FIRST ANNUAL REPORT
OF THE
INDUSTRIAL FATIGUE RESEARCH BOARD
TO
31st MARCH, 1920.

LONDON:
Printed and Published by His Majesty’s Stationery Office,
and to be purchased at any of the addresses shown overleaf.
1920.
NOTE:—A list of the publications of the Industrial Fatigue Research Board appears on page 28 of this Report (Appendix IV.) and the Reports can be purchased through any Bookseller or directly from
H.M. STATIONERY OFFICE at the following addresses:

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28, Abingdon Street, London, S.W.1;
37, Peter Street, Manchester;
1, St. Andrew’s Crescent, Cardiff;
23, Forth Street, Edinburgh;
or from E. PONSONBY, Ltd., 116, Grafton Street, Dublin.

The offices of the Board are unable to supply them directly.

N.B.—Applications by post to the above addresses should quote the description in full of the publications wanted, and should be accompanied by the price as indicated in the list.
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1920.
Price 6d. Net.
THE INDUSTRIAL FATIGUE RESEARCH BOARD.

C. S. Sherrington, Sc.D., F.R.S. (Professor of Physiology, University of Oxford), Chairman.
E. L. Collis, M.D., M.R.C.P. (Talbot Professor of Preventive Medicine, Cardiff).
Winifred Cullis, D.Sc. (Professor of Physiology, University of London).
Sir Walter Fletcher, K.B.E., M.D., F.R.S. (Secretary, Medical Research Council).
W. L. Hichens (Chairman of Messrs. Cammell, Laird & Co., Ltd.).
Edward Hopkinson, M.P., D.Sc. (Director of Messrs. Mather and Platt, Manchester).
Kenneth Lee, LL.D. (Director of Messrs. Tootal Broadhurst Lee Company, Ltd.).
C. S. Myers, C.B.E., M.D. F.R.S. (Director of the Psychological Laboratory, Cambridge).
Mona Wilson.
Bertram Wilson (Assessor, representing the Ministry of Labour).
D. R. Wilson (H.M. Inspector of Factories), Secretary.

Offices:—6, John Street, Adelphi, London, W.C.2.
FIRST ANNUAL REPORT
OF THE
INDUSTRIAL FATIGUE RESEARCH BOARD,
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§1.—Introduction.

The scientific study of the laws governing the healthy employment of the human mind and body in industry was strangely late in its development in this country, although it was in Great Britain that the industrial revolution had its first beginnings and industrial development was most rapid, and also that geographical, social and political conditions combined to intensify the evils arising from the neglect of scientific study. Even in the long parliamentary battles fought during the nineteenth century upon the specific question of the reduction of the daily hours of work, battles fought between the advocates of a laissez faire policy followed in the supposed interests of production and national wealth, on the one hand, and those pressing the claims of human charity upon the other, no appeal was made by either side to the laws of physiology or to the test of experiment, which might very rapidly have shown that a reduction of hours would have increased industrial output no less than human happiness and health. It was not until 1893 that Messrs. Mather and Platt, of Manchester, conducted their well-known pioneer experiment on this subject.* Mr. Mather, later Sir William Mather, to whose initiative this work was due, primarily endeavoured to show that "work before breakfast" was open to economic as well as to social objections. The working day, accordingly, during the two years' experimental period was shortened (permitting work to begin at 8 a.m. instead of 6 a.m.), and the breakfast interval was abolished. The experiment showed that the reduction in hours from 54 to 48 hours a week caused an increase in production and a decrease in lost time.

The results of this work were brought to the notice of the Government in 1894, who, upon the basis of the Manchester experiment, introduced the 48-hour week at the Government arsenals and shipyards. The results gained by Messrs. Mather & Platt did not, however, lead to any general adoption by engineering or other firms of the analogous methods or to any organised scientific study of the subject either by the Government or private firms.

Similar work had been undertaken meanwhile in other industrial countries who were our rivals in industry. Among the earliest and most prominent of these were the well-known studies at the Zeiss Optical Works (1901)† and at the Engis Chemical Works (1905)‡ in Belgium. In America investigations of this kind were actively forwarded, and in the years before the war many organised studies in the science of industrial physiology had been made there and in Germany.

The experience of the war, with the demands it brought for strenuous and long-maintained industrial effort by the workers, brought home our national lack of knowledge of the primary laws governing human efficiency, and in particular the need for systematic and scientific study of the hours of work, the arrangement of spells

of work and other conditions of labour likely to produce the maximum output at which the patriotic effort of the whole people was aimed. In the absence of such knowledge, work was undoubtedly carried on in many cases, particularly in munition factories, under conditions as to hours which were not only progressively detrimental to the maintenance of output for long periods but also immediately detrimental even for relatively short periods.

The first steps in the direction of a systematic study of industrial fatigue in this country were taken in 1918, when the Home Office accepted an offer made by Dr. A. F. Stanley Kent, Professor of Physiology at Bristol University, to undertake a series of experiments on behalf of the Department in connection with industrial fatigue (especially the determination of suitable physiological tests for the measurement of fatigue) subject to a financial contribution being made by the Home Office towards the cost of providing apparatus, etc. In the same year the British Association, at its annual meeting, appointed a Research Committee for the purpose of investigating fatigue from the economic standpoint.

Subsequently the Health of Munition Workers' Committee between 1915 and 1917 carried out research into the effects of long hours of work upon output, upon accident incidence, and upon sickness and lost time, in munition factories.† These pioneer investigations, which were necessarily limited to the war conditions of industry and to the making of munitions, were productive of results sufficiently striking in themselves, but still more so in their potential application to industries generally. To take one instance, it was demonstrated that in certain processes long hours may not only be harmful, but also uneconomical; in other words, shortening of hours may actually bring about increased production. On the disbandment of this Committee at the end of 1917 the Medical Research Committee and the Department of Scientific and Industrial Research, with the active encouragement of the Home Office, decided to form a Committee to investigate the subject of industrial fatigue on more comprehensive lines by embracing all classes of factories within its scope of work. A Research Board was accordingly appointed in July, 1918, by the Medical Research Committee (now the Medical Research Council) and the Department of Scientific and Industrial Research jointly with the following terms of reference:—

"To consider and investigate the relations of the hours of labour and of other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers."

Second Interim Report on an Investigation of Industrial Fatigue by Physiological Methods, 1916 [Cd. 8335]. Price 1s. 6d.
† Interim Report of the Health of Munition Workers Committee. Industrial Efficiency and Fatigue, 1917 [Cd. 8511]. Price 1s. 3d.
Final Report of the Health of Munition Workers Committee. Industrial Health and Efficiency, 1918 [Cd. 9065]. Price 2s. 0d.
The Board was originally constituted as follows:—

C. S. Sherrington, Sc.D., F.R.S. (Chairman);
E. L. Collis, M.D.;
Sir Walter Fletcher, K.B.E., M.D., F.R.S.;
Edward Hopkinson, M.P., D.Sc.;
T. M. Legge, C.B.E., M.D.;
R. R. Bannatyne, C.B. (Assessor, representing the Home Office);
D. R. Wilson (Secretary);

but was subsequently strengthened by the appointment in November, 1918, of Mr. W. L. Hichens and Dr. C. S. Myers, C.B.E., M.D., F.R.S.; in December, 1918, of Mr. Kenneth Lee, L.L.D., and in May, 1919, of Professor Winifred Cullis, D.Sc., and Miss Mona Wilson as additional members. In January, 1919, Mr. Bertram Wilson joined the Board as an Assessor representing the Ministry of Labour. The membership of the Board, as now constituted, is given on page 2.

