

An account of the research work carried out by the National Institute of Industrial Psychology during the years 1921-34.

Publication/Creation

London : National Institute of Industrial Psychology, [1934]

Persistent URL

<https://wellcomecollection.org/works/gttad468>



Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
<https://wellcomecollection.org>

THE NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY

Founded in 1921 for the Application of Psychology and
Physiology to Industry and Commerce

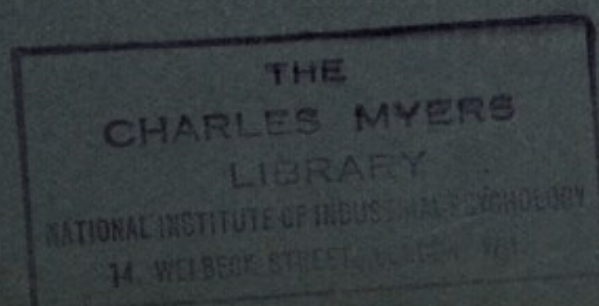


An Account of the Research Work
carried out by the
National Institute of
Industrial Psychology
during the years
1921—34

PRICE 2/6

PUBLISHED IN LONDON BY THE
NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY
ALDWYCH HOUSE, W.C. 2

GRATIS TO MEMBERS OF THE INSTITUTE



The National Institute of Industrial Psychology was founded in 1921—by its first Chairman, Mr. H. J. Welch, and by Dr. C. S. Myers—as a scientific association for the theoretical and practical study of the human factor in occupational life. Its first President was the first Earl of Balfour. On his death Viscount D'Abernon accepted the presidency; but, owing to ill-health, he was succeeded in 1932 by Lord Macmillan. Its Vice-Presidents include (or have included) Viscount Haldane, the Marquess of Reading, Sir Josiah Stamp, and the two immediate past-presidents and the present president of the Royal Society, Sir Charles Sherrington, Lord Rutherford and Sir Gowland Hopkins.

The Institute's activities may be classified under three heads—(a) research work, (b) services rendered for individual companies, firms and persons for which a fee is payable, and (c) educational work.

Its research work is described in this Report.

The varied work which it carries out for individual companies and firms is recorded in the Annual Reports of the Institute. The success of these services is attested by the frequency with which the Institute's investigations are extended, sometimes over several years, beyond the time (and scope) originally allotted to them, and with which its services are from time to time again sought by any one concern after it has had experience of their value. The Institute has carried out such work in over 150 different industries and for over 250 different firms and companies.

The Institute has now given vocational advice to several thousands of young persons at the Institute or in schools throughout the country. Thanks to the activities of its Women's Committee, it has a fund available to assist a limited number of those who cannot afford to pay the cost to the Institute of such advice.

Its educational work consists, briefly, in giving advice to teachers, 'outside' research workers and others, in arranging and delivering lectures for its members and for the general public, in publishing journals, reports and books, and in providing training for future industrial psychologists, managers, welfare workers, engineers, and careers masters. Thus it is at present affording instruction for individual industrial concerns, for the School of Economics and the Institute of Education in the University of London, for the University and the Technical College of Glasgow, for two courses of business management in London, and for certain Local Education Authorities throughout the country.

For the development of its work the Institute is dependent entirely on voluntary support and is debarred by the terms of its incorporation from distributing profits. It has to meet an expenditure of some £28,000 annually.

An Account of the Research Work
carried out by the
National Institute of
Industrial Psychology
during the years
1921—34

PUBLISHED IN LONDON BY THE
NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY
ALDWYCH HOUSE, W.C. 2

An Account of the Researches
conducted out by the
National Institute of
Industrial Psychology
during the years
1921-24

REPRINTED BY THE
NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY
1927-28

PREFACE

EVER SINCE the creation of the world, it has seemed reasonable to review past work in order to rest assured of its value. But that is not the sole object of publishing this account of the researches conducted by the National Institute of Industrial Psychology since its foundation.

Research needs money—to meet the salaries of research workers and the cost of supervision, rooms, apparatus, clerical work and publication. So far the Institute has defrayed these expenses to no small extent from its own funds, but for the most part from special grants which have been most generously bestowed by the Rockefeller and Carnegie Trusts and by certain other Bodies. But this handful of donors cannot be expected to finance the Institute's researches permanently; already the Rockefeller Trustees, who have up to now given the Institute the total sum of over £22,000, mainly for research, have definitely informed the Institute of this impossibility. Consequently a wider appeal to the general public becomes imperative, if the Institute's research work is to continue.

Indeed this work must virtually cease within the next two years unless the public can be brought to appreciate and actively to show appreciation of its importance. On the vocational side, the many analyses, made by the Institute and summarized in this Report, of the 'general,' 'group' and 'specific' factors involved in various tests of intelligence, of manual skill and of mechanical ability have opened out a wide field for further research, both into the extent to which these factors enter into different kinds of educational and occupational work and into the best practical methods of assessing their presence in different individuals. This Report also indicates how rudimentary is our present knowledge of the nature and assessment of temperamental and character qualities, and how much remains to be done by further occupational analysis to improve our knowledge of the mental abilities and qualities required for success and happiness in different occupations.

On the industrial side, an equally vast field awaits research, despite the valuable and extensive work already published in the sixty-nine Reports of the Industrial Health (formerly Industrial Fatigue) Research Board. Numerous important problems relating to the human factor in occupational life, hitherto untouched, can only be solved by research. These the Board, with its now wider scope (covering industrial sickness

and diseases) and with its now reduced investigating staff, cannot be expected to undertake alone.

The Institute can, and will, continue with its paid work of conducting investigations for businesses in order to reduce the wastage of effort, time and material among all concerned, and of giving vocational guidance to young people who require examination and advice as to their choice of a suitable occupation. But improvement in the methods employed and in the results obtained by the Institute is often impossible without parallel research. Unless these are to stagnate, unless the spirit of the Institute's practical work is to languish from its abandonment of research work, further financial support must be forthcoming to meet the costs of research.

A glance at the detailed list of over fifty of the Institute's researches, tabulated on pages 34-37 of this Report—many of them protracted and costly—will suffice to indicate the nature and importance of this branch of the Institute's work.

CHARLES S. MYERS
(*Principal*)

Aldwych House, W.C. 2
November 1934.

CONTENTS

	PAGE
1 Vocational Guidance	5
2 General and Special Abilities	11
3 Temperament and Character	18
4 Vocational Selection	21
5 Occupational Analysis	25
6 Industrial and Other Research	26
7 Future Outlook	32
8 Chronological Table of the Institute's Research Work	34

AN ACCOUNT OF THE RESEARCH WORK CARRIED OUT BY THE NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY DURING THE YEARS 1921-34

THE National Institute of Industrial Psychology was established thirteen years ago. Even before its formal foundation, it convened a meeting of various Heads of Psychological and Physiological Departments in Universities and other Institutions throughout the country, in order to discuss projects of research. The members of the Institute's Technical Advisory Board, thus formed, have never since ceased to be helpful with advice. As will be seen, the Institute's research work has lain predominantly, although not exclusively, in the fields of vocational guidance and vocational selection.

I. VOCATIONAL GUIDANCE

First Experiment

Vocational Guidance was started tentatively by the Institute in the first year of its existence, 1921. In 1923 began its first experiment (6)¹ on the value of such guidance, conducted, in conjunction with the Industrial Fatigue Research Board, on 100 boys and girls in three elementary schools of a certain London Borough. At the outset of this experiment, the occupations adopted by 1000 boys and 1000 girls leaving neighbouring elementary schools were analyzed, in order to ascertain what qualifications of aptitude and temperament would be required for the employments which the subjects of the experiment were likely to enter. Then an intensive study was made of the mental and physical abilities, temperamental and character traits, interests, etc., of the children who were about to leave the three schools, and on the basis of this study vocational guidance was given them. Their homes were re-visited two years after the date of the original recommendations, and in only 18 cases was adequate information of their subsequent careers not forthcoming. Of the remaining 82 children rather less than half were found to be in occupations which had neither been recommended

¹ For this and other reference numbers, see the Chronological Table (first column) at the end of this Report.

to them nor were even similar to the occupations they were advised to seek. Over 80 per cent. of those who had entered occupations of the kind recommended were satisfied with their work, their prospects and their pay ; whereas of those who had found employment different from the kind advised, less than 40 per cent. were satisfied, and of these, many appeared to be so rather because they happened to have unusually good employers than because they liked their work. Further, the children who had followed the vocational advice given them were, on the average, in receipt of higher wages, had obtained promotion earlier, and had experienced fewer changes of situation than the children who had not followed the advice given.

