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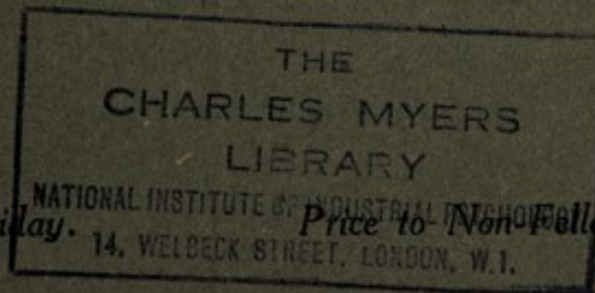
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FRIDAY, MARCH 21, 1924.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C. (2)

NOTICES.

NEXT WEEK.

MONDAY, MARCH 24th, at 8 p.m. (Cobb Lecture). DR. T. SLATER PRICE, Director of Research, British Photographic Research Association, "Certain Fundamental Problems in Photography." (Lecture I.)

WEDNESDAY, MARCH 26th, at 8 p.m. (Ordinary Meeting.) Neal Green, "The Fishing Industry and Its By-Products," Professor E. W. Macbride, D.Sc., F.R.S., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

FOURTEENTH ORDINARY MEETING.

WEDNESDAY, MARCH 12TH, 1924; Sir HERBERT JACKSON, K.B.E., F.R.S., in the Chair.

The following candidates were proposed for election as Fellows of the Society:—
Campbell, Andrew, Beckenham, Kent.
Sharp, Mrs. Katharine Dooris, London, Ohio, U.S.A.
Williams, Professor Clement Clarence, Urbana, Illinois, U.S.A.

The following candidates were duly elected Fellows of the Society:—

Bruce, Oswald B., Weston-super-Mare.
Haunz, Charles F., M.Am.Chem.S., Buffalo, New York, U.S.A.

Howgrave, Arthur Atherfold, London.
Porro, Thomas Joseph, Tacoma, Washington, U.S.A.
Shallenberger, Professor Garvin Dennis, Montana, U.S.A.

Vaid, Bakhshi Dina Nath, Rawal Pindi, India.

A lecture on "Personal Recollections of Some Notable Scientific Men" was delivered by Mr. ALAN A. CAMPBELL SWINTON, F.R.S., late Chairman of Council.

PROCEEDINGS OF THE SOCIETY.

TWELFTH ORDINARY MEETING.

WEDNESDAY, FEBRUARY 27TH, 1924.

SIR ROBERT BLAIR, LL.D.

(Education Officer, London County Council), in the Chair.

THE CHAIRMAN, in introducing the lecturer, said Dr. Myers was now recognised, both in this country and abroad, as the leading psychologist

in Great Britain. He was at one time Professor of Psychology at King's College, London; and, later, Lecturer in Experimental Psychology at Cambridge. At Cambridge his initiative and generosity secured the building and equipment of the new Psychological Laboratory; and for some time he was its director.

During the War he became Consulting Psychologist to the British Expeditionary Force, serving as a lieutenant-colonel in the R.A.M.C. The War turned his interest and attention from problems of pure or abstract psychology to its more practical applications, particularly in medicine and industry. On the conclusion of the war, by enlisting the interest and support of eminent men of business and science in the new possibilities of psychological methods, he founded the National Institute of Industrial Psychology, and shortly afterwards gave up his post at Cambridge to become the Director of that Institute. As its Director, and as a member of the Industrial Fatigue Research Board (a Government Department under the Privy Council) he had organised and assisted in many investigations in industrial psychology. Research students and psychological investigators, working under his guidance, had carried out numerous fruitful experiments and enquiries in large firms throughout various parts of the country, and, more recently, in trade and other schools in London and elsewhere. He had of late become especially interested in the possibility of vocational guidance for children leaving schools; and last January obtained from the Carnegie Trustees a grant of £6,000 for carrying out an experimental investigation into the practicability of such a scheme.

The following paper was read:—

THE USE OF VOCATIONAL TESTS IN THE SELECTION OF A VOCATION.

