Progress Report 1949-1950

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- N. Dolphin (Until February, 1950).
- 12. E. Farmer, M.A.
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- 14. CB. Gibbs.
- 15. R.L. Gregory, B.A. (Started September, 1950).
- 16. A.D. Harris, M.R.C.S., L.R.C.P.
- 17. N. Harris, B.Sc.
- 18. A.W. Heim, M.A. , Ph.D.
- 19. W.E. Hick, M.D.
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- 21. R.E.F. Lewis.
- 22. M. O'Loughlin, B.A.
- 23. R.D. Pepler, B. A.
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- 25. W.J. Shaw, B.A.
- 26. D. Sijmataids (Started April, 1950).
- 27. M. Vince, B.A.
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- 28. H. Walford (Started February, 1950).
- 29. K. Watts.
- Attached;

Lieut. Commander Clutton-Baker, D.S.C., R.N. A.W. Mills (June-August, 1950). Wartfmaster A.G. White, R.N. . Sick Berth Attendant Petty Officer A.G. Steggles, R.N., (Until August, 1950). Sick Berth Chief Petty Officer G. Joisce, R.N. (Started August, 1950).

I. A SHORT GENERAL STATEMENT

The principal developments during the year under review have concerned:

- A. Problems of bodily and mental skill,
- B. Climatic psychology,
- C. Problems and methods in the use of Mental Tests, with particular reference to Medical Students
- D. Road Research problems.

A. Bodily and Mental Skill

Poulton and Mackworth have carried further their experimental studies of anticipation and forethought in human performance, the former especially in relation to manipulatory skill and the latter in cases calling for rapid decisions in a developing situation such as that of a busy traffic control station. They have demonstrated that fully controlled experimental methods are capable of showing the range, functions and conditions of the varied forms of anticipation and forethought.

Mackworth, Conrad and others have given special attention to studies of speed and load stress in a variety of skilled performances. They have shown that speed and load are independent but closely related factors in performance, and have investigated their relations in detail in a number of practical activities. Gibbs, Clutton-Baker and others have continued their experiments on display and control in machine operations. They have particularly considered these factors in display and control which may hinder or help the transfer of training from one situation to another, with special reference to synthetic training. "Counter" recording devices have been proved greatly superior to the more common dial recording devices in many machine tools, and detailed attention has been given to types of isometric control which require a minimum of active movement. "Pressure" control raises many fundamental questions concerning the functions of different sources of nerve impulses in the carrying out of accurate and "easy" skilled movements.

Hick, Vince and others have continued basic experimental investigations designed to determine more exactly the nature of the peripheral and central nervous processes which select and use perceptual evidence in the interests of skilled action. Much has been done to clear up the notion of a "psychological refractory period".

Poulton and Broadbent have begun work on the ways in which information or evidence conveyed to a listener along a number of channels simultaneously can be efficiently used.

B. Climatic Psychology

Pepler has completed studies in Singapore which show how prolonged exposure to high degrees of heat and humidity affect performance, and the relation of such effects to those observed in specially constructed experimental rooms where temperature adaptation is only temporary.

Mackworth and others have begun special studies on local adaptation to extreme cold.

Related methodologically to this work, but not itself a climatic problem, is Broadbent's new investigation of the effects upon various types of performance of prolonged exposure to very loud noise.

C. Mental Tests

The work on long-term follow-up studies of the selection of medical students "by Harris and others hts continued with full cooperation by the medical schools concerned. Special periodic assessments have been arranged to supplement all examination results. The tests initially used, all of the routine "intelligence test" variety, show up to date a reasonably satisfactory prognosis in the case of the less successful students, but appear of little value for the higher grades. Attempts are being made to develop a different type of test examination, discarding entirely the principle of the one correct answer, and using instead situations presented with incomplete evidence for a type of diagnostic assessment.

Dr. Heim and others have proceeded further with studies of repetition testing, and have shown that practice in intelligence tests of the routine type may significantly affect score levels. A new investigation has begun dealing with the effects of apparent test difficulty upon intelligence scores. Extensive experiments have been carried out on a new series of spatial perception tests.