Where possible, the tests applied in this experiment were in themselves tested by comparing their scores with the teachers' estimates ; but teachers are not infallible in their estimates, their estimates are not always obtainable, and the standard of one teacher cannot be equated with that of another. On the other hand, the importance of regarding tests as a servant, not as a master, in vocational guidance was clearly revealed. Broadly speaking, they cannot be regarded as a foot-rule which any psychologically untrained person is competent to use : the test-scores need to be interpreted, not just treated mechanically as a number-quantity. Their indications, when clear, may easily be overridden by other considerations ; or they may be too slight to afford much help. They are only one of the vast number of complex factors which determine vocational guidance. Among these must be stressed qualities of temperament and character ; and an interesting incidental study was made, in the course of this experiment, of the uniformity of the estimates of these qualities by different observers in regard to one and the same person. In the absence of reliable tests for temperament and character, it became clearly important to improve the technique of conducting the personal interview and of obtaining reports as precise and detailed as possible from those who knew the child and his history best. Considerable progress has since been made by the Institute in these directions (*cf.* p. 20).

Second Experiment

The Institute's second experiment (8), begun in 1924, benefited greatly by the experience gained in the previous one. It was clear that larger numbers of children must be advised in order to arrive at a really

trustworthy result, that a more thorough study of their after-careers over a longer period was advisable, and that a comparison was needed between children who were guided by the Institute's investigators and a 'control' group who received merely the usual methods of advice. In this experiment, accordingly, 1200 elementary school children were examined, 600 of whom formed the 'control' group; the follow-up period extended over four years after the children had left school. Further, the methods of vocational guidance, the statistical treatment of the data obtained, and the methods of getting reports from employers, as well as from employees, were all improved in this experiment. The results confirmed those of the previous experiment. Unfortunately, however, unforeseen difficulties once again became manifest: among these was the region chosen on expert advice—a poor, rather overcrowded one, comprising few large factories and workshops and a correspondingly large proportion of 'one-man' firms (from whom reliable information was not easy to obtain); the children, too, belonging to a less intelligent and hence to a somewhat abnormal section of a city population.

Third Experiment

These and other defects were remedied in the third experiment (28), begun in 1927 by the Education Authority at Birmingham and carried out by a member of their staff (trained by the Institute) and by a member of the Institute's staff who had been seconded to the Birmingham staff. Here 328 boys and girls about to leave elementary schools were advised by methods almost identical with those employed in the second experiment. 'Experimental' and 'control' groups were formed as before, and both groups were followed up two years after leaving school. But here the children were intellectually and socially more typical of those of the average elementary school, and fuller knowledge was available of the nature and conditions of local occupations. The results obtained are therefore not only more reliable but also more striking than in the second experiment. The drift of children from their first posts to other posts is, as the following table shows, far less in the 'experimental' group when the first post was in accordance with the advice given ('accordance posts') than when it was not in accordance ('non-accordance posts'); whereas in the 'control' group the drift was far greater or (in the case of the boys) even reversed in direction.

PERCENTAGE OF FIRST POSTS RETAINED THROUGHOUT THE FOLLOW-UP PERIOD

<i>Experimental Group</i>	<i>In accordance posts</i>	<i>In non-accordance posts</i>
Boys	21	1
Girls	35	4
<i>Control Group</i>		
Boys	7	15
Girls	20	15

The next table, showing the average time spent in the first post, is equally striking: the differences are large and are all favourable between the two columns for the 'experimental' group, but again are reversed in all the corresponding data for the 'control' group.

TIME SPENT IN FIRST POST

<i>Time Spent</i>	<i>Experimental Group Percentage</i>		<i>Control Group Percentage</i>	
	<i>in accordance posts</i>	<i>in non- accordance posts</i>	<i>in accordance posts</i>	<i>in non- accordance posts</i>
Over 18 months	45	12	30	33
7-18 months	20	14	17	22
Under 6 months	35	74	53	45

In the 'experimental' group multiple posts held during the follow-up period are indeed, as the following table shows, far commoner when the first post was not in accordance with the advice given; whereas in the control group the difference is far less and in the first and last lines is even reversed.

NUMBER OF POSTS HELD

<i>Number of Posts</i>	<i>Experimental Group Percentage</i>		<i>Control Group Percentage</i>	
	<i>When the first post was in accord- ance</i>	<i>in non- accordance</i>	<i>When the first post was in accord- ance</i>	<i>in non- accordance</i>
1	43	9	27	30
2	23	41	29	28
3 or 4	26	29	26	35
5 or more	8	21	18	7

Not less satisfactory have been the results (41) of following-up the pupils of 'public' and other secondary school boys and girls who had been vocationally guided by the Institute during the years 1927-29. If

a correct prediction can permissibly be defined as a case in which the applicant for guidance followed the Institute's advice and succeeded, or rejected it and failed, in his subsequent occupation, then the proportion of correct predictions turns out to be nearly 80 per cent. Among those who rejected the Institute's advice, the chances of success were only one-and-a-half times as great as the chances of failure ; whereas among those who followed its advice, the chances were eleven to one in favour of success—surely a satisfactory result when it is borne in mind that those who come to the Institute for vocational guidance are, on the whole, cases of more than average difficulty, as many of the easier cases in the general population would tend to dispense with the Institute's aid.

Fourth Experiment

A fourth experiment in vocational guidance (30), begun in 1928, was conducted by the Institute in Fife. Here both rural and urban school children, 472 in number, were vocationally examined and received advice. Of these 378 had left school by the summer of 1932 and were followed up in their occupations. Each boy or girl was first tested at the age of eleven or twelve, and the tests were annually repeated on as many as possible of the same children, so as to ascertain the constancy or the course of development of different vocational and scholastic abilities in the same child. Differences were found between rural and urban children ; the former, for example, proving rather more competent in dealing with practical problems, the latter in abstract school subjects and in verbal tests of intelligence. By grouping together the facts regarding children who were recommended for similar kinds of work and by studying the relation between these facts and the occupational success later achieved, it was possible to suggest certain minimum standards of proficiency in tests of aptitude, temperament, etc., for different classes of work ; and the importance of particular abilities in relation to particular occupations was clearly demonstrated. Valuable conclusions were also reached as to the age at which vocational studies should be begun. Tests of intelligence repeatedly applied to the same individuals between the ages of ten and sixteen gave results so consistent that they might justifiably be considered as affording 'long-range' forecasts. On the other hand, tests of scholastic attainment showed scant consistency over periods longer than one year. The consistency of the

measures of mechanical ability repeatedly applied to the same individual appeared high enough to warrant forecasts from the age of thirteen, perhaps even from the age of twelve. But in the case of manual dexterity, the age at which stability occurs appeared to vary from one individual to another.

Fifth Experiment

A fifth experiment, begun in three secondary and central schools of Willesden in 1932, had to be abandoned on account of unforeseen circumstances. 'Experimental' and 'control' groups of pupils were formed as before, but it was found necessary later to reduce the size of these groups so materially that the results were likely to have little statistical reliability. Moreover, as very few of the parents in this area proved able to afford further technical or professional training for their children, most of whom proceeded at once to clerical employment, a satisfactory demonstration of the full value of the application of psychological methods to vocational guidance became impossible.

Borstal Experiment

At the request of the Prison Commissioners, and on behalf of the Industrial Health Research Board, the Institute, after conducting some preliminary work in 1929, began a vocational experiment in the following year on a group of 400 Borstal Institution boys (40). Before beginning their occupational Borstal training, these boys were all examined by a member of the Institute's staff. Recommendations were made for each boy, but they were forwarded to the authorities of the Borstal Institutions only for alternate boys. The remaining 200, forming a 'control' group, were allocated to their work-parties by their housemasters in the usual way. Reports on the progress of each of the 400 boys were furnished at six-monthly intervals by the housemasters, and at the end of the experiment, lasting over four years, each boy was classed as a Grade A or as a Grade B member of his work-party. It was found that of those who had been placed in the work-parties recommended for them by the Institute, 69·5 per cent. had become Grade A workers ; while of those who had been placed according to the recommendations of their housemasters, only 45·6 per cent. had become Grade A workers. There were good reasons for believing that under ordinary conditions this important difference would turn out to be even greater.

Vocations for the Blind

On behalf of the National Institute for the Blind, the Institute carried out an investigation (29) into the possibility of improving vocational opportunities for the blind (*cf.* p. 31).

Social Factors in Unemployment

In 1928 a broader research (32) into certain social factors underlying juvenile unemployment was begun by one of the Institute's investigators in a suburban area of North London. The industrial experience and the social, educational and family background of two large and representative groups of seventeen-year-old lads were studied. These two groups were strictly comparable in respect of their initial occupations and were drawn from neighbouring homes and from the same schools. But whereas the members of one group were unemployed at the time of the inquiry, those of the other group had never drawn unemployment benefit. The object of the study was to discover what differences, if any, of economic or social background, or of intellectual or temperamental endowment, distinguished the two groups. Its results were subsequently published in book form and were accepted as a University doctorate thesis. Besides demonstrating the predominant importance of temperamental factors and character in the occupational success of these lads, the investigation showed that a large proportion of them were entering their first occupations without advice from adults, and that the industrial careers of those who were occupationally aimless on leaving school seriously suffered from such lack of aim.

