (not necessarily restricted to seating problems) to reduce postural fatigue rather than to give rest allowances for bad positions. There is prima facie no reason for allowances to be given to workers standing and yet none to those sitting. The C.R. Allowances given in Time Study practice (Ref. 4) for workers sitting and standing appear to be 0% and 2% respectively: it is suggested that 2% should be applied to both conditions of sitting and standing without special attention is given to the design of the work place in order to reduce postural strain and that the nature of the work involves movements which would relieve such a condition.

In the case of industrial workers habituation to the work position takes place: it was commented by one of the workers of Group 2 Factory A "I was in a shop and when I first came here I couldn't sit down....I couldn't stand the sitting down but I got used to it". In making enquiries from workers the attitude is met that their particular jobs require the adaptation to a particular position despite the postural aches involved so that any change towards betterment of work positions would probably involve education of the workers themselves.

The proximity of workers to each other gives opportunity for talking and on occasion talking can be continuous. The earlier work of I.H.R.B. investigators (Ref.8) recommended that if work be automatic, then facilities for conversation were desirable and if provided resulted in increased output. It is considered that the factor of talking influences work other than described above as automatic. In a wartime study of neuroticism amongst men and women workers in the engineering industry (Ref. 11) the following factors were found to be associated either with a lower or with a higher incidence of neurosis (certain factors in the report were omitted here).

With lower incidence

- (1) more than average normal domestic responsibilities with under 75 hrs. of industrial duties per week,
- (2) more than average social contacts
- (3) work found congenial.

With higher incidence

- (1) working over 75 hrs. of industrial duty per week
- (2) restricted social contacts, recreation or leisure interests
- (3) work found boring or disliked
- (4) very light or sedentary work
- (5) work inappropriate to workers' intelligence
- (6) work requiring constant attention especially if giving little scope for initiative or technical responsibility
- (7) work programmes offer little variety

That such factors are associated with high incidence of neurosis does not imply that they are causal factors as they can be symptoms of neurosis. It may be taken however that the opportunity to talk relieves the monotony of the work and therefore is helpful towards a reduction in neurosis. In the study of group in both factories it was noticeable that when workers talked together there was a tendency to look at each other which, as far as could be realised, was not necessarily associated with inaudibility.

General unquantified observation of people suggests that this is common to most social behaviour. The workers in both group of Factory B were engaged on work in which visual attention was generally not necessary; the level of talking (including listening) was some 20 - 25% but the press of work was such that only 1 - 2% of time was spent in talking and not working. In the case of Factory A the level of talking varied between the two groups being generally of a level half that of Factory B whilst the time spent in talking and not working was double that of Factory B. In making these comparisons the data for Factory A has been evaluated by considering the high value for Group 1 on the Tuesday (Table II) was not typical for the group as the leader was absent on that day which led to a certain amount of disruption. Again the low value for Group 2 on the Thursday (Table III) was not typical as one worker may have been effected by the investigator and another worker was new to the operation that day and as her work rate was slow paid more than usual attention to the job whilst talking less. The resulting difference between the two factory groups suggests a tentative hypothesis that if work requires visual attention then the amount of talking will be lower but the time spent talking and not working will be higher than for work requiring less visual attention: this can be extended to cases where other sensory modalities other than sight are necessary for successful performance of work. It is difficult to suggest values for C.R. Allowances based on this effect other than to regard 2% as a maximum. In the case of Factory A the degree of talking whilst not working may have been reduced if the work positions had been more closely spaced and by positive training of the workers to talk whilst working.

In discussions on industrial psychology it is common for curves of daily production variation throughout the working week to be presented in order to illustrate causal factors obtaining. These curves often shew low production on Mondays, due to "warming up", and on Fridays, due to "fatigue". The presentation of curves claiming to be typical of industrial conditions is, in this writer's submission, misleading especially if vague causal factors are assigned to effects such as lowered production. The studies reported here were designed to include Fridays as periods of observation in order to investigate the existence of special factors: in view of the end purpose of the investigation Mondays were not included. In the case of Factory B, the production records and the results presented here shew (1) that production remained practically constant throughout the week (2) that there was no significant change in the time not worked (for Group 2) but the talking was significantly lower.