By CHARLES S. MYERS, C.B.E., M.D.,
Sc.D., F.R.S.,

Director of the National Institute of Industrial Psychology.

By "vocational guidance" is meant the advice given to the worker, based on systematic examination of his mental and bodily condition, as to the occupations for which he is fitted and unfitted. "Vocational selection," on the other hand, is the process of choosing, by such examination, those workers best fitted for the vacancies in

any one occupation. That is to say, vocational guidance aims at finding the best job for the particular worker, whereas in vocational selection we select the best worker for the particular job. Vocational guidance rests on the assumption that of all occupations some are better suited than others to the mentality and physique of any worker; vocational selection assumes that some workers are better fitted than others to any particular job. No one will deny the truth of these assumptions; the only question at issue is the best means of acting upon them.

Until recently, vocational guidance has been left almost wholly to the individual and his family. The young worker, choosing his life's work, may be influenced by his own interests and desires. A love of adventure may prompt him to go to sea; an instinct for self-display to go on the stage; the ambition to rise in the social scale may lead him to take up office instead of artisan work. Or he may be influenced by similar aspirations on the part of his parents, by their desire that he shall follow his parent's occupation, or shall avail himself of the special influence expected of some relation or friend in a particular vocation. The result is too often disastrous. Because a boy or girl has certain interests or desires in relation to a given occupation, it by no means necessarily follows that he will do well at it. The interests or desires may be confined to a very insignificant aspect of his future work. Thus the love of adventure will not make a good seaman; nor will the desire for self-display make a good dancer or actress. So too, a strongly developed instinct of protection and the emotion of tenderness associated therewith will not suffice for success in nursing, medicine or agriculture; and far more than a strongly developed instinct of constructiveness is necessary to make an efficient engineer. Owing to his natural desires and ambitions, the parent's opinion as to the best vocation for his child is notoriously unreliable; he is apt to be singularly blind to the most obvious signs when they point to a career opposed to his own inclinations.

Of late years, school committees have been voluntarily formed for the purpose; the teacher's knowledge of the child has been invoked; and juvenile labour advisory committees have been established. But until quite recently, none of the work has

been conducted in a systematic, scientific fashion. The teachers' reports have not proved sufficiently helpful. Nor has vocational guidance, merely based on interview, proved adequate.

The method of interview has until lately been practically the sole basis of vocational selection. A certain number of vacancies occur in a factory. A larger number of employees apply for them. Recommendations from past employers or reports from the candidate's school may be taken into account, but selection and allotment to different occupations within the factory is commonly based on the results of a brief interview. Thereafter, the engaged employee, if found unsuited for his work and undischarged, is wafted from one department to another, on the principle of trial and error, until he finds work at which he proves successful. Let me at the outset emphasize the fact that I do not for one moment suggest the abolition of the interview. It supplies information which, at present at least, can be adequately obtained in no other way. It affords an excellent idea—and by systematic study of the possibilities of the interview, if scientifically conducted, it can doubtless afford even a *more* excellent idea—of the personality of the candidate, his bearing, address and speech, his honesty, loyalty, leadership, etc. But for successful selection we need far more detailed information than this; and this information is only obtainable by special methods of examination, which must be added to the method of interview. These methods involve medical, physiological and psychological examination of the candidate and are already being applied, as we shall see, by some of the more progressive firms. In a rough way, they have already been applied in the case of certain occupations. The soldier is examined for his eyesight, the sailor and the engine driver for his colour vision, a certain standard of physique is required by the army, navy and air force, and of health in certain occupations. But we need to go much further than this. A large number of tests to which I will later allude are now available, by which we can arrive at an estimate of intelligence, memory, attention in its various forms, the strength, speed, precision, dexterity and control of movement, etc. And a large amount of information can be obtained, both from observation of the candidate's behaviour at