D. Road Research Problems

Parmer, Lewis and others have continued their recording of the control movements of motor transport drivers on the road. A number of instrumental improvements in the method of recording have been made, and a report should be available in the near future. Much appears to depend upon speed estimation, by pedestrians of cars, and from oar to car, bicycle to car and car to bicycle. Methods have been devised for a more detailed and accurate study of this than has been hitherto available, and experiments are in progress. The work on Road Safety Propaganda has shown that few, if any, of the common criteria for assessing its effectiveness have any certain bearing upon action. Search is being made for more valid criteria. It should be added that in connection with all of the work mentioned extremely valuable assistance has been given by the statisticians attached to the group. Further, Dr. Carpenter has rendered invaluable help by devising many new and improved methods of recording experimental results.

The second section of the report deals with the work of the Unit in more detail under seven main headings:

- 1. Experiments on Thinking and Perceiving.
- 2. Researches on Skilled Muscular Movements.
- 3. Visual Display Problems.
- 4. Effects of Abnormal Environments.
- 5. New Devices.
- 6. Temperament and Social Studies.
- 7. Statistical Investigations.

Appendix; List of Publications.

1. Experiments on Thinking and Perceiving

To clarify some of the main lines for experimental analysis the Director has published a research programme outlining the experimental approaches likely to be rewarding in investigations of thinking (Bartlett). Further theoretical considerations have been discussed by the same author around the key problem of anticipation in a memorandum as yet unpublished (Bartlett).

These ideas have been taken up by several investigators in the Laboratory and a start has been made to devise actual experimental situations to test the hypotheses put forward. Two such research methods are to investigate experimental tasks in which the subject can solve the problems with which he is presented either (I) by altering the spatial position of objects on the table in front of him, or (2) by noticing differences between adjacent pieces of data as the situation changes. Clearly, the required speed of decision is an important factor, but this factor of speed stress can, and his been isolated from that of load stress; this refers to the number of separate streams of signals to which the subject must attend to almost simultaneously (Mackworth). The effects of load stress have also been found in another laboratory task in which the subjects have rapidly to report a large number of quickly occurring incidents which are taking place almost simultaneously in several places at once (Conrad). Proposed work on this load stress factor includes an experimental study of the ability to listen to several loudspeakers sometimes all going simultaneously and each giving short verbal messages (Poulton and Broadbent). Some initial work for this study has been done on the ability to listen accurately to a new message while replying verbally to a previous guestion (Broadbent).

The importance of the effects of anticipation in thinking and perceiving has been emphasised in a series of recent papers (Poulton). The ability to recall material is clearly affected by the expectation formed by the subject as to when and how he will have to recall the material presented (Poulton). Similarly, in fast eye-hand tasks requiring little skill, a lack of preparedness for what is about to be done leads to poor performance more often than a failure to recover from what has been done (Poulton). This kind of study will be extended to make comparisons between the short range of anticipation found in eye-hand tasks in response to a randomly changing display and the much longer range of anticipation and more marked action lag obtained in dealing with meaningful material, as, for example, is found in receiving dictation (Poulton). The factor of anticipation has also been studied by the method of foreknowledge in which the subject is continuously supplied with a series of answers to his problems, each answer being timed to arrive at a given period ahead of the time at which that particular answer is needed (Mackworth).

Simultaneously with these laboratory studies attempts are being made to put some of these ideas to the test under practical field conditions. For example, the factors of speed and load stress arc being measured in a task presented by cotton winding and this pilot experiment is being done under actual industrial circumstances. The speed stress is the rate at which spindles are filled (as determined by the thickness of the yarn), and the load factor is the number of spindles being watched by the operative. The output of each worker is measured by the weight of cotton produced with various arrangements of speed and load (Conrad). It is hoped that similar practical studies can be undertaken in the wool spinning industry, since this would provide further evidence on the effects of these basic components of many forms of work. Great importance is laid on the extension of such in investigations done under real life conditions to compare the results obtained in this way with those found in the laboratory (Conrad).