From July, 1918, to March, 1920, eighteen meetings of the full Board have been held.

§2.—PLAN OF WORK.

The Board decided as a first step to take over from the Welfare and Health Section of the Ministry of Munitions (who were continuing the work initiated by the disbanded Health of Munition Workers’ Committee) three pieces of research then in progress or in contemplation, namely:—

(i) An investigation into the effect of different systems of employment on output in shell-making, then being conducted by Mrs. E. E. Osborne.

(ii) An inquiry into the incidence of multiple accidents by Dr. M. Greenwood.

(iii) A statistical examination of the large mass of output, sickness and accident records accumulated at the Ministry of Munitions and in National Factories.

The results of the first investigation are contained in Report No. 2, and those of the second in Report No. 4, both published in July, 1919, while the last, which was entrusted to Miss G. M. Broughton, is still in progress (see §7 (O)).

The Board were next confronted with the task of settling in which industries investigations should be pursued and the sequence in which they should be approached. On seeking the opinion of the Home Office on this point, they were advised that the industries specified in the following list appeared to afford a particularly favourable field for research for the reasons stated:—

1. Iron and Steel.

   (a) Arduous and continuous character of work.
   (b) Co-existence of different systems of employments.
   (c) Negotiations proceeding between employers and workmen as to reduction in length of shift.
2. *Cotton.*
   (a) Largest textile industry.
   (b) Conditions of work, especially in regard to temperature and humidity.
   (c) Uncertainty as to optimum length of spell.

3. *Silk.*
   (a) Fine nature of many processes.
   (b) Negotiations proceeding between employers and workmen as to the most suitable method of reducing hours.
   (c) Possibility of comparing automatic and manual processes.

4. *Laundries.*
   (a) Irregularity of work.
   (b) Conditions of work (temperature and moisture).
   (c) Special opportunity for studying effects of fairly arduous work on women.

5. *Boots and Shoes.*
   (a) Example of a trade in which normal hours are much below legal maximum.
   (b) Variety of processes.
   (c) Uncertainty as to optimum spell of work.
   (d) Variation in hygienic and other conditions in different factories.

Investigations were instituted into these industries, and are now proceeding. A small investigation, now completed, was also undertaken into the tinplate trade. In addition to these general inquiries, research upon certain specific problems connected with industrial fatigue (such as fatigue tests, vocational selection, and motion study) is being conducted irrespective of any special industry. Full details of each of the nine investigations now in progress will be found in §7 (iii).

In regard to future investigations, the Board are considering the possibility of classifying the industries of the country into large groups composed of industries having certain features in common, in the hope that research into a few of the constituent members of these groups will disclose principles capable in some degree of application to the whole group. The work of classification has been entrusted to a special Committee, who will report to the Board in due course.

§3.—*Methods of Investigation.*

The Board recognised at the outset that the problem of industrial fatigue could only be successfully attacked by two simultaneous lines of research, the one medical and the other industrial. In accordance with this conception they formulated and submitted to their Appointing Authorities as early as January, 1919, the following forecast of the methods to be adopted, which has proved to be accurate:

—
(I.) Laboratory Experiments, e.g.:

(a) Devising of suitable methods of measuring industrial fatigue with a view to ascertaining whether any physiological or psychological test can be quantitatively applied, or whether reliance can be placed only on statistical methods of investigation.

[Under (a) may be included the attempts made by the Board to devise a reliable test of fatigue. The search for a psychological test has been abandoned for the present, and a study of the possibilities of a physiological test has been substituted. (See §7 F. & S.)]

(b) Intensive researches into industrial fatigue conducted on individuals rather than on groups, by the application of laboratory methods in the factory.

[Method (b) was attempted in the case of certain workmen in the steel industry, who were made the subjects of periodic individual tests, in the hope of discovering the effects of different systems of employment. In the absence of any test that could be regarded as reliable this investigation was discontinued in June, but it may be found possible to revive it at a later date. (See §7 G.)

The same method has also been introduced with interesting results in the cotton industry. (See §7 H.)]

(c) Selection on the basis of natural fitness—i.e., grouping of individuals according to their muscular and mental efficiency and according to their powers of improvement and adaptability in regard to the work demanded of them.

[An investigation on vocational selection is now in progress (See §7 N.)]

(II.) Research into Past, Present and Future Conditions in Factories, e.g.:

(a) The collection and statistical investigation of—

(i) Output Records,
(ii) Accident Records,
(iii) Lost time and sickness records, and
(iv) Records of spoilt work,

derived from factories in which a change in the system of employment has been made.

[Use has been made of existing records in the tinplate and iron and steel investigations, and also in the investigation dealing with sickness, lost time and labour turnover amongst women workers. (See §7 A. G. and O.).]

(b) The collection from selected factories and co-ordination of records on more general lines with a view to standardisation.

[A report dealing with standard forms of records is now in draft. (See §7 O.).]
The systematic keeping of factory records on a pre-arranged plan.

[Arrangements have been made with employers for the systematic keeping of current records in the boot and shoe and laundry investigations. (See §7 I. and L.)]

Ascertaining the general view of employers and operatives who have had actual experience of different conditions of employment.

[ Cf. inquiry into attitude of workers towards scientific management. (See §8).]

Observation in Factories, e.g.:
Actual measurements of output conducted in the factories themselves on the lines of Dr. Vernon’s researches, the selection of the most suitable factories for the purpose being made in consultation with Panel Members nominated to act for a given trade.

[Measurements of output are now being taken on a large scale in the cotton and silk investigations (see §6 H. and K.) and may, later on, be attempted in the boot and shoe and laundry investigations (See §7 I. and L.).]

Large Scale Factory Experiments, e.g.:
(a) The experimental alteration of hours of employment or introduction of rest pauses.

[Experimental alteration of hours of employment has so far been found unnecessary owing to the modifications now being adopted in the various industries under observation, which provide an opportunity for investigating the effect of limiting the period of employment. The introduction of rest pauses is under observation (See §7 I.).]

(b) The experimental introduction of motion study methods.

[Motion study methods are being evolved in a London factory with a view to subsequent wider application (See §7 M.).]

In order to remove all misapprehension as to the real functions of the Board, an explanatory leaflet was prepared for distribution amongst workmen invited to participate in tests. This leaflet is reproduced in Appendix III.

§4. STAFF.

In the selection of staff for the actual investigations, the Board decided as a first step to form a nucleus by inviting certain of the Investigators who had previously worked on problems of Industrial Fatigue for the Health of Munition Workers’ Committee, for the Ministry of Munitions, and for the Home Office to transfer their services to the Board. On being approached, Dr. H. M. Vernon, Professor T. Loveday and Dr. A. F. Stanley Kent agreed to accept appointments. Subsequently other principal Investigators, for the most part with psychological qualifications, were added to the staff as new inquiries arose.
At the present time the investigating staff numbers 25, and is graded into four classes:

6 Investigators, Class I.,* and 4 Investigators, Class II., who conduct, or are responsible for the conduct of, investigations.

12 Assistant Investigators, who undertake research work under the instructions of an Investigator.

3 Assistants, who undertake routine work only under the instructions of an Investigator.

In addition, the Board employs eleven clerks and three mill operatives.

It is pleasant to testify to the efficiency with which the whole staff have carried out their duties. Not only have new and difficult problems been ably attacked, but the sympathy and co-operation of many employers and workmen have been secured, and any preliminary misunderstanding on the part of workers has been removed by tactful explanation of the real functions of the Board.