the tests, and from questions to the candidate by the examiner, as to other important qualities which are not, at present at least, capable of measurement or submissible to experiment. For this and even more cogent reasons, many of the tests must be applied, or at least their application must be supervised by a properly trained person. The present practice of entrusting colour-blindness tests to examiners untrained in the psychology and physiology of the subject is apt to be at times unsatisfactory. How much more so must it be in testing for other characters far more complex, more intricate and less susceptible of simple, direct measurement. In a very rough way, general intelligence, memory and the like can be determined by the untrained applying standardised tests to groups of subjects, but injustice may be done in individual exceptional cases. Would an engineer place any confidence in the results of a test of brake horse-power carried out by a psychologist or physiologist? How much more unreliable must psychological and physiological tests prove, when carried out by an engineer! Yet this is what educational and industrial authorities are always demanding,—a series of mental and physical tests which can be safely applied without expert supervision, by those untrained in psychology and physiology.

I need hardly lay stress on the immense importance of utilising the best means at our disposal in vocational guidance and vocational selection. What a wastage of time, money and happiness arises from the "round peg" trying to fit the "square hole," and passing by trial and error through a variety of different holes, until at length a hole is found which the peg fits! The employee becomes discontented and dispirited; the employer wastes time and expense in training the employee to work at which he will never do well. If a man is fitted to his work, not only is he happier and more efficient at it, but his health is better, and the sickness records of the factory are immensely improved. Moreover, the enormous wastage at present going on, through workers leaving because they are unfitted for and hence dissatisfied with their job, becomes enormously reduced. It has been truly said that the number of firms in this country who keep a really reliable record of the actual costing of their manufactures is extremely small. Still

smaller is the number of those who know the amount of their annual labour turnover and endeavour to estimate satisfactorily and to remedy its various causes,—one of the most potent of which is unsuitability for the job.

The value of systematic vocational guidance at the school-leaving age, and of vocational selection at the factory and office, is fast becoming recognised abroad. In Barcelona, there exists an Institute of Vocational Orientation, supported with an annual grant of about £1,400 from the city and the province, to which boys and girls leaving school are encouraged to apply for a medical, anthropometric, physiological and psychological examination. Students of the Barcelona Municipal Polytechnic are compelled to be examined at the Institute, if they are not making satisfactory progress at their work. In the medico-anthropometric department, measurements are taken of the head, chest, stature, weight, respiratory capacity, visual and auditory acuity; the condition of the digestive, circulatory, excretory systems, etc., is also examined. In the psychometric department tests are applied to determine the intelligence, judgment, memory, attention, imagery, emotionality, speed of reaction, etc., of the subject, and information is sought as to the candidate's interests, ideals, defects, etc. The Institute co-operates with various local Unions or Federations of employees and employers, and has examined into the social and economic condition of about fifty different occupations, including the special physical and mental requirements of each. There are four departments of the Institute, each with a paid qualified expert, and with younger unpaid assistants.

Greater Brussels possesses a rate-supported Inter-communal Bureau for the vocational guidance and apprenticeship of young people. The separate Communes of Brussels are also establishing (three have already been opened) their own Vocational Guidance Bureaux, equipped with the services of medical, psychological and educational experts, who work under the ægis of the Inter-communal Bureau.

In Tokio, a section of the Japanese Association for the Promotion of Industrial Harmony, to which the Government has contributed one-third of its endowment of £800,000, has been established, which is concerned with research in industrial

psychology, the provision of training courses for factory managers, the investigation of factory problems, including those of vocational selection, movement and fatigue-study.

Berlin, of course, has its Institute of Vocational Psychology, now a branch of the Institute of Applied Psychology there, and has devised methods of testing compositors, telegraphists and skilled metal workers.

Geneva has its Institut Rousseau, Paris its Institut Lannelongue, Prague its Academy of Labour, all devoted *inter alia* to the problems of vocational psychology.

In the United States, training in vocational psychology is carried out in most of the Universities, the Carnegie Institute of Technology contains a Division of Co-operative Research, in which is included a Bureau of Personnel Research, financially maintained by a group of industrial and commercial firms who obtain and exchange information relating to the selection, training, organisation and supervision of personnel. Indeed, so numerous are the bodies undertaking research and applying it in regard to vocational psychology, that the United States National Research Council has recently organised a Personnel Research Federation, with the objects of creating a clearing house for information on the subject, of avoiding needless overlap by better co-ordination, and of undertaking hitherto neglected advanced research.