Similarly, other practical studies have been made with tasks which are much more intellectually demanding; work has been started for the Royal Navy on speed and accuracy of decision in synthetic situations imitating the problems set to air traffic controllers (Mackworth and Steggles). It has been interesting to develop this work to cover the civil aviation controller's task since a further research method developed from this form of work has also enabled a distinction to be made experimentally between speed and load stress. It is possible that performance on tasks of this sort has a predictive volume in the pre-selection of air traffic controllers for civil and military purposes, and a study is in progress of this possibility in conjunction with the Ministry of Civil Aviation and the R.A.F. (Mackworth and Batts).

Other researches into the problem presented by high-grade selection have included a series of studies of the selection of medical students. Four medical schools have afforded facilities for a long-term follow-up study of students enrolled during a particular two-year period. Nearly all (95% or over) of those asked to take part have done so and about 600 have been interviewed and have taken one or more psychological tests. Arrangements have been made to supplement examination results with periodical assessments of these students by their clinical teachers. Particular attention is now being given to those students who have abandoned medical training before the second examination, and their reasons for withdrawal are being studied in relation to what was known of them at the time they started their training (Harris A. and Walford). It appears that the correlation which has been reported between intelligence test scores and examination results is largely due to agreement between the two measures at the lower end of the scale. There seems to be a "critical level" on the test below which students have a negligible prospect of passing their medical examinations above this level other factors become of much greater importance. In connection with this part of the work the variation in test scores which may be induced by changes in environment or conditions of testing is being examined. Experiments have also been carried out to determine the effect on test scores of stimulant drugs (Harris A and Walford). There has been some evidence to suggest that it is more profitable to make use of diagrammatic rather than verbal material in these tests. In view of the increasing importance of visually presented data in medical practice today, further experiments are projected on individual differences in recognition and recall of material of this type (Harris A. and Walford).

The medical student selection problems have also led to a search for tasks involving the choice and manipulation of data to a greater extent than is usually required by an intelligence test. Two forms of task have been used. In the first, ideograms have to be deciphered and the clues by which this may be done are provided in such a way that the experimenter can follow the methods being used by the subjects. In the second form of task the subject is required to construct a family tree by making the most plausible use of fragmentary information. An important feature of a successful performance in this type of task appears to be the capacity, highly developed in some people, to link together pertinent items of information into a conceptual whole. Despite the crudity of their scoring, the predictive value of these tests has been found to be as high as that of an intelligence test, and preliminary evidence suggests that discrimination is attained on rather different

grounds and occurs at a level of ability where intelligence tests are of little practical value (Harris, A. and James).

The effects on intelligence test scores of practice on the same test at weekly intervals have also been investigated; a long-term experiment on the effects of practice at 3'early intervals has been in progress for three years and it is planned to continue this for four more years. The experimental subjects cover a wide range of intelligence levels and the results suggest that practice has a marked, but not uniform effect on intelligence test performance. The extent, the speed and the quality of the improvement depend largely on the relation of the level of the test used to the level of the group tested (Heim, Cane, Harris, N., Watts, Wallace).

Extensive research has also been done on a series of new spatial perception tasks with an equipment which gave these to six subjects simultaneously, and automatically registered the time at which each subject began and finished his response to each question. The results on secondary school children show great differences between people in speed of work and in the time required for different questions. Little relation is found, however, between self-chosen speed and the correctness of answer, or between the difficulty of a question and the average time spent on it. The superiority of boys over girls which has previously been found in spatial perception tasks proves greater with three-dimensional than with two-dimensional problems. A fairly constant order of difficulty is found between various types of questions. It is planned to construct six parallel tests of spatial perception. These will be used for further experiments on the effects of practice. It is also intended to compare the effects of practice alone with those of (a) practice plus knowledge of results, and (b) practice plus knowledge of results as well as coaching (Heim, Cane and Horn). Transfer of training will also be investigated in an experiment on the effects of a University training in logic on intelligence test performance (Heim). An item analysis of Test AH 5 has been made from the answers of some 700 university students. It suggests, amongst other results, that the sex difference usually found with diagrammatic test material decreases as the intelligence of the women subjects rises; and also that the intelligence level of the subject bears no relationship to the making of careless mistakes. (Heim and Watts).