A full list of the staff is given in Appendix I.

§5. Publications.

Up to the present four Reports have been published and three others are now in preparation for the press. In addition to these Reports, certain memoranda which deal with matters of scientific rather than general interest have been submitted by Investigators. The Board feel that these would appear more appropriately in a scientific journal than as part of the series of their own reports, and the Investigators concerned have been authorised to publish them accordingly. Two such papers have been recently accepted by the British Journal of Psychology.

A list of publications appears in Appendix IV.

§6. Delegation of the Functions of the Board.

It soon became evident, as the number of investigations undertaken increased, that the full Board would be unable to deal in the necessary detail with the whole programme of work. They therefore resolved to appoint a Committee for each investigation, with powers to deal in the first instance with its progress, and to reserve for the Board itself only questions of general policy and recommendations definitely submitted by the various Committees.

The constitution of these Committees has not been confined to the Members and Assessors of the Board. Where an investigation is concerned with a particular industry, one of H.M. Inspectors of Factories having special knowledge of that industry has, with the approval of the Chief Inspector, been co-opted as an Assessor, and two or more Panel Members from the trade itself (representing employers and operatives) have in every instance been secured through nominations from the Joint Industrial Council or (where such a Council does not exist) from the principle Trade Associations. These Assessors and Panel Members have given invaluable help by expert criticism and suggestions and by securing facilities for investigations.

* Two of these give part-time work only.
In addition to these Standing Committees, a certain number of ad hoc Committees have been formed to consider specific questions that have arisen, and to report to the Board on them. In certain instances external assistance has been invited from persons with special knowledge of the issues under discussion, who have been co-opted Members of the Committee, and also from others who have acted in an advisory capacity.

The following Committees are now in existence:

"A" General Purposes.
"B" Textile.
"C" Iron and Steel.
"D" Boot and Shoe.
"E" Grouping of Industries.
"F" Statistical.
"G" Employment of Women.
"H" Fatigue Test and Vocational Selection.
"I" Time and Motion Study.
"K" Literature.
"L" Potteries.

The full constitution of each Committee will be found in Appendix II.


Since the formation of the Board 20 investigations in all have been sanctioned; of these, four have been completed and the results published; two and part of a third have been abandoned for the reasons stated (Investigations E, F, and G), nine are now proceeding, and six have not yet started.

The following account shows shortly the action taken and progress made in each case:

(i) Investigations completed.

A. Tinplate Industry.—In September to December, 1918, a small investigation was made by Dr. H. M. Vernon into the work of the "mill-men" in the tinplate trade, which is very arduous and involves continuous exposure to high temperatures. The effects on output and fatigue of (1) shifts of different length and (2) different systems of ventilation were compared, the data being obtained partly from existing records and partly by direct observation.

In this investigation the Board were assisted by two Panel Members, namely, Mr. F. W. Gibbins (later succeeded by Mr. Wm. Morris), nominated by the Welsh Plate and Sheet Manufacturers' Association, Swansea, and Mr. Ivor Gwynne, nominated by the Tin and Sheet Millmen's Association, Swansea.

A report, embodying the results of the Investigation, and entitled "The Influence of Hours of Work and of Ventilation on Output in Tinplate Manufacture." was presented to the Board in January, 1919, and was published in July, 1919, as Report No. 1.

B. Shell-making Industry.—Under the direction of the Welfare and Health Section of the Ministry of Munitions, a small research
into the effects of different systems of employment on fatigue (as measured by output) in a National Shell Factory was instituted and entrusted to Mrs. E. E. Osborne, M.Sc. Pending the formation of the present Board, the research was continued and financed by the Medical Research Committee, and was finally transferred to the authority of the Board on the 30th July, 1918.

A large mass of data had by then been collected by Mrs. Osborne, but owing to her sudden return to Australia, some of these are not yet accessible to the Board. Part of the investigation, however, relating to the hourly output records of 43 women engaged in shell-turning during one week on two 12-hour shifts and during another week on two 8-hour shifts is embodied in Report No. 2 ("The Output of Women Workers in Relation to Hours of Work in Shell-Making"), published in June, 1919, in which the fatigue and output under the two systems of employment are compared.

C. IRONFOUNDING INDUSTRY.—In 1916, Mr. Vincent Jobson, Managing Director of the Derwent Foundry Company, Limited, Derby, notified the Department of Scientific and Industrial Research of a system of Motion Study which he had successfully introduced into his works. The correspondence was referred to the Board in July, 1918, and after some preliminary inquiries it was resolved to ask Mr. Jobson to agree to a full investigation of his methods, with a view to publication. The inquiry was made by Dr. C. S. Myers, and the results were published in June, 1919, in Report No. 3 ("A Study of Improved Methods in an Iron Foundry").

This report (which indicates the large increase in output following the introduction of the methods) caused considerable public interest both here and in the United States, and the original imprint was quickly exhausted.

D. ACCIDENT INCIDENCE.—In May, 1919, Dr. Major Greenwood, M.R.C.P., then of the Welfare and Health Section of the Ministry of Munitions, presented to the Board a report based on the statistical investigation of certain accident records relating to women workers in the possession of the Ministry. The purpose of the investigation was to elucidate the causation of accidents, especially how far they are due to a special susceptibility on the part of the individual, and also whether the victim of one accident is more or less likely to incur a subsequent accident as a result of his experience. The results, which were published in July, 1919, as Report No. 4 ("The Incidence of Industrial Accidents on Individuals, with Special Reference to Multiple Accidents"), indicate that accidents are very largely due to a special susceptibility inherent in the personality of the individual, so that the bulk of accidents occur amongst a limited group of individuals, and that the incurring of one accident is in itself of minor importance in connection with the probability of the incurring of a second or subsequent accident.

The inferences drawn, though new and of great interest, are admittedly based on slender data, and cannot yet be regarded as finally established. The Board, however, consider them of sufficient importance to justify a continuance of the investigation on wider lines, so as to include men and boys, and hope to extend it by psychological inquiry into the causation of accidents. (See Investigation R.)
(ii) Investigations begun, but abandoned.

E. STANDARDISATION OF RECORDS.—In February, 1919, the Board approved the institution of a general inquiry into the forms of record kept by certain progressive employers, with a view to standardisation.

The work was at first entrusted to Mrs. V. Farone, but was subsequently transferred to Miss Broughton in July, 1919. (See Investigation O.)

F. PSYCHOLOGICAL TEST FOR FATIGUE.—In March, 1919, an investigation having for its object the determination of a reliable psychological test for fatigue was entrusted to Mr. B. Muscio. After attempts extending over several months, Mr. Muscio reported that he had been unsuccessful, and that owing to the impossibility of eliminating will in the subject, there was little probability of devising such a test suitable for practical application. On the recommendation of Committee "H," the Board, in October, 1919, resolved that this investigation should be temporarily abandoned, and that Mr. Muscio should be invited to devote himself to the study of vocational selection. (See Investigation N.)

In the course of this investigation certain experiments were carried out on groups of medical students at the London (Royal Free) Hospital for Women, an account of which will shortly be published in the British Journal of Psychology.

(iii) Investigations in Progress.

G. IRON AND STEEL INDUSTRY.—Shortly after the appointment of the Board in July, 1918, it was suggested by the Home Office that the first investigation undertaken by the Board should be concerned with the iron and steel industry, for the following reasons:

(1). The work generally is heavy and much of it involves exposure to high temperatures.

(2) Many of the processes are continuous and, at the time when the suggestion was made, were being worked with three shifts of 8 hours in some localities and with 2 shifts of 12 hours in others, so that an opportunity was afforded of comparing the effects of two different systems of employment.