Some form of psychological test is applied to their employees by over thirty firms in the United States. In Germany such tests are used by the Allgemeine Elektrizität Gesellschaft, the Siemens and Halske and Osram Companies, the Great Berlin Tramcar Company, the German State Railways, the Post Office, etc. All these concerns have installed psychological laboratories in which vocational tests are conducted.

Germany indeed makes no secret of her aspirations, that by concentrating on the human problems of industry and commerce she may attain that success in the present century which she won in the past century by devotion to the mechanical aspects of the subject.

Let us now turn to the methods of vocational testing. They are broadly three in number. The first may be called the method of 'sample' tests. These are to be found among the tests contained in the following illustration, devised for

shorthand and typewriting for the National Institute of Industrial Psychology by Dr. Cyril Burt. He begins with four tests which form part of a scheme of tests of general intelligence, namely, opposites and synonyms, analogies, mixed sentences, and completions.

I may here note that such tests of general intelligence are proving of the greatest practical value. They were employed in the war by the United States Army, where they were applied to over 1,700,000 soldiers, including about 42,000 commissioned officers, for the selection of non-commissioned and commissioned officers and of men for special duties, for the rejection of the mentally unfit, etc. They are now employed to determine the entrance of students at several American Universities, and in certain examinations in our own Civil Service. They are found to be useful in vocational guidance and selection so as to secure the proper standard of intelligence which experience finds to be requisite for different occupations; too high an intelligence in a given occupation often leading to as great inefficiency as too low an intelligence, owing to the tedium and unrest thereby produced. The National Institute of Industrial Psychology has standardised a series of tests for general intelligence, which are being introduced at their request into several of the more progressive firms in this country. The preparation of a series of performance tests, specially adapted for manual rather than for clerical and literary work, is also well advanced.

In the opposites and synonyms test, a list of pairs of words is presented to the candidate, who is instructed to indicate by a mark against each pair, whether they are opposite in meaning or are identical; in the analogies test, he has to underline a fourth word among those given bearing the same relation to the third as the second bears to the first, *e.g.*, cat; kitten as dog; bitch, puppy, hound; in the mixed sentences test a series of short sentences is given, with the words in each sentence arranged in disorder, of which the candidate has to make sense, stating whether it is true or false; in the completion test, a prose passage is given with various words omitted, which the candidate has to supply. A certain time-limit is fixed for each test, which is insufficient for the most intelligent candidate to complete the whole of it. This intelligence test is followed by a test

of arithmetic and by one of spelling, in which a list of difficult words is given, some of which are misspelt, which the candidate has to correct where he thinks necessary. Then come two linguistic tests (i) of synonyms, (ii) of definitions. Finally the candidate is submitted to two 'sample' tests, to present which I have made use of this example. Sample tests are so called because they involve work which is a sample of that which the candidate will be subsequently engaged in his occupation. The first of these sample tests is for shorthand. Six passages are read out to the subject at different prescribed rates,—60, 80, 100, 120, and 140 words per minute being successively read to him. Then a series of unusual words of graded difficulty, exemplifying important principles in shorthand, is given to him, which he has to express in proper shorthand outlines and transcribe back into longhand, no time limit being provided. The second series of sample tests is for type-writing. Five tests are employed,—(1) for speed (a) with time limit and (b) with amount limit, (2) for accuracy, copying a much corrected manuscript, (3) for display, (4) for tabulation of a complicated list of data, (5) for manuscript reading of two very illegible letters. The entire test lasts two hours, and has been found in practice to correlate highly with the opinions of the supervisors of the clerks. That is to say, when the ranking of the subjects according to their success in these tests is compared with their ranking according to the views of their supervisor, there is a very close correspondence. The tests also allow of the preparation of a list of minimal standards which a candidate must obtain, according as (1) he is needed for work of a high order of intelligence, (2) he is required only for routine work, (3) information is desired as to whether after adequate training he is likely to be fit for practical work, or is unfitted for any work whatever in shorthand and typewriting.