Subjects of every level of intelligence fall short of a performance which by other criteria they should be able to attain. An investigation has therefore been planned in which easy and difficult intelligence test questions combined in different proportions and orders are presented to groups previously equated on intelligence test scores, the aim being to determine these effects of level of difficulty of the task on subjects of different degrees of intelligence (Heim, Horn and Watts).

2. Researchers on Skilled Muscular Movements

At a recent symposium held by the Royal Society on Information Theory it has been emphasised that the concepts of this subject can develop specific theories of real predictive capacity (Hick). A comprehensive account of researches in this field has recently been published (Hick and Bates). Initial experiments have also been done on the application of information theory to problems of skill, especially those associated with the perceptual aspects of the task, such as arc involved in the selection of a response to a complex visual stimulus. From the time required to respond to complex visual material it seems that the process may be a chain of

operations of classification, all basically similar and so arranged as to effect the greatest economy of information (Hick).

Much interest has also centered round the theoretical concept of the psychological refractory period. The emphasis has been on the effects of thinking on the performance of skilled movements - the intelligent participation of the operator as a factor in skill. A summary of the main conclusions on the validity of this idea is being prepared, especially on the maximum rate of response obtainable under the most favourable conditions (Vince). A recent study on the amendment of a response has shown that when this change in the response has to overcome an unexpected force the time taken show, the lengthened reaction time normally found for the second of two stimuli in close succession. Previously other workers had suggested that this was not the case and this exception to the refractory period or recovery time rule is now known to have arisen from an artefact largely due to mechanical factors (Hick).

Another investigator has shown that the psychological refractory period can be reduced in length if incorrect anticipation is removed (Poulton). Similarly tracking tasks in which the operator has to prevent the movement of a stimulus pointer are known to give twice the error score of those in which the operator has to match the movement of a stimulus pointer with another pointer under his control. Again this underlines the importance of cognitive factors such as anticipation since anticipation is much more difficult in the former case (Poulton). There are signs that intellectual control of the moments at which eye blinks occur does usually reduce the calculated detrimental effects of this process on skilled manual tracking, and work is shortly to be undertaken on this point (Carpenter and Poulton).

The intellectual factors in skilled muscular performance also become evident in studies of the learning of manual skills and the carry-over of the newly acquired ability to similar tasks (Gibbs.) This shows the overriding importance of the assumptions built up by the subjects during everyday life of the relationship between the direction in which they have to move a control lever to produce a movement in a given direction of the visual signal to which they are responding. There is little carry-over from situations with the accustomed arrangements to those with novel directional relationships but in the opposite sequence the transfer of skill is high (Gibbs). A summary has also been prepared of a series of papers on the effect on ability as measured by tests of muscular cc-ordination of unusual directional relationships (Vince and '.'ritchcll). Further work is proposed on the relation between success in a learned task and the operator's awareness of his response movements (Vinco).

A paper has been written for the 1951 International Conference on Automatic Control on the advantages in highly co-ordinated manual movements of fixed or pressure control levers which bend slightly and produce the ultimate mechanical effect after electronic magnification of the torsion effects in the lever. Under certain conditions this form of pressure control lever gives better accuracy than the more conventional displacement type lever (Gibbs and Glutton-Baker). Future work will include a detailed analysis of the reasons for this discovery, which is of real theoretical and practical importance. The aim here will be to determine the interactions between the sense data obtained from the visual, pressure and movement senses in continuous as

well as discontinuous manual coordination tasks (Gibbs). This work on the pressure control lever has also been accompanied by other research on the relative merits of the arrangement in which there are two operators each with one lever for one of the dimensions of a two-dimensional display compared with the situation in which one man corrects in both dimensions with one single joystick control. The one-man arrangement has given greater accuracy than the two-man situation (Clutton-Baker). An analysis has also been made of the effects of high speed on accuracy of movement of a pencil type control; again, accuracy in two dimensions was the criterion (Fraser).