(3) The Iron and Steel Trades Confederation representing the workmen had recently approached the associated and non-associated employers with a request that "arrangements be made by means of the machinery of negotiation existing in trades concerned with a view to the preparation of a scheme for the establishment of an eight-hour shift at the end of the "War," and had asked Government Departments to lend any assistance in furthering the negotiations for this object.

Acting on this suggestion, the Board decided to approach the industry with the proposal that a general inquiry into fatigue and the human side of efficiency should be proceeded with at once, and in accordance with their usual practice, they invited certain of the Trade Associations concerned to nominate representatives to join the Board as Panel Members for the purpose of this inquiry. The invi-
tations were accepted, and throughout the investigation the Board received the help of the following Panel Members:

Capt. H. L. Davies, nominated by the South Wales Siemens' Steel Association.
Mr. T. Phillips, nominated by the South Wales and Monmouthshire Steel Makers' Association.
Mr. Hewitson Hall, nominated by the Steel Ingot Makers' Association.
Mr. David Maclay, nominated by the Scottish Steel Makers' Wages Association.
Mr. T. Griffiths (Neath), nominated by the Iron and Steel Trades Confederation.
Mr. W. Griffiths (Darlington), nominated by the Iron and Steel Trades Confederation.
Mr. P. W. Whitehead (Newport), nominated by the Iron and Steel Trades Confederation.
Mr. James Walker (Glasgow), nominated by the Iron and Steel Trades Confederation.
Mr. Llewellyn Carter (Ebbw Vale).
Mr. H. J. Wilson, O.B.E., H.M. Superintending Inspector of Factories, Glasgow.

The Board are also indebted to Mr. J. M. Allan, Managing Director at Sheffield of Messrs. Cammell Laird and Co., Ltd., for many valuable suggestions on technical points.

The primary object of the inquiry was to compare the effects of the two shift systems by two parallel lines of research, namely:

1. by a general survey of the industry and an investigation of mass data, and
2. by an intensive study of fatigue in individuals.

By these means it was hoped eventually to gain information which would be of value in the negotiations that were then proceeding. Of the two lines of research the first was entrusted to Dr. H. M. Vernon, the second to Dr. A. F. Stanley Kent.

Shortly after the armistice an agreement for the establishment of a universal 8-hour shift became operative, and the 12-hour shift ceased to exist in February, 1919. The original purpose for which the investigation was initiated could not, therefore, be fulfilled, but the Board decided that the research should be continued, as it was thought that comparison between the two shift systems might still be effected through examination of existing records, and that other results of value capable of application outside the particular industry concerned might be expected.

The first part of the investigation is now complete, and a full report dealing with it (No. 5, Fatigue and Efficiency in the Iron and Steel Industry) is under the consideration of Committee "C." The effects on fatigue and production in the principal processes of the 12 and 8-hour shifts are compared, and attention is drawn to many matters whereby a reduction of fatigue and an increase in human efficiency may probably be secured. Issue of the report is deferred pending the statistical examination of sickness and mortality records of workers in the industry, kept by the Iron and Steel Trades Confederation.
In July, 1919, the second part of the investigation dealing with fatigue in individuals was abandoned in the continued absence of any known reliable test for fatigue. Efforts, however, are still being made to discover such a test, and if these are successful, it is proposed to revive this part of the investigation at a later date.

H. COTTON INDUSTRY.—Amongst the suggestions received from the Home Office special emphasis was laid on the importance of carrying out an investigation into the cotton industry. The reasons for this selection were:

(i) The importance of the trade as the largest textile industry.

(ii) The standard hours worked, equivalent (at the time the suggestion was made) to the maximum permissible under the Factory Act of 1901, viz., 55½ hours per week.

(iii) The special conditions attaching to the industry, such as heat, noise, and humidity, which tend to make it particularly trying and have given rise to much complaint.

(iv) The variety of processes involved, affording an opportunity of studying work of different kinds.

(v) The difference of opinion existing between employers and operatives as to the optimum spell of work.

In the absence of a Joint Industrial Council for the Industry, the Provisional Reconstruction Committee was approached and nominated Mr. John Taylor, of the Blackburn and District Cotton Employers' Association, Blackburn, and Mr. Cephas Speak, J.P., of the Amalgamated Society of Weavers, as Panel Members of the Board. Mr. J. J. Jackson, O.B.E., H.M. Superintending Inspector of Factories, was also with the approval of the Chief Inspector invited to join the Committee as an Assessor.

The investigation has been entrusted to Mr. S. Wyatt. The methods of research employed have made it necessary to sanction the appointment of a large staff working under him, which at present comprises four Assistant Investigators (Mr. H. C. Weston, Mr. A. D. Ogden, Miss P. M. Vickers, Miss B. S. McFie), three assistants, and six clerks.

Many of the processes in the cotton trade, especially in the spinning section, are nearly automatic, the output depending almost entirely on the running of the machines and being affected only to a negligible extent by the human factor. At the outset of the inquiry, therefore, it became evident that more useful results would ensue from output measurements in other processes, and the spinning section of the trade has been left untouched until some direct test for fatigue becomes available.

Weaving, however, offers a more fruitful field, as here the output depends to a much greater extent on human effort. It was accordingly decided to confine the investigation for the present to this section of the industry, and the Panel Members were selected with this object in view.

The investigation is based principally on current observations in the actual weaving sheds. Automatic "pick recorders" have been affixed to a large number of looms, which, by arrangement with the
employers concerned, will be run on uniform material during the whole course of the experiment (about one year). Hourly readings of these recorders are taken, from which it is hoped eventually to trace the course of fatigue and to discover the point at which it begins. At the same time, the relation between certain conditions (such as heat, noise and humidity) and fatigue (as measured by output), is being investigated, and time study of the weaving process is being made.

In order to ensure that output may be a true index of fatigue, the disturbing effect of extrinsic conditions (such as temperature and humidity) on output must be eliminated as far as possible. With this object, it has been suggested that the Research Association for the Industry should be invited to undertake a research on the effects of different degrees of humidity on the weaving of the cloth concerned. Professor Crossley, the Director of Research, has been approached, and has agreed to bring the matter before his Committee when occasion arises.

No results from the main investigation can be expected for some months, but a report on "Individual Differences in Output in the Cotton Industry," indicating the relative importance of the human and mechanical factors in various branches of the industry, and a further report, embodying the results of a small side-investigation into bobbin-winding, have lately been received, and are being prepared for publication. An experiment has also been carried out on a "knotting" test for fatigue, an account of which will shortly be published in the British Journal of Psychology.

I. Boot and Shoe Industry.—An investigation into the boot and shoe industry was originally suggested by the Home Office on the following grounds:—

(1) The trade is recognised by employers and employed as an arduous one, and the weekly standard of 52½ hours, already worked by mutual agreement practically throughout the trade, is much below the maximum fixed by the Factory Act for women and young persons, namely 60.

(2) The trade includes a great variety of processes, including sedentary work. As uniform hours are worked, it should be possible to compare the different effects of hours according to the nature of the effort demanded from the workers.

(3) Spells of various length (4½, 5, and even 6 hours) are worked in the trade, so that an opportunity for comparison is afforded.

(4) The hygienic and other conditions vary in the different factories, and have recently been the subject of special inquiry by the Home Office and by the Medical Research Committee, in view of the prevalence of tuberculosis. Having regard to the uniformity in the hours worked, it might be possible to make a comparison between good and bad factories which would enable some estimate to be formed of the influence of conditions other than hours in relation to fatigue.