The second method of vocational testing involves the employment not of 'sample' tests, but of 'analogous' tests. Thus, in order to examine workers to be engaged on feeding machines, Link devised a gramophone box on the circular horizontal disc of which he placed a larger metal disc, presenting a small sector which was cut out and the size of which could be varied. This open sector when it passed over a certain spot below would allow of a shot

dropped to pass through it into a stationary receptacle beneath. When the disc revolved the candidate had to drop the shot at a precise moment so that the ball fell through the slit into the receptacle. Link found that some workers did better with a slow rate of rotation, whereas others did better with a quick rate; and that this corresponded to their varying industrial efficiency with slow or fast-moving machines which they had to feed. The same individual differences in optimum rhythm of movement were noted in our munition factories during the war, some workers succeeding better with fast, than with slower machines, and others vice versa.

The third method of vocational testing attempts to analyse the various qualities required for success in a given occupation and to test each of these qualities separately, instead of employing the complex 'sample' or 'analogous' tests of the two methods previously described. As an illustration of this method, I will describe an examination of 28 telephone exchange girls by Fonteigne of Strasburg. The tests which he finally selected were those for memory of numbers and names, for accuracy of aim, for speed of reaction, for speed and accuracy of cancellation of given letters wherever they occur in a given sheet of printed words, and for speed and accuracy of card-sorting. I omit for the moment the unsatisfactory results of seven subjects. The remainder correlated very highly in order of success at the tests with the order independently ascribed by the telephone supervisor. I present successively the tests-order and the supervisor's order of ranking. Where two girls, say the 9th and 10th are equal in the tests, they are each given an intermediate rank, 9.5.

1	2	3	5	8	9	10	11	12	13
3	2	1	4	5	8	13	7	12	9.5
14	15	19	20	21	22	23	25	26	27
14	11	16	23	19.5	26	21	22	19.5	25

In such an occupation as telephone-exchange work in which breakdowns are frequent from the strain involved, it is obvious that much suffering could be saved by some such carefully devised methods of selection whereby the unsuited are eliminated at the outset of their career. We are able to measure the correspondence between the ranking by tests and the official ranking by means of a formula giving a co-efficient of correlation. This

co-efficient is zero when there is a total absence of correlation; it is $+1$ when the direct correlation is perfect; and it is -1 when the correlation is inversely perfect, *i.e.*, when the top individual in the one ranking is last in the other, and so on. Between 0 and $+$ or -1 the correlation co-efficient has any value, expressed as a decimal fraction, according to the degree of correlation, direct or inverse. The co-efficient in the above tests for telephone operators was $+0.698$, in Mr. Burt's tests for clerical workers it was $+0.7$.

A few of the telephone operators, as I have said, showed poor correspondence between their ranking according to the tests and according to their supervisor's opinion. Several causes may be responsible for this. The supervisor may have been wrong in his opinion; I shall presently instance a striking illustration of such an error. Or the tests may have been inadequate; there can be no doubt that they are capable of improvement. General intelligence, too, must play some part in telephone exchange work. How important a part remains to be ascertained; but a highly intelligent individual may be able by round-about ways to compensate at her work for deficiency in one or more of the abilities which are determined by these different tests. It will be recalled that some tests, highly correlated with general intelligence, were included in the examination; whereas others, accuracy of aim and speed of reaction, are not correlated with general intelligence. Again, each of the tests is given the same weight in determining the final rank of the operator. But more careful research will certainly discover that some traits are more important for telephone work than others. Consequently instead of determining the final ranking by averaging the ranks in each test, certain tests will need to be "weighted," thus allowing of greater importance being given to them than to others, in the settlement of the final order based on the results of all the tests. Further, the tests need to be supplemented by others, such as the ability to interpret indistinctly heard words. In testing for visual acuity by means of letters, it is found that some subjects are ready to interpret the vague indications suggested by letters really imperfectly seen, whereas others stolidly read only the letters which are clearly visible. So it is with the discrimination of two near