2. GENERAL AND SPECIAL ABILITIES

Intelligence Tests

From this work on vocational guidance there developed a series of researches into general and special abilities, their nature and their estimation. These inquiries must in time prove as helpful in practice as they are of value theoretically. The first vocational selection investigation by the Institute (see p. 21)—into the qualities required for success in shorthand and typing—had shown the need for a satisfactory test of the *general* factor of 'intelligence' which, in contrast to such *special* factors

as those entering into mathematical, mechanical, manual, or musical ability, is widely believed to be common to *all* cognition.¹ A test was required which could be applied simultaneously to a large number of persons and was suitable for use in this country. To meet this demand, the Institute's general intelligence test, known as "Group Test—Series 33," was prepared and early published (2). It was probably the first test of the kind devised in this country and was in many respects superior to those then current abroad. It consists of several groups of tests which involve essentially the discovery of relevant relations and their appropriate utilization—that is to say, the use of 'intelligence.' The test can be given, and objectively scored, with comparatively little previous training ; and, although never regarded as infallible, it has been widely and successfully used, not only by the staff of the Institute, but also in various psychological and social investigations conducted by others throughout the country, in the scholarship examinations of certain Local Education Authorities, and elsewhere. Indeed the noteworthy change in general attitude towards such intelligence tests was shown recently in a remarkable way when the Institute wished to standardize, on several thousands of public-school boys and girls of different ages, an alternative test (not for general publication) constructed on lines similar to those of this test. Not one of the thirty foremost public schools in the country, which were asked to help in this work, refused their co-operation, despite the not inconsiderable inconvenience and the loss of time involved : they realized the ultimate advantage to themselves of the further development of intelligence-testing.

"Group Test—Series 33" was devised for *secondary* school pupils and for adults. But the Institute's second experiment in vocational guidance (described on pp. 6, 7), begun in 1924, which was conducted in *elementary* schools, demanded an intelligence test of a less linguistic nature and suitable for younger children. To meet this need, a group test was constructed by the Institute and published (9) under the title of "Group Test—Series 34." Its correlation with the individual Binet-Simon test and with the teachers' estimates of the subjects' intelligence, and its reliability were statistically determined. It has proved to be of great value in the vocational guidance of elementary school children

¹ Cognition is roughly equivalent to knowing. Three forms or 'modes' of consciousness are commonly distinguished by the psychologist—popularly termed knowing, feeling and willing.

(who leave school at fourteen) and in estimating the intelligence of children at a still earlier age.

A further modification of "Group Test—Series 33" was prepared for the War Office and has now for several years been used regularly by the Army to aid in the selection of its 'tradesmen.' More radical changes, which may prove to increase the efficiency of the same test, have been made in its recent use by Scotland Yard for the selection of police officers. Another research, still in progress (51), aims at devising an intelligence test which will resemble most of the Binet-Simon sub-tests in involving no time limit, in permitting the subject to answer in his own choice of words and in being graded sectionally according to age. On the other hand, it will resemble the Institute's Group Test in the type of questions asked and in being suitable (as the Binet-Simon test is not) to late adolescence and to adults. It will be applicable either to small groups or (orally) to separate individuals.

One drawback of these intelligence tests is that they all involve the use of language, numbers or pictures, and thus raise a doubt whether fair justice is done to the person whose intelligence is, through aptitude or habit, usually employed on practical, concrete, rather than on symbolic, abstract material. 'Performance' tests of intelligence, requiring the manipulation of objects, had already been devised for this purpose, chiefly in America, before the Institute's second experiment in vocational guidance (see pp. 6, 7) began. These practical tests were designed primarily (and were widely believed) to measure general intelligence—as distinguished from manual dexterity (*i.e.* finger deftness) and mechanical ability (*i.e.* the apprehension of mechanical relations), although these abilities might well enter into the performance of the tests.

In the Institute's second experiment in vocational guidance the child's intelligence was considered in relation to its achievement both at the 'verbal' and at the 'performance' tests of intelligence, both of which were employed. When the two scores showed discrepancy, an attempt was made to discover whether this could be attributed to any special cause, *e.g.* to some exceptional handicap in regard to scholastic attainments in reading or in regard to vocabulary. Where no such cause was discoverable, a child who did far better in the 'performance' than in the 'verbal' test of intelligence was considered 'practical,' while the reverse relation was held to denote a certain 'linguistic' bent.

In the course of the same experiment, it became clear that far more

knowledge was needed concerning the nature and value of the performance tests of intelligence than was at that time available. Accordingly, six of the tests which had been included in the battery of performance tests of intelligence and applied to some 570 school children were made a special subject of research by the Institute (22). It was found that these tests involved the play of a common group factor (of intelligence) which ran through all of them, and of various special factors responsible for special ability in each test. But these special abilities did not appear to develop uniformly in different individuals; a child might achieve the average mental age level of sixteen years in carrying out one of the performance tests but only that of ten years in carrying out another. Certain tests were also affected by a common factor, apparently of spatial perception. Moreover, in addition to general intelligence in the 'verbal' tests of intelligence, there seemed also to be a common group factor in these tests which did not enter into the 'performance' tests. (The presence of this 'verbal' factor in the verbal tests of intelligence has since been corroborated by other research workers.) Although, for the above reasons, it seemed as if the scores at the various performance tests (as here chosen and employed) could not be safely combined to estimate general intelligence or to give an estimate comparable with that given by the verbal tests, this research served the useful purpose of indicating more precisely their value as a supplement to the verbal tests in the practical work of vocational guidance.

In the application of these performance tests, greater stress was laid on the dangers of practice and on the need for the subject's 'freshness' towards the tests than on the reliability of the data obtained from their necessarily brief application. It seemed doubtful, too, if the tests were of sufficient difficulty to be suited to all boys and girls of school-leaving age. In another long research (53), for which in its last stages during 1933 and 1934 the Institute undertook responsibility, these drawbacks were avoided and clearer and more valuable results were obtained. Groups of elementary, secondary and technical school pupils were examined. The same single general factor (of intelligence) was found both in the verbal and in the performance tests of intelligence, and also in all school subjects. In addition, a 'verbal' factor was definitely revealed in the verbal tests and, to a varying extent, in all school subjects save shop work. And, for the first time, a 'practical' factor was established common to the performance tests, which was not found in any

of the school subjects save shop work and mechanical drawing. The general intelligence factor seems to enter relatively least into English and shop work and most into mathematics and science ; it is approximately equal in importance to the verbal factor in the usual verbal tests of intelligence, and it is present in the ratio of 7 : 5, relatively to the practical factor, in performance tests of intelligence. Owing to the improved choice, and the improved methods of use, of performance tests in this research, the important conclusion is reached that the general factor of intelligence can be about as well determined by performance tests as by verbal tests of intelligence, provided that steps are taken to insure their equal reliability.

But success in all school work save English appears from this research to be more dependent on yet another common factor (possibly concerned with interest or with method of teaching) than on the general intelligence and verbal and practical factors combined. Moreover, a fifth common factor of less importance emerges (possibly concerned with number or with spatial relations) which is most prominent in shop work and in certain performance tests. When, after further research, we know the relative extent to which these various factors enter into different school subjects and into different occupations, and when we know more exactly their nature and the relative extent to which they enter into different tests, clearly the future adviser should be better enabled to predict educational and vocational success.

Tests for Manual Dexterity

The Institute's second experiment in vocational guidance (*cf.* pp. 6, 7) afforded material for a special research (begun in 1927) into the nature of manual dexterity (25). Here, as in the performance tests, the norms for boys and girls, the average scores and their distributions were determined. But here more than 1000 boys and girls were examined, their ages varying between twelve and seventeen and the average scores for different ages being determined. As in some of the performance tests of intelligence, certain sex differences were observed : the boys excelling where strength and speed of movement were needed, the girls excelling where the independent control of different fingers and fine deliberate movements were involved. The conclusion of certain previous investigators was confirmed in this research—that the abilities involved in the various *simple* tests employed for estimating manual dexterity are largely

specific to each such test. Although, however, no 'common' factor of dexterity was here clearly indicated, the presence of certain 'group' factors, common to certain manual skills, *e.g.* to those in which speed or accuracy of movement appeared to be an important acquirement, was revealed. Despite, however, the small inter-relation between the various simple tests of manual dexterity employed in this research, evidence was adduced of the likely value of particular tests in the selection of applicants for training in certain occupations; these have since been usefully employed, in combination, in the Institute's vocational guidance service.

Test for Mechanical Aptitude

Yet another research resulted simultaneously from the Institute's second experiment in vocational guidance—on the nature of mechanical ability (23), *i.e.* the ability to apprehend and to employ the mechanical principles involved in the use of machines and implements. In the particular test employed in this research—one of assembling various objects—success appeared to be determined by—(i) the general factor, identified with intelligence, (ii) a common factor tentatively attributed to the spatial perception of form relations, and (iii) a common factor (see later) of manual dexterity. The value of this test, as predictive of aptitude for different kinds of mechanical work, must therefore vary according to the degree to which these different factors enter into the work. But its broad diagnostic value was established for vocationally advising boys up to fifteen or sixteen years of age who have not yet received any specialized mechanical training; and this is the main purpose for which the test has been employed by the Institute.