In Factory A there was a marked "Friday effect" in both Groups with lower production and this was also associated with a "Monday" effect on the second week of the study of Group 2. The individual production figures for five members of Group 2 are shown in Fig. 1 for the two weeks (the first Monday excepted) for the period of study. This may serve to justify partially the writer's assumption that the observer effect on the operators generally was small. This overall picture is misleading without one considers the stoppages occurring in the work process and their nature. The percentage time spent not working on each of the three days of study were plotted against production in Fig. 2 to illustrate the large individual differences taking place. In considering this it must be borne in mind that the individual production indices are not comparable between individuals as the work was different in each case. Operator 1 production rate fell from 574 to 473 (some 18%) whilst the time spent not working was only 3% (of total time) greater. Operator 2 production rate remained substantially constant whilst the time spent not working increased by 13% (of total time): this was associated with a learning effect as on the first day of study she came fresh to the particular operation studied. Similar contradictory results can be seen with other operators whose results have not been presented. The increased time spent not working on Fridays in both groups can be assigned to increased social activity occasioned by anticipation of the weekend and by special effects of thunder storms which by chance happened on the two Fridays of observation and not on the other days. The anticipation of the weekend was seen in both groups by discussions on the form that weekend activity would take (boyfriends, cinemas, dancing etc.) and the wearing and discussion of new dresses and jewellery. An example of this in Group 1. activity occurred when a girl from Group 2 was exhibiting beads; this accounted for 1% of the total shown. The increase in social activity was not marked in Group 1 by an increase in talking, but it must be remembered that the definition of talking in this Group was restricted to cases of actual physical talking only, which restricted any increase when possibly 3 or 4 girls might be engaged in a discussion. The Group 1 talking was already at a high level compared with Group 2 and in those circumstances a large increase would not be expected. On both Fridays thunder storms occurred and these proved a distraction with both groups: especially was this so with Group 2 as rain entered the workroom and an inspection was made by the manager.

"Music while you work" was broadcast in both factories studied but the effect was different. In Factory B the radio was on during the official B.B.C. "Music while you work" programme only. In this case the workers sang on occasions when a particularly popular tune was broadcast but it had no observable effect on their behaviour otherwise. In Factory A the radio could be left on beyond the official B.B.C. times: in both groups singing took place but when a particularly popular singer or instrumentalist was announced work sometimes stopped whilst discussion took place on the merits (or demerits) of the artiste.

In both factories the programme was distinguishable from other noises: this is not always so with other factories visited and it is questionable whether "Music while you work" performs any function in many factories other than adding to the general noise level. These results do not nullify previous results found by I.H.R.B. investigators on the effects of "Music while you work". The results obtained do emphasise however the need for careful study and explanation of the impact of such devices as "Music while you work" on a variety of work group rather than an easy acceptance that Music has a beneficial effect on productivity and worker-management relationships in all work groups.

The results obtained on absence at the toilet suggest that an allowance of $2\frac{1}{2}$ - 3% would cover amply the behaviour noted during the months of August to November 1954.

The discussion has called attention to various factors which enter into the rest pauses taken by women workers engaged on two types of light work. The results obtained suggest that further work is needed to cover effects of

- (a) similar works with similar groups in other districts
- (b) Group A type work with older women and with married women
- (c) Group B type work with younger women and with single women

before any hypothesis such as that formulated tentatively can be verified.

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The co-operation of the managements of the two firms who assisted in this study is gratefully acknowledged. The value of the whole study is, in the final analysis, dependent upon the women workers studied and their co-operation in working under observation, in answering questions and in being filmed is greatly appreciated as being of direct service to workers in British industry.

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APPENDIX I

Aspects of Ratio Delay

The present study was made at an intensity of sampling far greater than that usually reported although Tippett has reported taking readings every 30 secs. Abruzzi has suggested that the method should be confined to long term characteristics of industrial behaviour (termed by him 'grand characteristics'): the reason for this is not appreciated by the present writer although it is conceded that both ratio delay and memomotion are more suitable than other known methods in analysing long term effects.

An important practical point which seems to be overlooked by many writers concerns the stipulation of confidence limits of accuracy of the study values. Such confidence limits apply only if the behaviour studied is statistically stable: if trends exist in the behaviour then the mean probabilities quoted are the best estimate for the whole period of observation but the standard error $\sqrt{p \left(\frac{1-p}{n} \right)}$ does not apply and if used will underestimate the limits. The quotation of confidence limits, in general will not affect the use of ratio delay by industrial Work Study technicians to whom such limits have dubious value. Abruzzi has designed ratio delay studies using limits specified by managements but it is questioned by the present writer whether they have practical use in production planning. The planning of studies by Work Study technicians is necessary but it is suggested that such designs must be related to practical ends. When causal factors are being investigated then it is imperative to obtain confidence limits in order to establish significant changes in conditions and it is agreed that statistical analysis of the data is necessary. A number of recording machines of a push button counter type appear to be in use in Gt. Britain (Kinniburgh and McTaggart 1954): these machines can only give an estimate of the probability occurring within a period and afford no estimate of confidence limits without sub-totals are obtained for sub-periods and then examined for stability.

Ratio delay has not yet been accepted as an everyday technique by Work Study technicians despite the fact that it is nearly 30 years old. Its place in the techniques used in Work Study has not been fully explored, but it is considered that it has a place in Method Study, in that it quantifies qualitative data, and in Work Measurement; it is not known to be in use by industrial or social psychologists but, as this study shews, it can be applied to establish causal factors.

FIGURE 1.
Group 2. Factory A.
DAILY VARIATION OF OPERATOR PRODUCTION INDEX OVER STUDY PERIOD.