The Joint Industrial Council for the industry were approached and invited to nominate representatives of the industry to assist the
Board in the investigation, with the result that F. J. Marquis, M.A., Secretary, Federated Association of Boot and Shoe Manufacturers of Great Britain and Ireland, and E. L. Poulton, Secretary, National Union of Boot and Shoe Operatives, have joined the Board as Panel Members. Mr. W. Williams, H.M. Superintending Inspector of Factories, has also joined Committee "D" as an Assessor.

Some misunderstanding having arisen as to the object of the inquiry and the functions of the Board, the Secretary attended a meeting of the Joint Industrial Council in June, 1919, and after an explanation had been given by him, a resolution was passed undertaking to render every assistance.

The investigation was entrusted to Professor T. Loveday, working with four Assistant Investigators (T. Bedford, W. Hambly, J. Loveday, and S. H. Munro), and has been in progress since January, 1919.

The variety of processes in the industry and the lack of uniformity in the finished article make the study of output particularly difficult. and it has, therefore, been found necessary to turn to other indices of fatigue.

Several employers have been induced to make periodical returns to the Board of sickness and lost time, from which it is hoped that valuable information may be obtained.

Pending the collection of these returns, special attention has been directed to the effect of ventilation, and especially the relation between ventilation and sickness, and a preliminary report on this subject is now before Committee "D."

A second preliminary report has been made on the effects of allowing to every one of certain operatives in a press-room a rest of 20 minutes in each hour by the introduction of a system of short shifts. A noticeable increase of production followed immediately on the introduction of this method, but in order to judge of its permanent value it was necessary to ascertain the results attained after (say) six months' trial. Unfortunately, the factory in question has now changed hands and the experiment has been abandoned, but an attempt is being made to gain access to the records up to the latest possible date.

A further line of research proposed by Professor Loveday is the study of posture, etc., which may probably be undertaken in co-operation with the Research Association for the industry.

K. Silk Industry.—This investigation was originally suggested by the Home Office on the grounds that changes in hours of employment were under consideration, in which the industry would be glad of the help of the Board, and also that the special fineness of many of the processes gives the industry an individual character.

A meeting of a Special Committee of the Joint Industrial Council was accordingly attended by the Secretary, at which the co-operation of the Board was heartily welcomed. Subsequently, the following Panel Members were nominated by the Joint Industrial Council:—

Mr. S. Courtauld, Mr. W. Frost, representing Employers.
Mr. J. Downs, Miss F. Saward, representing Operatives.
The investigation was allotted to Mr. P. M. Elton, H.M. Inspector of Factories, and its supervision entrusted to the Textile Committee, as reconstituted with the appropriate Panel Members.

The methods of investigation are generally similar to those adopted in the case of cotton, but are on a smaller scale and are modified in some degree according to the special conditions of the industry, in particular, the extensive variety in the products turned out. Particular attention is being paid to illumination, which, in view of the fineness and dark colour of much of the material, may be an important factor influencing output.

L. LAUNDRY INDUSTRY.—The laundry trade possesses special features in regard to industrial fatigue inasmuch as the hours allowed by law and actually worked are far more irregular than in any other class of factory, and the variation in daily hours therefore affords a good opportunity for the investigation of daily fatigue. The use of steam and gas heated irons also gives rise to special conditions which may be found to be related to fatigue. For these reasons this trade is included amongst those in which the Home Office considers an early inquiry desirable.

In the absence of a Joint Industrial Council, nominations of the following Panel Members were obtained from the Trade Board for the industry:

Mr. J. J. Stark, representing Employers.

Mrs. Agnes North, representing Operatives.

The investigation was allotted in August, 1919, to Miss May Smith (with Miss R. Lubbock as Assistant Investigator), and its supervision entrusted to the Employment of Women Committee (Committee "G").

The short time during which the inquiry has been proceeding has been chiefly occupied by Miss Smith in a preliminary survey of the industry with the object of ascertaining the most promising methods of research, and in gaining first hand experience by working personally in a laundry for several weeks.

The study of output by the usual methods of estimation by numeration is difficult, on account of the variety in the articles dealt with. In a few processes it has been found possible, by limiting the experiments to periods when articles of one type are treated, to make comparisons between the work from hour to hour and from day to day, but the research has not at this stage advanced sufficiently to admit of the presentation of statistics, as the collection of data by such methods is necessarily slow.

For other processes, for which no method of output measurement has as yet suggested itself, an attempt has been made in one factory with the consent of the employer to estimate fatigue by the application to individuals of a psychological test, and records of morning and evening variations from day to day for a fortnight have been obtained. It is hoped that other laundries will become available for such tests.

In the meantime the National Federation of Laundry Associations, to which Mr. Stark is Secretary, has co-operated with the Board, and has distributed to many employers a special form of sickness and lost time return, the results of which will be analysed later.
M. Time and Motion Study.—The results of the inquiry into the methods adopted at the Derwent Foundry Company, an account of which is given in Report No. 8, appeared to the Board to be so significant that they resolved to start an investigation having for its object the experimental introduction of motion study methods into an industrial establishment, combined with a careful measurement of the results.

For such a research the first step necessary was obviously to secure the good will of some employer, and after some unsuccessful attempts the Board were fortunate enough to obtain the permission of Messrs. James Pascall & Sons, Limited, Confectionery Manufacturers, of Blackfriars Road, S.E.1., to make use of their two factories for the purpose.

In April, 1919, Mr. Eric Farmer was appointed to take charge of the investigation, and Mr. C. Carlile has recently joined him as Assistant Investigator.

The processes selected for experiment are “dipping” (i.e., dipping almonds into melted sugar) and “bottling,” both of which are manual and depend entirely upon human effort. A long time must necessarily elapse before the success of the method can be definitely gauged, but from a preliminary report submitted in October, 1919, it appears that satisfactory progress is being made, and that even at this early stage increase of output has resulted.

The subject of motion study is closely allied to vocational selection, and an investigation bearing on the latter has recently been carried out by Mr. Farmer. Measurements of the hands and fingers of over 1,000 girls have been taken, with the object of finding whether dexterity in a given process is due to any special characteristics. A preliminary report on this point is expected shortly.

Supplementary to the main investigation, a small inquiry is being made by Mr. H. de Havilland into a system of time study, instituted during the war by a firm of engineers.

N. Vocational Selection.—On the abandonment in October, 1919, of the research on a psychological test for fatigue (see Investigation F.), Mr. Muscio was invited to devote himself to the study of vocational selection.

The preliminary lines on which the research should proceed, as approved by Committee “H” in November, are:—

(1) To devise vocational tests for different types of engineering work.

(2) To carry out an investigation to determine existing standards of physical strength among youths from 14 to 20 years of age.

(3) To investigate the extent to which different motor capacities are inter-related.

A large and appropriate field has been secured for this Research. Part I. will be conducted chiefly at the Middlesex Trade School at Chiswick in co-operation with the Director, Mr. H. Tagg, B.Sc., who is keenly interested in the work. For Part II., arrangements have been made through Mr. H. de Havilland (who is a member of the Essex Education Committee) for access to all the principal tech-
nical schools in that County (attended by about 1,500 boys), and, if it is thought desirable to make use of an industrial establishment, it is hoped that the help of one or more employers may be obtained. Part III. is now being conducted in a secondary school in Cambridge.

The investigation has not yet progressed far enough to admit of a report being submitted.

Mr. Muscio is now assisted by two Assistant Investigators (Mr. H. Holt and Miss S. C. M. Sowton).