This research showed the need of a test specially devised to measure the ability to grasp the spatial relations between two or more shapes or forms. Such a form-relations test was accordingly prepared in 1924–25 by the Institute (10), and it has been found useful in vocational guidance, particularly in relation to such occupations as engineering, surveying, architecture and designing.

Analysis of Manual Skill

The nature and measurement of manual skill, as a whole, were further explored by the Institute in a lengthy research (34), begun in

1928, into the abilities involved both in assembling operations and in simpler manual operations of various kinds. Here, again, the complex character of manual skill was revealed : the order of persons in skill at any one operation was not necessarily the same as their order in skill at other operations. Nevertheless, by closer consideration, four factors were clearly established—(i) a general factor identified with intelligence, (ii) a common factor of mechanical aptitude (the ability to understand and to solve problems involving moving mechanisms), (iii) a common factor of manual dexterity, and (iv) specific factors peculiar to each manual operation. The general factor was determined by correlating the scores with those for general intelligence ; and the mechanical factor was determined by correlating the scores with those for mechanical aptitude in situations where no manual activity was involved, due allowance being made for the influence of the general intelligence factor. The remaining manual factor was deduced from certain manual assembling tests which involved no mechanical factor and from the fact that the combined general and mechanical factors were, in certain other tests, not large enough to account for the observed degree of correlation between their scores. The degree of saturation of different manual operations with these factors, and the measurements of these factors by selected batteries of tests, were determined : similar determinations have yet to be made in manual operations other than those which were the subject of investigation in this research.

In the assembling tasks not only were the parts assembled, but the assembled parts were also stripped, *i.e.* taken apart. The general factor and the mechanical factor proved more important in the assembling than in the stripping operations, where indeed the mechanical factor tended entirely to disappear. In the simpler manual operations, too, the general intelligence factor entirely disappeared, while the common mechanical factor and the common manual factor also became much less important than in the more complex assembling operations.

Although, therefore, the previous research of the Institute (see pp. 15 and 16) is corroborated, namely that in *simple* manual operations a common manual factor plays little part, this later research demonstrates the importance of such a common factor in the more *complex* manual operations. A suitable test, consequently, involving fairly complex manual operations, will have high predictive vocational value as estimating the general manual skill required in complex manual work ;

whereas it will be of little value for estimating the special skills which are relatively so much more important in performing simple manual work. The practical application of these important conclusions is now being undertaken (52).

In the same research previous observations were confirmed—that prolonged practice in *one* operation (here one kind of assembly work) had little or no influence on the skill with which *other* operations (here other kinds of assembly work) were subsequently performed. When, however, in this research, instruction in the basic principles (as revealed by careful observation and introspection) that govern the performance of one assembly operation was substituted for the merely routine repetition (or practice) of that operation, a very considerable transfer of skill to other operations and a greater speed of the acquisition of such skill were obtained. Clearly, these results are of considerable practical importance to industry. New workers must not be allowed to pick up their methods by haphazard *practice*; if transfer of the skill acquired in one manual operation to other operations is to be expected, the worker needs to be systematically *trained* in the general principles determining the efficient performance of that manual operation. It was also found that, throughout the practice period of assembling, individuals tended to maintain their relative order of proficiency; indeed, the separate tests of mechanical and of manual aptitudes employed in this research proved as effective in determining the final skill as in determining the initial skill of the subjects to whom they were applied. The practical importance of this result is also obvious. Finally, the detailed subjective analyses to which these operations were submitted served to indicate the lines along which many other forms of manual work should now, with great advantage, be analyzed.

Educational Tests

In 1933 a research was begun at the Institute (55), in order to devise tests of mathematical and linguistic abilities for use in educational guidance.

3. TEMPERAMENT AND CHARACTER

General intelligence has already been defined as the ability to discover relevant relations and to utilize them appropriately. Its practical

value appears to be dependent, not only on its own amount, but also upon the kind of relations to which it is directed, *e.g.* as has been shown in the foregoing researches, according as a person has to deal with (*a*) abstract thought, words and other symbols or with (*b*) concrete objects. A third kind of relation may well be supposed when he has to deal with (*c*) living individuals. Thus may be recognised 'verbal,' 'practical' and 'social' intelligences. In 1930 an investigation (43) was begun by the Institute into the analysis of what may be conveniently, if vaguely, termed 'social ability,' into which, conceivably, social intelligence may enter. A detailed questionnaire was drawn up, with reference to a number of social qualities belonging to various types of character, according to the schemes of certain previous workers in this field. The answers to this questionnaire afforded a useful basis for subsequent interviews. Descriptions of social attitudes were aimed at in terms of observed activities, rather than in terms of conjectured psychological elements. Various tests were also tried, the most promising of which consisted in the subject examining a series of pictures and sorting them into two piles according as he would like or dislike to be in the situation shown in the picture; whereupon he was questioned and asked to give his reasons for placing each picture in the one or other pile. Partly owing, however, to the illness of the investigator, this inquiry had had to be discontinued.

Not only 'social ability,' but also efficiency in every occupation, is determined largely by qualities of temperament and by traits of character. Unfortunately a review of the relevant literature made by the Institute in 1928 (31) had shown that no satisfactory tests of temperament and character had been discovered. An attempt was made by the Institute in the same year to devise tests for estimating calmness under pressure (33), but was interrupted owing to the appointment of the investigator to a University post, where it was for some time hoped that he would later be able to resume it. A more fruitful research, however, began in 1929, employing certain tests of 'perseveration' (37)—*i.e.* the degree of resistance to changing from one conscious process to another. As is indicated in the following table, a definite association was revealed between *extreme* perseveration (E.P.) or *extreme* lack of perseveration (E.N.), on the one hand, and 'difficult' or 'unreliable' persons on the other; and between *moderate* degrees of perseveration (M.P. or M.N.) on the one hand, and 'self-controlled' or 'persevering'

persons on the other. These tests have later proved of practical value in vocational guidance.

In the following table :—

A = results from 116 men and women.

B = results from 194 boys and girls.

E.P. and M.P. = extreme and moderate 'perseverators.'

E.N. and M.N. = extreme and moderate 'non-perseverators.'

The figures given below should be read in columns, *i.e.* from above downwards. Most of the 'difficult' and 'unreliable' characters will be seen to relate to those who score as *extremes* in the perseverance tests; whereas most of the 'self-controlled' and 'persevering' rank only *moderately* in the tests.

	'Difficult'		'Unreliable'		'Self-controlled'		'Persevering'	
	A	B	A	B	A	B	A	B
E. P.	19	36	17	38	3	12	4	10
E. N.	16	39	19	37	3	8	2	9
M. P.	5	10	6	15	15	37	14	32
M. N.	7	14	4	15	11	33	12	33

According to the same investigator, the extreme 'perseverator' tends to be 'nervous,' sensitive, effeminate and 'sentimental,' whereas the extreme 'non-perseverator' tends to be inconsiderate, tactless and critical. And he considers that other temperamental qualities and character traits are similarly attached to the moderate 'perseverator,' and yet others to the moderate 'non-perseverator.' Although these conclusions require corroboration by further research (50) before they can be accepted, the broader conclusions derived from the above table have often proved helpful in vocational guidance.

Some most useful work on temperament and character (46) has been carried out by the Institute since 1931 by devising suitable questionnaires which can be answered by the parents and teachers of those who are applying for vocational guidance. These forms have now been incorporated in the Institute's normal procedure for vocational guidance and have proved of considerable value. Further, they have provided useful material for a tentative analysis by the Institute of the prime factors (or 'regulators') common to different temperamental traits, which is still in progress. These factors may turn out ultimately to be few in number, and their final determination is likely to be of great value in vocational psychology.

4. VOCATIONAL SELECTION

Early Work

The very first piece of research carried out by the Institute (in 1921) was directed to devising tests for the better selection and employment of shorthand-writers and typists who had already been trained for this work (1). When these tests were applied to clerical workers in an office of the London County Council, a close correspondence was obtained between their scores at the tests and their supervisors' order of their efficiency at their work. The tests were later so standardized that they could differentiate (*a*) those persons who were capable of clerical work demanding high intelligence ; (*b*) those capable only of routine clerical work ; (*c*) those who, although as yet unfit for clerical work, were likely to become capable after further training ; and (*d*) those permanently unfitted for any kind of clerical work. Several of the tests (those relating to general intelligence, educational attainments, linguistic ability and general information) were also applicable to untrained beginners, for the purpose of deciding whether they were likely to make efficient typists after training.

These typing and shorthand tests have since been greatly improved : some have now been incorporated by the Civil Service Commissioners into their examinations for typists and shorthand-writers. And a further series of tests (including tests of copying, checking, classifying, filing and arithmetic) has since been devised by the Institute, and published under the title " Clerical Test—Series 25," for the purpose of selecting general office workers for engagement or training (7). This series of tests has found such favour in the United States that, after having been slightly modified for American needs and re-standardized, arrangements are being sought for its publication in America.