The much more skilled muscular coordination task of car driving has also been studied by means of an experimental car. A single-shot cine camera, adjusted to take one frame per second, records simultaneously the situation on the road, the elapsed time, the present speed and the present acceleration or deceleration over periods of about twenty minutes in all. The camera is synchronised with an ink-writing recorder which gives the movements of the controls (clutch, brake and accelerator pedals, as well as steering wheel movements). Experiments are being done on the day-to-day consistency of these scores in a road situation without traffic and the acceleration/deceleration records appear to give the most useful single index of driver behaviour. Now that the instrumentation has been completed and this statistical index has proved promising, the next aim is to consider the effects of traffic of varying levels of difficulty, and the changes in measured driving behaviour due to other possible difficulties such as car radio, prolonged driving and alcohol (Farmer, Lewis, O'Loughlin).

3. Visual Display Problems

The experimental car has also given information from visual tests of the ability of pedestrians to judge the speed of oncoming vehicles at speeds between 20 to 50 m.p.h. There is a tendency for some subjects to under-estimate the higher speeds (Belbin and Lewis). This is based on estimates by the subjects of how long they thought they could safely delay crossing the road. Comparisons of such opinions and actual behaviour are now possible and cine records of trials are under way, with subjects delaying as long as they think safe and then crossing a parallel roadway barricaded off from the car (Belbin, Lewis and Simmonds). Tests at night and car-to-car speed judgments are also proposed.

Laboratory studies have been made of the smallest visible sudden change in the velocity of a moving object; over a wide range of initial speeds the required increase was usually about one tenth of the initial speed For the easiest detection the change should be in the middle of an exposure period of not less than half a second (Hick). Cathode ray tube displays are also being studied by the R.A.F. research group in the laboratory and some help is being given by the M.R.C. Unit in the running of these experiments to determine the factors in the optimum visibility of radar echoes (Horn and Simmonds). Investigations have also been made of the effects on performance during prolonged visual search of arranging that the subjects should look straight forwards, or straight down, or with their line of regard depressed by 45° from the horizontal (Fraser).

Four practical studies have been undertaken in experiments on vision. The high importance for defence purposes of good synthetic training for radar operators has led to the design of an optico-mechanical simulation of the radar display most widely used in the Services. The effects on the speed of learning and the breadth of experience provided will be analysed in terms of changes in the number of targets, their speed of approach and their visibility on the screen, especially as regards the sector in which they appear and the time intervals between their appearance (Gibbs). The detection of aircraft by searching through binoculars has raised the question of whether searching with one eye (the better of the two) is as efficient as using both eyes. One eye proved just as effective as two in the particular conditions. It was also deduced statistically that the proposed addition to Naval binoculars of an optical arrangement whereby one eye looked at the horizon so that the other could search at a given angle above the horizon was a suggested modification which would greatly improve the searching efficiency (Hick). Visual problems in relation to aircraft also arose in descriptions of the faulty design and arrangement of instruments in the newest training aircraft used by the R.A.F. (Lewis and Simmonds). On the industrial side another practical suggestion has been made, .and experimentally proved correct, that the use of a counter device instead of a dial display on jig-boring machines Will greatly improve speed and accuracy of work. This device is now being fitted to lathes to determine the extent of the effect of this improved visual display on skilled workers and trainees (Gibbs).

4. Effects of Abnormal Environments

These studies can be grouped under four sub-headings - the effects of heat and high humidity, of cold, of blast and of noise. The researches on high atmospheric temperatures need a new orientation now that it has been decided to continue the research units at Singapore and Lagos. The full benefit of these field units will depend on further basic laboratory researches in this country and the main aims here will be (I) to study performance and physiological changes during acclimatisation to heat, (2; to determine the effects of acclimatisation to heat on acclimatisation to cold atmosphere and vice versa, (3) to devise experiments to discover whether heat stress acts by making men try less strenuously at performance tasks than they would under normal temperature conditions (4) to sec whether speed stress can interact with heat stress to increase the performance changes due to the latter, (5) to investigate how far proficiency on a task will affect the deterioration obtained in performance for a given level of heat stress, and (6) to consider the influence of sudden increase in working temperatures on ability as well as the effect of sudden reduction in the room temperature- (Carpenter and Mackworth). A progress report has been prepared on the initial performance studies at Singapore and a further report has been made on a survey undertaken on some cf the civilian residents at Singapore (Carpenter). The experiments comparing the Cambridge and Singapore evidence arc nearing completion and three draft reports have been written on the Singapore studies on the effects of heat on the ability to work at various tasks (Pepler).