O. STATISTICAL INVESTIGATION No. 1.—In January, 1919, the attention of the Board was drawn to the possibility of making use of some of the large number of records accumulated at the Ministry of Munitions, which, it was suggested, might on examination yield valuable information in regard to sickness, lost time, accidents and labour turnover amongst women workers.

The Ministry were accordingly approached with a request for access to the records, and gave every facility for the investigation by placing the whole of the records at the disposal of the Board and by instructing the managements of certain National Factories to suspend the routine destruction of records over a certain age.

The examination of the records was entrusted to Miss G. M. Broughton, O.B.E., formerly of the Ministry of Munitions, who has been seconded to the service of the Board by the India Office until the 1st of August, 1920. A preliminary report on the results of the investigation was submitted to Committee "F" in September, 1919, who decided to supplement the inquiry by including data drawn from ordinary factories. Facilities have now been offered by several large firms for the examination of their records.

In a further report submitted by Miss Broughton, standard record forms dealing with output, lost time, accidents and labour turnover have been drafted. As it is important that the nature of these forms should be carefully considered from all points of view before publication, the Committee have invited criticism from various external sources (including Government Departments, Trade Unions and Employers), and will shortly be in a position to make definite recommendations to the Board.

In addition to Miss Broughton, one Assistant Investigator (Miss E. C. Allen) and two clerks are engaged on this investigation.

P. STATISTICAL INVESTIGATION No. 2.—The absence of any published data as to general sickness incidence was brought to the notice of the Board in June, 1919, and the suggestion was made that sickness data limited to any given industry would lose much of their significance failing the possibility of comparing them with similar data derived from general sources. The Board accordingly resolved to invite the help of one or more Approved Societies independent of any special trade with a view of supplying the information needed. Since the 1st January, the investigation has been proceeding in charge of Mr. E. Rusher, who as a preliminary step is compiling a short historical memorandum of existing standard sickness experiences in this country. The Hearts of Oak Benefit Society have promised to place their figures at the disposal of the Board from the beginning of 1920: these should prove of great value when they have accumulated over a sufficient period of time.
(iv) **Investigations approved but not yet begun.**

Q. **Post Office Work.**—It has been intimated that the work of telephonists and telegraphists would constitute an instructive and fruitful field for investigation by the Board. The Board accordingly have invited the Medical Research Committee to approach the Post Office, suggesting, as a first step, that a conference should be arranged with representatives of the Post Office.

R. **Causation of Accidents.**—The Board have resolved to extend the investigation started by Dr. Greenwood on the causation of accidents (Investigation D) so as to include men and boys and industries other than munition making.

The Statistical Committee has been invited to consider the appointment of a suitable investigator and the lines on which the inquiry should proceed. In the meantime provisional arrangements have been made with two large engineering firms to place their accident records at the disposal of the Board if required.

S. **Physiological Test for Fatigue.**—As already mentioned under Investigation F, the attempt made by Mr. Muscio to devise a satisfactory psychological test for fatigue proved unsuccessful. The Board, therefore, resolved to discontinue this inquiry and to proceed upon physiological lines, which seemed to offer a more hopeful prospect.

An offer from Mr. B. A. McSwiney, M.B., Lecturer in Physiology at Leeds University, to undertake research on this subject has been accepted, and as a beginning arrangements have been made to study the possibility of using the wink reflex and changes in the pulse-rate as a media for a satisfactory fatigue test.

T. **Optimum Conditions of Heavy Work.**—The arrangement of hours of work and length of spells most favourable for work of different kinds has never yet been systematically investigated. The Board on the 23rd of October, 1919, approved an investigation on these lines, and inquiries are now being made as to a physiologist who will undertake the work.

U. **Functional Periodicity.**—A research on the effects of work of different kinds on the menstrual period has been approved by the Board, and the selection of a suitable woman investigator is now under the consideration of the Employment of Women Committee.

V. **Pottery Industry.**—A suggestion received from the National Council for the Pottery Industry that the Board should undertake an investigation for them has lately been approved. It is proposed that the inquiry should be a joint one, to be carried out by Dr. H. M. Vernon and an expert in pottery processes nominated by the industry.

**§8.—External Relations.**

In December, 1918, a letter was addressed to the Admiralty, Air Ministry, Board of Agriculture, General Post Office, Ministry of Labour, Ministry of Munitions, Ministry of National Service, H.M. Office of Works, and the War Office, notifying the existence of the Board and offering any assistance in their power.
In November, 1918, Professor Frederic S. Lee, Chairman of the American Committee on Industrial Fatigue (organised under the Council of National Defence to co-operate with the Public Health Service in investigating conditions on industrial work), attended a meeting of the Board, and arrangements were subsequently made for the free interchange of results and publications between the two bodies. Valuable assistance and advice have already been received from Professor Lee on several occasions, and the Board are indebted to him for the gift of the necessary apparatus for carrying out the Martin and Ryan fatigue tests.

Similar relations have been established since September, 1919, in France with the Comité d'Hygiène, recently appointed by the Institut d'Hygiène Sociale and the Direction des Recherches Scientifiques jointly, and in response to an invitation received the Secretary of the Board attended a meeting in Paris on March 18th, 1920.

The relations of the Board to the proposed National Institute of Physiology and Psychology applied to Commerce and Industry have for some months been under consideration. The question was recently referred to a special Committee for detailed examination, and a report will be submitted at an early meeting of the Board.

In November, 1919, a memorandum on the constitution and functions of the Board (a copy of which is contained in Appendix V.), was distributed with a covering letter to every member of the Joint Industrial Councils and other joint bodies by the Ministry of Labour.

The co-operation of all Research Associations has been invited by means of a similar letter sent out by the Department of Scientific and Industrial Research. A copy of the letter is contained in Appendix VI. Replies received from four Associations have been notified to the Board by the Department.

Dr. C. S. Myers and Miss Mona Wilson have recently visited a number of factories in which some form of Scientific Management has been adopted, and will submit a report on the attitude of Trade Unions and workmen generally towards these methods.

In March, 1919, the Coal Commission applied to the Board, inviting them to furnish evidence as to the optimum hours of employment for work of different kinds. The matter was carefully considered by Committee "A" on March 20th, who recommended that inasmuch as no direct evidence as to the relation between hours of work and fatigue in the coal mining industry is as yet available, it would be undesirable to accept the invitation. This recommendation was duly adopted by the Board, and a letter offering future assistance was sent to the Commission.

§9.—Library.

The library now contains all the principal text books on industrial fatigue and kindred subjects, and a list of the periodicals to which the Board will subscribe is in course of preparation.

To ensure access to all current literature on the subject (much of which is hidden in trade and popular journals) steps are being taken to appoint two "collectors," one in the U.S.A. and the other in this country, who will advise the Board of the appearance of relative articles as a matter of routine.
The Board have approved the preparation of a summary of existing literature. The method of carrying this out has been considered by the Literature Committee, who have agreed that it should be dealt with sectionally as follows:

Indirect Tests for Fatigue, Dr. Vernon.
Motion Study, Mr. Farmer.
Vocational Selection, Mr. Muscio.
Direct Tests for Fatigue (Appointment not yet made).

As a first step each of the investigators concerned has been requested to submit an outline of the system on which they propose to deal with the part of the subject allotted to him.

§10.—Conclusion.

Most of the investigations hitherto undertaken by the Board fall into two clearly distinct categories:

(a) those limited to a particular industry; and
(b) those limited to a particular subject bearing on industrial fatigue.