This early work on the selection of typists was quickly followed in 1922 by similar research into selection tests for two other common occupations—namely, dressmaking (4) and engineering (5). At that time more girls were leaving London elementary schools to become dressmakers' apprentices than to engage in any other single occupation ; and the problem of devising tests for their selection (and guidance) had not received adequate attention in America or on the Continent. The

Institute's tests were applied first to girls attending dressmaking classes in certain Trade Schools of the London County Council. They proved so successful that they have since been adopted by a well-known London firm, before selecting girls to be sent for preliminary training at these schools.

Equally successful, as judged by the reports of firms who adopted them, and by subsequent development, was the next research (5) carried out by the Institute into devising a battery of suitable selection tests for engineering apprentices. This was conducted in various engineering firms and technical or continuation schools ; the predictions partly based on these tests are still being followed up (11, 56). It served as a useful basis for the later developments of the Institute's selection tests for engineering.

Work for the War Office

An investigation was also begun in 1926 (18) by the Institute (on behalf of the Industrial Fatigue Research Board), at the request of the War Office, into the vocational aptitudes of apprentices at the Army Technical School at Beachley, by means of suitable tests. Here, however, the problem was not one of ordinary selection. The 220 lads under investigation had already been admitted to the School on a purely scholastic examination. They had necessarily to be allocated there to one of four trades—that of the electrician, fitter, carpenter or blacksmith ; total rejection of any boy was rarely possible, however unsuitable he might be. The tests had to be simple, few and short : it was therefore difficult to devise a battery of them really adequate for selecting apprentices for each trade. In the later follow-up work conducted on 125 of the above lads by the Industrial Health Research Board, it proved impossible to determine the value of the tests which had been devised for each of the four trades. For not only the test scores, but also temperamental factors and the results of interviews determined the Institute's vocational recommendations. Moreover in each trade the data were too few for statistically significant conclusions. No opportunity has yet occurred for the case studies of these lads to be worked out in detail individually. But their follow-up by the Board's investigator clearly demonstrated that the Institute's tests afforded a better prediction of practical ability than the scholastic entrance examination.

Later Work

In 1927 the Birmingham Education Committee, on to whose staff a member of the Institute's staff had been seconded, undertook the experiment of applying the Institute's engineering tests (with others devised by Dr. J. W. Cox before he joined the Institute's research staff) to sixty apprentices at a Central Technical College and to fifty-two senior boys at a Junior Day Technical School (27). A striking correspondence was found between the scores of these lads at the tests and their school ranking in apprentice ability ; indeed, when allowance was made for certain temperamental traits which the tests did not take into account, broad agreement between these scores and rankings occurred in over 90 per cent. of the 112 cases.

These early researches of the Institute in vocational selection laid the foundation of the general principles on which its later work in this field was based when tests came to be devised and installed for numerous other occupations at the request of different firms. These include tests for weavers, spinners, solderers, packers, telephone and telegraph operators, post-office counter-clerks, shop assistants, printers, leather-workers, cleaners, dyers, paint-sprayers, etc. They are not considered in this article as coming further under the head of research, once the general underlying principles and methods had been ascertained. The Institute's principles and methods of vocational selection have been described at length in its *Journal* (1926, vol. iii, pp. 147-153, 213-217).

The Selection of Colour Workers

Two other researches, however, in vocational selection may be mentioned because of their unusual interest. The first was an investigation (14)—preceded by a review of relevant literature on the subject (36)—into the discovery of some inexpensive, simple and readily given form of test which would estimate the ability to discriminate very fine differences in shades of colour, such as is required in the dyeing, colour-printing, paper-making and other trades. Enormous individual differences in this ability were found even among experienced employees in colour work ; and a satisfactory test, which was applied to over 200 industrial workers, was ultimately devised. It is noteworthy that a surprising lack of correspondence was observed between the score in

shade discrimination made by a person when tested with one colour and the scores made by him when tested with other colours. Evidence was also obtained of the striking influence of previous experience in colour-shade discrimination and of previous training in scientific methods and in the work of inspection. There could, however, be no doubt of the importance of selecting for training as colour-workers those who were endowed with the keenest discriminative ability.

The Selection of Motor Drivers

The second investigation, begun in 1929, concerned the selection of motor drivers (39). It resulted in a series of tests for speed and accuracy of response, resistance to distraction, distribution of attention, vision, judgment of speed, size and distance, confidence, road-behaviour, etc. The scores made at these tests gave a highly satisfactory correlation with the supervisors' opinions and the recorded accident rates of seven batches of drivers of lorries and similar vehicles on the road. The tests promise not only to be capable of selecting the safest drivers and those most suitable for training as drivers; they appear able to indicate also those faults in a poor driver which may be improved by special training. Two well-known insurance companies have recently offered a substantial reduction in insurance premium to those who have passed these tests of the Institute satisfactorily.

Research on Attention

It seemed likely that an important basis for the selection of persons for certain occupations might be found in the ability of some people to attend to many things at once ('distributed' attention) in contrast to the ability of others to attend wholly to only one thing at a time ('concentrated' attention). Accordingly an investigation (26) was conducted during the years 1927-29 by the Institute, in which various tests of distributed and concentrated attention were applied to seventy-eight elementary school children. The results indicated, somewhat surprisingly, that the *nature* of attention (concentrated or distributed) is less important fundamentally than the *intensity* of attention and the *speed* at which successive acts of attention are demanded. The tests were therefore classified according as they involved (*a*) situations which required either a high intensity of attention or a slow succession of acts

of attention, occurring at a rate within the individual's control, or (b) situations requiring a succession of acts of attention, which were presented at a very rapid rate or, at least, at a rate beyond his control. The results of this latter group of tests showed far less resemblance *inter se* than those of the former, to which a group factor proved to be common. Specific factors, therefore, appear to bulk most largely in situations where rapidly successive acts of attention are required ; and different tests will therefore be needed to meet each such situation.

5. OCCUPATIONAL ANALYSIS

Both Vocational Guidance and Vocational Selection depend for their success not merely on suitable methods of estimating aptitudes and the like, but also on an adequate knowledge of the requirements and working conditions of occupations. (This knowledge is also necessary for vocational training and for other purposes in industrial psychology.) It is obtained mainly by what is termed 'occupational analysis.' At the outset of the Institute's second vocational guidance experiment (*cf.* pp. 6, 7), its investigators visited the factories and offices of the neighbourhood in which the experiment was being conducted, in order to ascertain the nature of, and the qualities required for success in, the occupations which were most likely to be adopted by the elementary schoolchildren who were about to be advised. During the course of this experiment, in 1926, the Institute published a report (12) on occupational analysis, describing the general procedure which should be adopted, with illustrations drawn from various occupations and departments of occupations. Special attention was paid in this report to the different types of manual and bodily skill required in different industrial operations ; to a new method of scientifically recording the basic movements involved in these operations ; and to the relations found between the scores made at the Institute's tests of manual dexterity when classified according to the kind of movements which they involved, and when applied to several groups of students who were being trained for different kinds of skill in junior technical schools.

Some minor investigations into a few specific occupations were later undertaken by the Institute, *e.g.* into the requirements of certain legal clerical occupations (38) and into the psychological make-up of

higher business executives (20). Much additional information has become available from the Institute's various investigations in vocational selection (*cf.* pp. 21-25). Recently three more extensive pieces of research (42, 45, 49) have been separately conducted by the Institute (only one of which is now unfinished) into the occupations of (i) women secretaries, (ii) women nurses, and (iii) women assistant secondary-school teachers. All three have been carried out along the following lines. Detailed questionnaires were prepared and circulated among several thousands of those who had adopted one or other of these occupations. The questionnaires asked for information on such points as the reasons for entering the occupation, the description of the occupation, the education, training and experience obtained, the qualities believed to be required for success in it and for contentment with it, the extent to which these qualities were in the respondent's opinion possessed by her, the degree of and reasons for the satisfaction or dissatisfaction felt in the work, etc.

The replies to these questionnaires afforded, among much other valuable information, 'psychographic profiles' of those who were successful or unsuccessful in their work or were contented or discontented with it. They were supplemented by interviews granted to the investigators by some of those who had replied; it was thus possible to inquire into, and to develop in greater detail, certain answers that had been sent in. The practical value of these investigations for vocational guidance and the need for their extension need hardly be pointed out. For when occupational analyses are prepared by those who have had no psychological training, the lists of qualities required for success in different occupations are apt to bear a strong likeness to one another, and to be couched in vague general terms which have little psychological, specific or practical significance.