The effects of local adaptation of the hands to extremely cold atmospheres has continued in the Low Temperature Research Station of D.S. and I.R. and this has confirmed the field evidence that such acclimatisational changes do occur with daily exposures to cold over several weeks; the hands do not numb so easily (Mackworth and Steggles). These researches have been done in close touch with, the M. R. C. Unit of Human Physiology. The Defence Research Board of Canada sent a member of their staff to the Unit this summer and this investigator is now extending the initial studios of the effects of cold on human performance under the real field conditions at Fort Churchill (Mills).

The possible effects of gun blast on human ability and function have raised some difficult metodological problems requiring extensive initial laboratory experiments, until more is known about the physical nature of blast waves, it is assumed that they consist of a shock wave of high pressure, a loud sound and a bodily translation of a mass of air. The second and third of these physical factors will be amenable to laboratory experiment, but it is believed that initially much could be learned from laboratory investigations of the startle reaction to sudden, intense and unexpected stimuli (Carpenter and Gregory). It is hoped to study the startle response by the interruption produced in performance tests of intellectual or manual skill and also by simultaneously obtaining measures of the time intervals between heart-beats, of the skin resistance and possibly of the peripheral blood-flow - as well as the recording of muscle potentials and eye blinks (Carpenter and Gregory).

A study is being made of the effects of prolonged and continuous loud noise on human performance. Previous workers have not found in laboratory tasks the consistent deterioration that is popularly supposed to result from noise. This investigation will therefore use a type of task not previously tried which requires sustained attention and which does not indicate to the subject when efficiency is being impaired. The task takes the form of twenty dials which must be closely watched for occasional signals during watch-keeping spells of an hour or more at a time. The test is now known to give consistent results under quiet conditions and a room is now ready in which recorded noise of very high intensity is reproduced to simulate the presence of noisy machinery (Broadbent). Further researches will include the use of very loud intermittent noises occurring at regular intervals to simulate a series of salvoes of rockets and also studies of meaningful noise distraction, and an analysis of the effects on skilled motor tasks of straining to hear instructions through a noise background (Broadbent).

5. New Devices

In addition to the apparatus required for the above investigations, a considerable amount of research time has been spent on devising new forms of equipment to improve the methods of research. For example, an apparatus has been devised for the continuous operation of a film-strip projector (Carpenter). Then, again, two types of variable speed motor control circuits have been developed in a practical form. First, a highly accurate control making use of a velodync motor was developed for the speed and load stress studies, together with a convenient means of arranging that the motor speed can not only be kept constant, but can, if necessary, also follow a pre-determined series of gradual variations in speed (Carpenter). Secondly, a much simpler and less accurate variable speed control using thyratron valves has also been produced, and has been widely used in less exacting circumstances (Carpenter). Similarly, a simple electrical chronoscope has been devised for research and teaching purposes, and this is also of value for many experiments (Carpenter). For the studies on abnormal environments, work has proceeded on a finger plethysmograph and a cardio-chronograph

(Davidson), and a new form of microphone with no mechanical moving parts has been suggested for the recording of blast (Gregory).