The former were for the most part instituted in an industry for special reasons—generally on the recommendation of the Home Office—in the expectation that they would enable light to be thrown on various problems which at the time required elucidation. Since the armistice, however, many of the original problems have been adjusted, or at least alleviated, by the universal shortening of hours of work, and the investigations, therefore, instead of dealing with specific points, have become modified into general surveys—limited on the one hand by the terms of reference and on the other by the industry concerned—having for their object the discovery of "weak points" in the human side of efficiency.

The investigations in the second group, on the other hand, deal with specific questions bearing on industrial fatigue (such as time and motion study, vocational guidance, accident causation, etc.) irrespective of any given industry, with the object of studying the principles underlying them so as to fit them for practical application in this country.

The distinction thus drawn seems to indicate the lines on which the future work of the Board might usefully develop. In the first place there is the "observational" stage—the collection of the actual data on which the final conclusions are based; secondly there is the "critical" stage—the discovery of inefficiency and the determination of the causes underlying that inefficiency; and, finally, there is the "constructive" stage—the curative application of definite methods for the elimination or reduction of industrial fatigue and the increase of human efficiency.

The relative lengths of these three stages must vary according to the peculiar conditions of the industry under investigation, and in certain instances (e.g., cotton) some time must still elapse before sufficient data are collected to enable reliable conclusions to be drawn. In the meantime, constructive principles (such as time and motion study, vocational guidance, the laws governing heavy physical labour, etc.) are being intensively studied with the ultimate view to their practical application where they are shown to be most needed, whether by the Board itself or by some other body such as the pro-
posed National Institute of Psychology and Physiology applied to Commerce and Industry.

In investigations of the kind undertaken by the Board, initial progress is necessarily slow. Owing to the small amount of research on industrial fatigue which had been carried out when the Board was formed, they have been compelled to start their inquiries practically \textit{ab initio}, with an investigating staff to whom with a few exceptions all the problems were new. In addition, the nature of the experiments generally involve observations over a long period, so that final results cannot be expected for many months after an investigation has begun. The initial difficulties however are now being quickly overcome, and although the work of the Board is still largely tentative and must necessarily continue so for a long time, there is every ground for anticipating that progress in the future will be at a much more rapid rate than in the past.

As the scope of work is enlarged, the Board propose to consider whether an industry should not be invited to contribute to the cost of a given investigation. The industries now being investigated may be regarded as pioneers in a little-known field, and, as such, entitled to any benefits received through the work of the Board. In course of time, however, when the outstanding reports have been published and the importance of the subject fully established, industries may possibly desire to call on the Board for assistance on equitable terms as regards finance.

The Board cannot conclude their report without grateful acknowledgment of the assistance given and the interest in their work taken by employers and workmen alike, without whose active co-operation progress would have been impossible. Apart from the expert guidance and criticism given by the Panel Members, facilities for large scale experiments in factories have been readily afforded. access to records kept by employers and by Industrial Approved Societies has in every case been granted, and many individual workmen have voluntarily devoted considerable time both during and out of working hours to assisting the Board to secure data of various kinds.

The field of work to be covered is so large that it is impracticable at present to study more than a few selected industries, but the results so obtained may, it is thought, often be suggestive of wider application. Meanwhile, the spirit of collaboration met with by the Board since its inception encourages the hope that the time is not far distant when every industry will spontaneously investigate within its own boundaries the principal factors bearing on industrial fatigue and human efficiency.

As their first Annual Report goes to Press, the Board learn with deep regret of the death of their colleague, Mr. Bertram Wilson, who since January, 1919, has acted as Assessor representing the Ministry of Labour. His extensive knowledge of industrial conditions, which was placed unreservedly at the disposal of the Board, combined with the interest taken by him in their work, made his advice especially valuable, and the absence of his guidance will be greatly felt in the researches on which the Board have now embarked.

\textit{May, 1920.}
APPENDIX I.

LIST OF STAFF.

Investigators, Class I.

E. Farmer, M.A.                        B. Muscio, M.A.
H. de Havilland, M.A.*                 H. M. Vernon, M.D.
T. Loveday, M.A.*                      S. Wyatt, M.Sc., M.Ed.

Investigators, Class II.

P. M. Elton, M.Sc.                     Miss M. Smith, M.A.

Assistant Investigators.

Miss E. C. Allen.                     Miss R. Lubbock.
T. Bedford.                          Miss B. S. McFie.
C. Carlile, B.A.                     S. H. Munro.
W. D. Hamby, B.Sc.                  A. D. Ogden.
J. Loveday, B.A.                     Miss P. M. Vickers.
H. C. Weston.

Assistants.

H. Killingley.                      H. Radford.
L. Stocks.

Clerical Staff.

Miss F. M. Chalmers,             Miss D. M. Howells.
C. Y. Dickenson,                   Miss C. Thomas,
Miss F. C. Garner,                A. S. Thomas,
and six junior clerks.

APPENDIX II.

LIST OF COMMITTEES OF THE BOARD.

A. General Purposes.—E. L. Collis (Chairman), R. R. Bannatyne,
Sir Walter Fletcher, T. M. Legge, C. S. Sherrington, Mona
Wilson.

B. Textile.—Kenneth Lee (Chairman), R. R. Bannatyne, E. L.
Collis, Winifred Cullis, C. S. Myers, C. S. Sherrington.

Panel Members for Cotton.—John Taylor and Cephas Speak.

Panel Members for Silk.—S. Courtauld, J. Downes, W. Frost and
F. Saward.

Assessor.—John Jackson, O.B.E. (H.M. Superintending Inspector
of Factories).

Investigator in Charge (Cotton).—S. Wyatt.

Investigator in Charge (Silk).—P. M. Elton.

* Part-time Investigators.
C. Iron and Steel.—W. L. Hichens (Chairman), E. L. Collis, C. S. Myers, C. S. Sherrington.
Panel Members for Tinplate Trade.—W. Morris and Ivor Gwynne.
Investigator in Charge.—H. M. Vernon.

D. Boot and Shoe.—E. L. Collis (Chairman), C. S. Sherrington.
Panel Members.—F. J. Marquis and E. Poulton.
Assessor.—W. Williams (H.M. Superintending Inspector of Factories).
Investigator in Charge.—T. Loveday.

Assessor.—T. J. Jackson.

Assessor.—M. Greenwood.
Investigators.—Gladys M. Broughton and E. Rusher.

Panel Members for Laundry Trade.—J. J. Stark and Agnes North.
Investigator in Charge (Laundries).—May Smith.

H. Fatigue Test and Vocational Selection.—C. S. Myers (Chairman), E. L. Collis. Winifred Cullis, C. S. Sherrington.
Investigator in Charge.—B. Muscio.
Investigator.—H. de Havilland.

Investigator in Charge.—E. Farmer.

K. Literature.—Sir Walter Fletcher (Chairman), E. L. Collis, Winifred Cullis, C. S. Myers, C. S. Sherrington.

(Panel Members not yet appointed.)
APPENDIX III.
INDUSTRIAL FATIGUE RESEARCH BOARD.

Explanatory Leaflet.

The object of the Board is to obtain exact facts about fatigue caused by industrial employment in different trades and under different conditions in the same trade, but the Board is not itself concerned with the alteration of existing conditions by legislation or otherwise. The results obtained will be published, and it will then be possible for persons employed and others interested to make any suggestions they think necessary for improved conditions when they have weighed the facts.