6. INDUSTRIAL AND OTHER RESEARCH

The Institute has also been concerned in investigating the relations of certain external and human conditions to occupational efficiency. One of its staff planned and assisted in an inquiry (17) into the effects of ultra-violet rays on the factory worker's output. Here, in order to detect the influence of suggestion, a small control group of workers

was also observed who believed that they were receiving the rays which were in fact screened from them by a glass plate. The results obtained from the 'experimental' group, who were actually submitted to the influence of the rays, showed striking individual differences alike in regard to their output and to their subjective feelings. Some workers felt better after exposure to the rays and their output increased, falling off again after the ray treatment had ceased ; in others no difference was found ; in others the effect of the treatment was deleterious. Similarly striking individual differences were found in a laboratory research (15) into the effects of menstruation on mental and muscular output, conducted for the Industrial Fatigue Research Board by one of its staff and by one of the Institute's staff. In some women output was definitely lowered ; in others the menstrual period produced no change ; in others it increased output. The influence of menstruation did not appear to be generally greater than 'accidental' influences occurring at other times, and it seemed to depend partly on social status. Subsequent investigations on the same subject (35) under factory conditions, slender though they were, appeared to confirm this result. Clearly the discovery of such important individual differences needs to be followed by corresponding individual studies of a bio-chemical nature.

The Influence of Rhythm on Work

The influence of rhythm on occupational movements has also been the subject of research (44) by the Institute. Experimental observations of typewriting showed that on the whole those typists were quickest who adopted, and consistently adhered to, a definite time pattern in their strokes, typing some combinations of letters quickly and others more slowly. Although this rhythmization was in the first place suggested by the varying convenience of different combinations of letters on the keyboard, the important fact was that only certain typists actually followed the rhythm suggested. Those who instead maintained a uniform timing for all their strokes tended to be slower, the difference between the speed of the more rhythmical and that of the less rhythmical of the fifty-six subjects observed being 13 per cent. These results threw some doubt upon the wisdom of training typists, as is commonly done in current practice, to maintain uniformity of timing in their strokes. They suggested the possible value of training learners to type in

rhythmic patterns from the beginning of their course, and methods for carrying out training of this kind have been devised. The Institute's preliminary experiments have shown the practicability of such a course and suggest especially that it makes for greater accuracy in typing.

The principles which hold for rhythm in typewriting are doubtless applicable to other tasks (*e.g.* conveyor-feeding) as well; and it is to be expected that group rhythms and the capacity for such rhythmizing will in time play a greater part than they do at present in the selection and training of workers for many occupations.

The Miner's Lamp

In 1922 an investigation in a coal mine led to a laboratory research (3), conducted by two of the Institute's staff, on the disturbing visual after-images which arose from the use of the miner's standard electric lamp. Comparisons made when the filament was exposed to view, and when the surrounding glass was frosted so as to give a diffused light, suggested important improvements in the lamp. Moreover, the diffusion of the light was found to reduce not only the number and duration of the after-images, but also the liability of the lamp to cast shadows, thus further facilitating working conditions at the coal face. The slight loss in intensity of the light which resulted from its diffusion was found experimentally to have no appreciable effect on visual acuity.

Minor Researches

Many small pieces of research have been incidental to investigations carried out in the factories, mines, offices, etc., of firms which have asked for the Institute's services. Most of these researches have naturally yielded only tentative conclusions which require for their confirmation further work on a far larger scale.

In 1925 an opportunity arose for studying the influence of short time on speed of production (13); the conclusions reached by two investigators of the Industrial Fatigue Research Board in three other industries were confirmed.

In 1926 some useful observations on industrial accidents were made and published (16). From them it appeared that when standardized tests of manual skill and dexterity were introduced to differentiate the poor workers from the good ones, the accident rate for those who failed

to pass the tests was considerably higher than for those who passed the tests, being nearly four times as great in a group of fifty-three young workers. More detailed research along these lines has since been published by the Industrial Health (formerly Fatigue) Research Board.

In the same year another factory investigation drew attention to the needless movements, physical strain and discomfort frequently caused by badly designed machinery, where the psycho-physiological requirements of the machine operator had been neglected (21). Various changes in machine design made by the Institute's investigators led to notable increases in output and comfort, thus confirming a more general report on the subject which was issued in the same year by the Industrial Fatigue Research Board, through its Design of Machinery Sub-Committee, of which the Director of the Institute was secretary.

Among other minor experiments, incidental to the Institute's more general investigations, may be mentioned one carried out in 1931 in the assembly of wireless sets (48). Two inexperienced workers were chosen, who worked in alternate weeks with a complex and with a simpler unit of work. The complex unit consisted in fixing eight wires, the simpler unit in fixing only two or three wires, to each set. Both these and other workers preferred the more complex unit as being more interesting; and, correspondingly, their daily work curves showed evidence of boredom only when working with the simpler unit. Here the speed reached its maximum early in the week and then fell off, whereas with the more complex unit the speed continued to improve throughout each week. It is hence a mistake to attempt to simplify an operation to a point where mistakes can scarcely occur, since a stage is reached when boredom and inattention begin to exercise an adverse influence on the output of work and on its quality. Moreover, as the same investigator had already demonstrated two years previously, in connection with the sorting of blackcurrants in a jam factory, output may easily suffer from the unit of work, when simple, being too large. Here each worker had been supplied with a full tray of fruit: some spent the whole day over a single trayful, others managed to begin a second tray, but only a few completed two trayfuls in the day's work. The apparent endlessness of the task of sorting so large a trayful of fruit was experimentally dispelled by giving each worker only half a trayful at a time. Immediately most of the workers more than doubled their output. Even if improvements in the quality of the fruit (which were not noticeable to the investi-

gator) affected this striking result, there could be no doubt that much of the increased output was due to the reduced size of the unit, and to the consequently greater interest and the many small 'end-spurts' thus arising. The practice of half-trayfuls was henceforth adopted by the foreman; and the results obtained were later confirmed in an independent investigation by the Industrial Fatigue Research Board.

The Problem of Incentives

For many years the problem of incentives had received the Institute's close attention in the course of its investigations. In 1933 a research grant was given to an investigator (54) who had already been engaged, on behalf of the Industrial Health Research Board, in laboratory work on a special aspect of this subject. His laboratory work had demonstrated striking increases in the speed, uniformity and duration of the effects of practice when the worker was daily asked to conform to a certain prescribed standard of improvement, which was based on the level of output previously attained by him. His investigations also led him to believe that by a similar incentive similar, if less striking, improvements, especially in the uniformity of output, might be expected from highly practised workers. These laboratory results received some confirmation by the investigator's work carried out on behalf of the Institute, both in a workshop for the blind and in a factory. But this research revealed the necessity for a close study of individual differences in the effects of this incentive in relation to temperamental differences. The work in the industrial field was therefore temporarily interrupted by its re-transfer to laboratory conditions.

Working Conditions in Agriculture

In conclusion, brief reference is only possible to the research work involved in the application to other occupations of the principles, methods and results which have arisen from the Institute's investigations in the sphere of industry and commerce. In 1926 the Institute supervised an inquiry into the methods of picking and packing fruit and hops and of milking cows. Various improvements were effected or recommended, leading to greater output and to reductions in needless effort and fatigue. Attention was also given to the efficiency of the layout of a number of farms, and recommendations were made as to the desirability of further

inquiries by the industrial psychologist into the relation between farmers and their employees, the vocational guidance and selection of agricultural workers, and other matters. On the publication of this report (19) the Ministry of Agriculture assumed financial responsibility for a further investigation, in the supervision of which the Institute was asked to co-operate.

Working Conditions among the Blind

Reference has been already made (p. 11) to the investigations for the blind carried out on behalf of the National Institute for the Blind. Tests of manual dexterity were applied to the workers with the object of ascertaining the relations between trade, vision, training and age and their manual skill. An inquiry was also made into the processes in industry that are suitable for the blind. Methods of work and layout were studied and improved in certain workshops for the blind. The investigation revealed the economic importance of increasing the number of 'sighted' workers in many of the workshops for employment as supervisors or finishers ; and attention was drawn (by experimental evidence) to the need for introducing co-operative team work in order to overcome the feeling by the blind of their isolation. This investigation led to various further inquiries and recommendations which have since been made by the National Institute for the Blind and by the Ministry of Health.

Working Conditions in Schools

In 1931 the Institute began to apply its industrial experience to conditions of schools (47). Its special aim was to determine the extent to which various types of old and new schools attained the requisite standards of convenience and comfort, especially in regard to layout, equipment, lighting, heating, ventilation and freedom from noise. The handicap on children's development caused by unsuitable school buildings was demonstrated by comparing the sickness records in the older and in the newer schools. Several of the newest schools, however, proved far from satisfactory in important particulars ; and various recommendations were made to Education Authorities by the Institute in order to avoid their repetition. The investigation showed the importance of studying not only (i) the environmental conditions, but also (ii) the mental and physical conditions of the pupils themselves. For instance, the experi-

mental provision, during this investigation, of a suitable breakfast before beginning the morning's work was found to increase to a striking extent the mental and the physical efficiency and the educational progress of pupils whose breakfasts had been adjudged, by the pupil's previous low hand-temperatures, as well as by inquiry, to be inadequate. The widespread economic wastage which must result from either of these two kinds of adverse conditions is sufficiently obvious to need no comment. The investigation has awakened so much interest that it promises rapidly to develop both in intensity and in extent. The Pilgrim Trust has recently made a grant towards its continuation ; and experimental rooms have been erected by one Education Authority, fitted with several forms of heating, in which the Institute's further research can be conducted under controlled conditions.