6. Temperament and Social Studies

Further work has been done on the development of a test for assessing some qualities of foremanship. Early treatment of the data, in which the subjects responses were considered singly, has proved an inadequate method of distinguishing between the better and less efficient foremen. A recent analysis of types of response, based on the psychological and serial nature, is yielding promising results. The application of these methods with experienced foremen appears to justify the continuation of the research with potential foremen. This would be a long-term project, requiring much cooperation in industry, because it is hoped that groups of potential foremen drawn from a number of different factories may be tested and follow-up records kept of these subjects over a period of years, to compare the test scores with the eventual proficiency of the subjects who arc promoted to become foremen. It seems likely that three qualities of test performance most in need of study are variability of response, serial order of response, and the tendency to give original answers rather than to select from prescribed answers. More direct investigations are planned of these behavioural qualities in order to discover whether they are relevant in social situations less circumscribed than those of the foreman in industry (Harris, N.). A number of problems on rating methods generally have arisen from the specific problems encountered in validating the foremanship test. An experiment was performed in which University students rated their lecturers on six qualities considered essential to good lecturing. The ability to distinguish between a general impression and the assessment of single qualities was found to be confined to the very high scorers on an intelligence test (Harris, N.). Future work on rating Will be concerned with attempts to determine the main causes of inaccuracy and unreliability in rating. Experiments will be done in which physical material is presented so that it produces some of the same problems encountered when rating human abilities. It is hoped that the behaviour of subjects making ratings on this physical material, where inaccuracies can be measured, will provide clues to behaviour manifested in rating psychological material (Harris, N).

Experiments on road safety propaganda and its effectiveness failed to show any relationship between actual behaviour after propaganda and recall or recognition of the propaganda material. The possible causes of this effect have therefore been investigated (Belbin, E.). It appears that the classical tests of recall and recognition, although reliable and consistent, do not necessarily bear a relationship to changes in behaviour as a result of the initial stimuli. Laboratory experiments have shown with visual propaganda material that propaganda can be rejected at various levels, i.e. failure to lead to attention, perception, attitude change or behavioural change; effectiveness at any one of these levels does not necessarily corrolate with that at a higher level. A further series of six experiments has been conducted to investigate the consistency of current methods of measuring recall and recognition and also the extent to which the results of test scores relate to changes in behaviour. The six techniques that have been used have given the following main findings:- (I) If the stimulus is perceived in one room, then recall of that stimulus is significantly less if the test is given in a different room than if given in the same room. (2) Previous recall of a stimulus adversely affects recognition of that stimulus. (3) There is a significant difference between results obtained from a multiple-choice recognition test and those obtained from

a Yes/No response to a single item test of the same material. (4) The number of items presented in a multiplechoice recognition test partly determines the number of items recognized as having been perceived previously; there is a tendency to accept 50% and to reject 5C70 of the items. (5) Familiarity with a room adversely affects attention to a stimulus, although that stimulus is not itself familiar. (6) The environment can substantially affect the responses given in a rating scale judgment (Belbin, E.).

Buzzard and Shaw have been principally occupied in collecting extensive data for an analysis of sickness incidence and its leading causes, mainly in various branches of the Civil Service. A preliminary report on this should be available shortly.

7. Statistical Investigations

Experiments have been designed to throw some light on the statistical problems in the analysis of questionnaire data (Whitfield). A method of intra-class correlation for ranked data has been devised, which has many applications in experimental psychology (Whitfield). The present position of ranking statistics in psychology has been the subject of an extensive review (Whitfield). Further developments of these methods have been considered in relation to:- (I) Problems of the interaction of two or more variables (Harris, A. and Cane), and (2) a measure of association for use with material where one variable cannot be arranged in an a priori order. This has arisen from the attempt to relate choice of response in the foremanship test with rank position of the subject (Cane).

An attempt is being made to devise a numerical problem which will require a series of extrapolatory responses. It is hoped that this will make it possible to trace the development of a theory which has to be modified to fit changing evidence (Cane). Other experiments arc planned to investigate further the concept of randomness and its relation to the degree of organisation of the material presented, and to discover the possible effect of this on accepted methods of experimental design (Cane).

Much additional help and advice in the design of experiments and the analysis of the data has been entailed by the increase in the size of the Unit (Chambers, Whitfield and Cane). A book on the underlying principles of industrial psychology is in preparation (Chambers), and an introductory book is proposed on statistical methods for experimental psychologists (Cane).

F. C. BARTLETT.

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