Representatives of the workers are always invited to assist the Board as Panel Members in any trade enquiry which is undertaken. In the present enquiry Mr. of and Mr. of are Panel Members and have agreed that it is desirable to obtain the information which the Investigator (Mr. ) is trying to get. The Investigator may, for instance, invite some of the workers to take part in certain tests, and the Board will be grateful if workers will co-operate with them by carrying out these as explained to them by the Investigator, regularly for the period required. It may not always be easy to make clear to each worker who is asked to help exactly why particular tests have been chosen or why they should be repeated for a given number of times, as this would involve difficult scientific explanations, but workers are assured that none of the tests selected are in any degree painful or dangerous, and some will probably be found interesting and even amusing.

It may also sometimes be desirable to ask each worker for certain private or confidential information, or to make continuous observations on such matters as rate of production, etc. Before this is done, however, arrangements will be made with the firm that the information or results obtained shall not be divulged either to the firm or to any of the foremen, and when any report is published no individual names or initials shall be given. The information gained will, in fact, be treated as strictly confidential.

D. R. WILSON,
Secretary.

6, John Street,
Adelphi, W.C.2.

Note.—If there is a Works Committee this leaflet should be brought before it, and if the Committee wishes for further information arrangements will be made for a representative of the Board to meet the Committee.
APPENDIX IV.
REPORTS PUBLISHED AND IN PREPARATION.

No. 1.—The Influence of Hours of Work and of Ventilation on Output in Tinplate Manufacture, by H. M. Vernon, M.D.

[Price 6d. Net.]
(The fatigue and output of mill-men working on shifts of different length and in factories with different systems of ventilation are compared, the data being obtained partly from existing records and partly by direct observation.)

No. 2.—The Output of Women Workers in relation to Hours of Work in Shell-making, by Ethel E. Osborne, M.Sc.

[Price 6d. Net.]
(Embodies the result of a small investigation based on the booking of hourly output of 43 women engaged in shell-turning during one week on two 12-hour shifts and during one week on three 8-hour shifts, and compares the fatigue and output under the two systems.)

No. 3.—A Study of Improved Methods in an Iron Foundry, by C. S. Myers, M.D., Sc.D., F.R.S.

[Price 2d. Net.]
(Describes the effect on fatigue and output of the methods adopted in a certain iron foundry in the Midlands.)

No. 4.—The Incidence of Industrial Accidents upon Individuals, with special reference to Multiple Accidents, by Major Greenwood and Hilda M. Woods.

[Price 6d. Net.]
(A statistical investigation of certain accident records kept by the Ministry of Munitions.)

No. 5.—Efficiency and Fatigue in the Iron and Steel Industry, by H. M. Vernon, M.D.

[In preparation.]
(Based on an extensive investigation into the iron and steel industry throughout the country.)

No. 6.—The Speed of Adaptation to altered Hours of Work, by H. M. Vernon, M.D.

[In preparation.]

No. 7.—Individual Differences in the Cotton Industry, by S. Wyatt, M.Sc.

[In preparation.]

PAPERS BASED ON WORK DONE FOR THE BOARD AND PUBLISHED IN SCIENTIFIC JOURNALS.

A Performance Test under Industrial Conditions, by S. Wyatt, M.Sc., and H. C. Weston.


Fluctuations in Mental Efficiency, by B. Muscio. M.A.

[Ibid., Vol. X., Part 4.]
APPENDIX V.

MEMORANDUM ON THE CONSTITUTION AND FUNCTIONS OF THE INDUSTRIAL FATIGUE RESEARCH BOARD.

(As circulated to Joint Industrial Councils.)

1. The Industrial Fatigue Research Board was appointed in July, 1918, by the Medical Research Committee and the Department of Scientific and Industrial Research jointly with the following Terms of Reference:

"To consider and investigate the relations of the hours of labour and of other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers."

The Board is constituted as follows:

(Here follows list of Members),

with the addition of Panel Members as stated in Section 4.

2. The duty of the Board is to initiate, organise and promote by research grants, or otherwise, investigations in different industries with a view to finding the most favourable hours of labour, spells of work, rest pauses, and other conditions applicable to the various processes according to the nature of the work and its demands on the worker.

3. The short time during which the Board has carried on their work does not yet admit of any general conclusions being drawn, or even of the lines of their future procedure being definitely settled. The present intention, however, is to proceed on certain fairly well defined principles which may be briefly summarised as follows:

(a) Research into the comparative effects of the past, present and future conditions in factory and other industrial occupations in which changes of systems of employment have been or are about to be made.

(b) Current observations in factories, and collection of data (e.g., output), giving an indirect measure of fatigue.

(c) Large scale factory experiments, involving trial alteration of conditions of work, such as hours of employment, rest pauses, etc.

(b) Laboratory research, including the study of suitable tests of fatigue, and of vocational selection of individuals.

4. Investigations are already in progress in several of the most important industries in the country. For these, it has been the practice of the Board to invite the assistance of representatives of employers and workmen, known as Panel Members, who are invited to serve as members of the Board and Committees thereof whenever questions affecting their particular industries are under consideration.
5. The Board, in desiring to avail themselves of the help of Joint Industrial Councils, feel that the constitution and scope of the Councils render them particularly well adapted to further the work of the Board in the following respects:

(a) By bringing to their knowledge any problems within the scope of their reference which appear to require investigation.

(b) By placing them in touch with members of the Council or others in the trade, who have information likely to be of value or who would be willing to offer facilities for investigation.

(c) By acting, if so desired, as the nominating authority for Panel Members as described in paragraph 4.

6. In the event of questions arising which affect the functions of the Board, communications may be sent to—

The Secretary,
Industrial Fatigue Research Board,
6, John Street,
Adelphi, W.C.2.

APPENDIX VI.

EXTRACT FROM CIRCULAR LETTER ADDRESSED TO RESEARCH ASSOCIATIONS BY THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

The first part of the letter is identical with paragraphs 1 to 4 of the Memorandum to Joint Industrial Councils (see Appendix V.)

"... The Department will welcome the co-operation of Research Associations in the important work being undertaken by the Industrial Fatigue Research Board.

"It is not suggested that the Industrial Fatigue Research Board, when dealing with any particular industry, should invite the Research Associations concerned to co-operate in the whole of the investigation for that industry, but only that the Research Associations should be asked to undertake such portions of the work as they can conveniently and efficiently carry out.

"The Research Associations can afford valuable assistance by suggesting for solution problems arising in their industries which appear to fall within the scope of the Terms of Reference of the Industrial Fatigue Research Board.

"When the Industrial Fatigue Research Board has drawn up its programme, the portion of the field to be investigated by any Research Association can readily be determined by consultation between the two bodies.

"There are two matters of considerable importance to which attention must be drawn.
The first is that the results of investigations of this kind undertaken by a Research Association in co-operation with the Industrial Fatigue Research Board must be generally available and not confined to the Association itself. This is essential, since knowledge which is of value for the preservation of health or life or for that increase of output which is imperatively necessary should not be the sole property of any section of industry.

The second is that part at least of the expenses of such investigations as are carried out by Research Associations in co-operation with the Industrial Fatigue Research Board should be defrayed by the Associations themselves. From the nature of the case, the investigations carried out by the Research Associations will be of value mainly for the particular industry concerned; for this reason it appears desirable that the industry should contribute.

The expenses incurred for supervising the work and for collating the results in order to show their relation to other information in the possession of the Industrial Fatigue Research Board, and to indicate their general bearing on the general question of industrial fatigue will, however, be borne by the Industrial Fatigue Research Board.

It is not anticipated that any difficulty is likely to arise in determining the expenditure to be borne by the Research Association and the Industrial Fatigue Research Board respectively.