Domestic Working Conditions

The reduction of fatigue and boredom in domestic work has also been a subject of the Institute's investigations (24). It has involved a study of the best layout and arrangements of various types of houses, the equipment employed, and the most advantageous methods of work. The results have been broadcast by wireless and lectures; and many of the Institute's recommendations are now being adopted.

7. FUTURE OUTLOOK

The foregoing account not only describes what has been done by the Institute, but also indicates the vast field which still awaits research in order to increase the many practical benefits which have already resulted from applying psychological methods to the human factor in occupational life.

No unbiassed person can doubt the better vocational advice which is now obtainable by using such methods. But the qualities required for success in different occupations need far closer and wider analysis, while the tests at present available, and the methods of assessing temperament and character, demand far more study, both on theoretical and on practical lines, if further progress is to be made in improving the reliability and the scientific character of vocational guidance. Even more remains to be done in making similar improvements in regard

to educational guidance—the giving of advice as to what kind or ‘side’ of education the adolescent is best fitted for.

Industrial and commercial concerns which have used the Institute's services in selecting their staff are not less unanimous as to their value. But here again systematic research is needed to increase their reliability ; *ad hoc* investigations carried out at the request of any concern must necessarily conform to the broad lines indicated by previous experience, owing to the risk of failure or delay through the trial of new methods.

Many of the investigations carried out in the factories, mines, offices, etc., of firms which have asked for the Institute's services have revealed problems for detailed research which for similar reasons still await solution. For example, much remains to be learnt in regard to rest pauses—their desirable number and duration, the time at which they should be introduced and the way in which the pauses, and indeed leisure in general, should be spent—and in regard to movement-study, incentives, boredom, etc. Many of such problems require specific research in their application to agriculture, schools and domestic work. Fresh problems needing systematic inquiry have likewise been revealed in the Institute's work on market research and on other problems of distribution which it has recently been asked by an increasing number of industrial and commercial companies to undertake. All such knowledge must prove of ultimate social and economic value to the general community—to the consumer as well as to the worker and to management.

As has been mentioned in the Preface to this Report, *the Institute's research work must almost cease in two years' time, unless financial support for it is forthcoming.*

Benefactors are at liberty to spread their donations over seven years and to lighten their sur-tax by claiming relief from it in respect of such donations. Or with still less detriment to their income, they may make a bequest towards the Institute's research work in their wills. Every reader of this Report is urged to help as he or she best can.

8. CHRONOLOGICAL TABLE OF THE INSTITUTE'S RESEARCH WORK

N.B.—The letters, R., C., D., N.I.B., N.U.T., and H.C., indicate researches which have been financed respectively by grants from the Rockefeller, Carnegie United Kingdom and Carnegie Dunfermline Trusts, from the National Institute for the Blind, the National Union of Teachers, and the Heath Clark Bequest to the Institute. But almost always the Institute's Appeal Fund has been also drawn on to meet their cost.

<i>Reference number</i>	<i>Year</i>	<i>Name of Research Worker</i>	<i>Subject of Research</i>	<i>Year</i>	<i>Published Place</i>
1	1921	C. Burt	Selection Tests for Typists and Shorthand Writers	1922	N.I.I.P. Journal, i, 23-7, 79-81
2	1922	C. Burt	A Verbal Group Test of General Intelligence	1923	N.I.I.P. Group Test of Intelligence : Series 33
3	1922	S. Adams, E. Farmer, A. Stephenson	Visual Acuity and After-images in Coal Mines	1923	N.I.I.P. Journal, i, 173-81
4	1922-3	W. Spielman	Selection Tests for Dress-makers	1923	N.I.I.P. Journal, i, 277-82
5	1922-5	M. Tagg, J. G. Taylor	(R.) Selection Tests for Engineers	1924	N.I.I.P. Journal, ii, 129-33 ;
6	1923-4	C. Burt, W. Spielman and others	First Experiment in Vocational Guidance (Jointly with the Industrial Fatigue Research Board)	1925 1926	ii, 313-23 I.F.R.B. Rep. No. 33, price 4s.
7	1923-4	W. Spielman	Selection Tests for Clerical Workers	1924	N.I.I.P. Clerical Tests : Series 25
8	1924-30	J. Donald, F. M. Earle and others	(C.) Second Experiment in Vocational Guidance	1931	"Methods of Choosing a Career," pp. 334 (Harrap), price 12s. 6d.
9	1924	F. M. Earle	(C.) A Group Test of General Intelligence for Young Children	1925	N.I.I.P. Group Test of Intelligence : Series 34
10	1924-5	F. M. Earle, A. Macrae	(C.) A Test for the Appreciation of Spatial Relations	1926	N.I.I.P. Form Relations Test
11	1925-	F. M. Earle, D. E. R. Hughes, A. Macrae	Vocation Guidance for the Rugby Education Committee and follow-up		To be published later
12	1925-6	F. M. Earle, G. Roberts, M. B. Stott and others	(C.) Occupation Analysis	1926	N.I.I.P. Report No. 1, price 2s.
13	1925	A. Angles, G. H. Miles	The Influence of Short Time on Speed of Production	1925	N.I.I.P. Journal, ii, 300-2

AN ACCOUNT OF THE INSTITUTE'S RESEARCH WORK 35

Reference number	Year	Name of Research Worker	Subject of Research	Published Year	Place
14	1926-33	A. M. Hudson Davies, W. O'D. Pierce, A. Stephenson	(R.) Tests for the Ability to Discriminate Fine Shades of Colour	1934	"The Selection of Colour Workers," pp. 134 (Pitman), price 5s.
15	1926-7	C. S. Myers, S. C. M. Sowton	(R.) Effects of Menstrua- tion on Mental and Muscular Efficiency	1928	I.F.R.B. Rep. No. 45, price 2s. 6d.
16	1926	A. Stephenson	Psychological Factors in Accidents in Industry	1926	N.I.I.P. Journal, iii, 194-200
17	1925-7	R. St. C. Brooke, C. S. Myers, A. Lisle Punch, Russell Wilkinson	(R.) Effects of Ultra-violet Rays on the Efficiency of Factory Workers	1928	N.I.I.P. Journal, iv, 144-52
18	1926	F. M. Earle, D. E. R. Hughes, M. S. Munro	The Vocational Selection of Apprentice Tradesmen for the War Office at the Boys' Technical School, Beachley (conducted for the I.F.R.B.)		Not published
19	1926-7	W. R. Dunlop	(R.) An Investigation of Certain Processes and Conditions on Farms	1927	N.I.I.P. Report No. 2, price 2s.
20	1926-7	Rex Knight	(R.) The Psychological Make-up of Higher Business Executives		Not published
21	1926	A. Angles, G.H. Miles	A Psychological Investi- gation into Machine Design	1926	N.I.I.P. Journal, iii, 159-61
22	1927-8	F. M. Earle, M. Milner and others	(R.) The Use of Perform- ance Tests of Intelligence in Vocational Guidance	1929	I.F.R.B. Report No. 53, price 2s. 6d.
23	1927-9	F. M. Earle, A. Macrae and others	(R.) Tests of Mechanical Ability	1929	N.I.I.P. Report No. 3, price 3s. 6d.
24	1927-	W. Spielman Raphael	The Reduction of Fatigue and Boredom and the Increase of Efficiency in House Work		To be published later
25	1927-9	F. M. Earle, F. Gaw and others	(R.) The Measurement of Manual Dexterities	1930	N.I.I.P. Report No. 4, price 5s.
26	1927-9	F. M. Earle	(R.) Tests of Distributed Attention	1931	B. Jl. of Psychol., xxi, 215-41
27	1927-9	E. P. Allen (with P. Smith)	The Selection of Skilled Apprentices for the Engineering Trades	1931	Report of City of Birmingham Education Committee, price 1s.

36 AN ACCOUNT OF THE INSTITUTE'S RESEARCH WORK

Reference number	Year	Name of Research Worker	Subject of Research	Year	Published Place
28	1927-31	E. P. Allen (with P. Smith)	Third Experiment in Vocational Guidance. The Value of Vocational Tests as aids to Choice of Employment	1932	Report of City of Birmingham Education Committee, price 1s.
29	1927-31	C. B. Fox, A. H. Seymour	(N.I.B. and R.) Industrial Psychology Applied to the Blind	1931	N.I.I.P. Journal, iv, 389-90; v, 334-43
30	1928-34	J. Donald, F. M. Earle, J. Kilgour	(C. and R.) Fourth (Fife) Experiment in Vocational Guidance		N.I.I.P. Report No. 6 (in the press)
31	1928	W. Saunderson	(R.) Tests for Temperament and Character Traits		Not published
32	1928-32	S. Bevington	(R.) Influence of Psychological, Economic and Social Factors on Boys' Choice of Career	1933	"Occupational Misfits," pp. 102 (Allen & Unwin), price 6s.
33	1928-9	J. T. Wisdom	(R.) Tests for Calmness under Pressure and Self-reliance		Not published
34	1928-33	J. W. Cox	The Nature and Measurement of the Mental Abilities involved in Factory Assembly Operations	1934	"Manual Skill: its Organization and Development," pp. vii + 242 (Cambridge University Press), price 16s.
35	1929-30	C. A. Oakley	(R.) Extent and Causes of Daily Fluctuations in Industrial Efficiency		Not published
36	1929-32	W. O'D. Pierce, M. Walton	(R.) Review of Recent Experimental Work on Colour Vision	1933	Medical Research Council, Special Report Series No. 181, price 2s.
37	1929-31	J. W. Pinard	(R.) The Influence of Perseveration	1932	B. Jl. of Psychol., xxiii, 5-19, 114-26
38	1929	C. Howick	Occupational Analysis for Solicitors' Clerks		Not published
39	1929-33	G. H. Miles, D. F. Vincent	(R.) Preparation of Tests of Motor Driving Ability	1934	N.I.I.P. Journal, viii, 245-257
40	1929-34	T. A. Rodger	A Borstal Experiment in Vocational Guidance	1933	B. Jl. Ed. Psychol., iii, 127-41 (interim report)
41	1930-2	A. Macrae	A Follow-up of Cases Vocationally Guided by the Institute	1931	N.I.I.P. Journal, v, 242-7;
				1932	vi, 42-52;
				1933	vii, 41-50

AN ACCOUNT OF THE INSTITUTE'S RESEARCH WORK 37

Reference number	Year	Name of Research Worker	Subject of Research	Published Year	Place
42	1930-4	M. B. Stott	(R.) Occupational Analysis for Secretaries		To be published shortly
43	1930-1	M. Milner	Social Ability		Not published
44	1930-	D. W. Harding	Rhythm in Motor Activity	1931	(Interim report) N.I.I.P. Journal, v, 434-41
				1933	B. Jl. of Psychol., xxiii, 262-78
45	1931-	A. A. Frankford	(R.) Occupational Analysis for Nurses		To be published shortly
46	1931-	M. Milner, T. A. Rodger	(R.) Assessment and Analysis of Temperament and Character Traits	1933	To be published later
			N.I.I.P. Guidance material		
47	1931-	A. H. Seymour	(N.U.T.) A Study of School Equipment, Layout and Environment		To be published shortly
48	1931	D. W. Harding	The Sub-division of Assembly Work	1931	N.I.I.P. Journal, v, 261-4
49	1932-	M. Birkenshaw	(H.C.) Occupational Analysis for Women Teachers		To be published shortly
50	1932-3	B. Babington Smith	(R.) The Influence of Perseveration on Mental Abilities and Temperamental Qualities		To be published later
51	1934-	B. Babington Smith	(R.) A New Form of Intelligence Test		To be published shortly
52	1933-	J. W. Cox	Improved Tests of Manual Mechanical Abilities		To be published shortly
53	1933-4	W. P. Alexander	(R.) Elementary Factors in General and Special Abilities		To be published shortly
54	1933-	J. W. Taylor	(R.) Factors Contributing to the Forms of Work and Practice Curves		To be published shortly
55	1933-	A. Haas	(H.C. and R.) Tests for Educational Guidance		To be published shortly
56	1934	M. Tagg	A Follow-up of Selected Engineering Apprentices		To be published later

Officers and Council

PRESIDENT

The Right Hon. Lord Macmillan, P.C., K.C., LL.D.

VICE-PRESIDENTS

The Right Hon. Viscount D'Abernon, G.C.B., G.C.M.G.

Sir Frederick G. Hopkins, D.Sc., LL.D., F.R.S.

The Right Hon. Lord Rutherford, O.M., D.Sc., F.R.S.

Sir Charles Sherrington, O.M., G.B.E., M.D., F.R.S.

Sir Josiah Stamp, G.B.E., SC.D.

Henry J. Welch.

CHAIRMAN: Sir Robert Witt, C.B.E., D.LIT., F.S.A.

VICE-CHAIRMAN: Sir John Mann, K.B.E.

PRINCIPAL: Charles S. Myers, C.B.E., M.D., SC.D., F.R.S.

DIRECTOR: George H. Miles, D.Sc.

Council and Technical Advisory Board.

The Rt. Hon. Lord Askwith, K.C.B., K.C.,
D.C.L.

*†F. Aveling, M.C., PH.D., D.Sc., D.LIT.

†The Lady Ruth Balfour.

*P. B. Ballard, M.A., D.LITT.

Sir Thomas Barlow, K.B.E.

*F. C. Bartlett, M.A., F.R.S.

*Sir William Beveridge, K.C.B., D.Sc., LL.D.

Sir Steven Bilsland, Bart., M.C., J.P.

Sir Basil Blackett, K.C.B., K.C.S.I.

Sir Harold Bowden, Bart., G.B.E.

*William Brown, M.D., D.Sc., F.R.C.P.

*†Cyril Burt, M.A., D.Sc.

†E. S. Byng.

*E. P. Cathcart, M.D., D.Sc., F.R.S.

W. M. Citrine.

†D. A. Coles, M.D.

*Edgar L. Collis, M.D., M.R.C.P.

†Mrs. J. S. Courtauld.

*Winifred C. Cullis, C.B.E., D.Sc.

*Sir Henry Dale, C.B.E., M.A., M.D., SEC.R.S.

*E. Salter Davies, C.B.E., M.A.

Sir Ernest R. Debenham, Bart.

*James Drever, M.A., B.Sc., D.PHIL.

†Norman W. Duthie, C.A.

The Rt. Hon. Lord Ebbisham, G.B.E.

*Beatrice Edgell, M.A., PH.D., D.LITT.

A. P. M. Fleming, C.B.E., M.Sc., M.I.E.E.

*G. H. Gater, C.M.G., M.A.

*Sir Richard Gregory, Bart., D.Sc., LL.D., F.R.S.

Sir Robert Hadfield, Bart., SC.D., F.R.S.

R. C. Hazell, J.P.

*Sir Henry Head, M.D., F.R.S.

W. L. Hichens.

*A. V. Hill, SC.D., F.R.S.

*Sir Leonard Hill, M.B., F.R.S.

Frank Hodges, J.P.

*P. D. Innes, M.A., D.Sc.

*Technical Advisory Board.

*†D. T. John.

*Lt. Wynn Jones, M.A., PH.D.

†Lt.-Col. Sir John Keane, Bart., D.S.O., D.L.

C. W. Kimmins, M.A., D.Sc.

The Rt. Hon. Lord Kirkley.

Sir Kenneth Lee, LL.D.

J. Spedan Lewis.

*C. A. Mace, M.A.

J. J. Mallon, M.A., LL.D.

Loris E. Mather.

The Rt. Hon. Lord Melchett.

*E. Mellanby, F.R.S., F.R.C.P., M.A., M.D.

Geo. A. Mitchell, M.A., J.P.

Sir Evelyn Murray, K.C.B.

*Sir T. Percy Nunn, M.A., D.Sc.

*Sir John Parsons, C.B.E., D.Sc., F.R.S.

S. W. Pascall, J.P.

*T. H. Pear, M.A., B.Sc.

†W. Percy, C.B.E., B.Sc.

A. Pugh, C.B.E., J.P.

Sir Richard Redmayne, K.C.B., M.Sc., M.I.C.E.

†B. Seeböhm Rowntree, C.H., J.P.

†Julius Salmon.

*E. G. Savage, B.A.

*F. H. Spencer, D.Sc.

*G. H. Thomson, PH.D., D.Sc.

*R. H. Thouless, M.A., PH.D.

H. T. Tizard, C.B., F.R.S.

S. C. Turner, F.C.I.I.

†John Urie, O.B.E., C.A.

*C. W. Valentine, M.A., D.PHIL.

*H. M. Vernon, M.A., M.D.

A. B. Waring.

†Alan F. Welch.

Lt.-Col. Sir Arnold Wilson, K.C.I.E., C.S.I., C.M.G.,

M.P.

D. R. Wilson, C.B.E., M.A.

Sir Harold E. Yarrow, Bart., C.B.E.

†Executive Committee.

SECRETARY: C. B. Frisby, B.COM.

HON. AUDITORS

Messrs. Mann, Judd, Gordon & Co.

HON. SOLICITORS

Messrs. Stephenson, Harwood & Tatham

SCOTTISH DIVISION

142, St. Vincent St., Glasgow, C.2.

CHAIRMAN: John Urie, O.B.E., C.A.

DIRECTOR: C. A. Oakley, B.Sc., ED.B.

SECRETARY: E. H. Harris.