points simultaneously applied to the skin. There is a type of person ready to interpret suggested signs, and another type indisposed to do so. Anyone who has ever heard a foreign language through the telephone will realise the importance of the interpretation of indistinctly heard sounds for the most successful telephone exchange work. Moreover, the supervisor may base his opinion of the operators on such factors as obedience, punctuality, patience and courtesy, which the tests fail to take into account, or may be more or less unconsciously prejudiced in favour of or against some particular operator. Indeed, the marvel is that in all these circumstances the co-efficient of correlation should be so high. But we have not yet considered one important factor, which may affect the degree of correspondence in the two ranks,—the factor of interest. One of the seven operators whose ranking differed strikingly in the tests from that of the supervisor, did very well in the tests, but was comparatively low in the supervisor's order of ranking. The latter, when her attention was called to the fact, said, "Well, I am not a bit surprised. The girl could make an excellent telephonist if she only chose."

In its experience in this country, the National Institute of Industrial Psychology has met with similar instances. In one case, the tests devised for the selection of packers gave much better correlation co-efficients when they were correlated with the results of a special speed test of packing applied to the girls, than when they were correlated with the girls' average output as determined by their piece-rate earnings. Nevertheless, this firm estimates that the introduction of vocational tests into its factory has saved it at least £5,000 per annum.

On the other hand, there were one or two cases among the telephone operators, where girls who did poorly at the tests were ranked high by their supervisor. Doubtless this is in part explained by a lack of interest in the tests or a failure to do well under experimental conditions.

In this country, the National Institute of Industrial Psychology has devised a series of tests for dress-making, which are being successfully applied to the selection of apprentices in one of the largest firms in London. Ten tests are applied simultaneously to a group of 24 girls, taking 55 minutes for this application. They

include speed tests in knotting, threading and pricking, tests for good quality of work in the perception of parallel lines, bisecting lines, co-ordinating eye with hand movement, in lightness of touch, and tests of observation and memory.

The present value of the science may be judged by the following illustrations. A selection had to be made among apprentice tool-makers and machinists, of those best fitted for a course of intensive training. The foreman ranked these lads twice, first according to his original estimate of their abilities and later according to a final estimate of them after several weeks of close intimacy during the period of their training. Meanwhile Link applied to the chosen apprentices a series of three tests,—(1) the 'cube' test, in which a large cube had to be built up as quickly as possible from a number of smaller cube-bricks, one or more sides of which were painted in a given colour, so that all four sides of the larger cube were so coloured. (2) The Stenquist test, in which the time was recorded for assembling a series of simple mechanisms, such as a lock, a bell, etc.; a 'form-board' test, in which wooden pieces of different shape had to be fitted as quickly as possible into a board from which gaps of exactly corresponding size had been removed. Now the combined ranking obtained from these tests corresponded very indifferently with the *original* ranking by the foreman, but it corresponded very closely indeed with the *later* ranking by the foreman after he had had several weeks' experience in instructing his apprentices. The correlation between the tests and the foreman's first ranking was only .28, whereas between the tests and his second ranking it reached .9, perfect correlation being, it will be remembered, unity. Here are individual examples of the discrepancy between the foreman's two rankings and of the successful ranking by the tests.—A pleasant willing youth, first ranked by the foreman as fourth, but later as ninth, came out ninth in the tests; an overgrown, 'slipshod,' dreamy-looking youth, first ranked by the foreman as tenth, but later as fifth, came out 1st, 2nd and 5th in the three tests, respectively; a third apprentice, ranked first as eighth, later as fourth by the foreman, came out fourth in the tests; yet another apprentice, ranked successively as fifth and twelfth by the foreman, came out eleventh in the

tests. It may be argued that this particular foreman happened to be exceptionally ignorant, at the start, of the abilities of the apprentices under his charge; but for my own part I suspect that such ignorance is far from uncommon, and I prefer to stress the great help which can clearly be rendered by systematic tests towards selecting the ablest candidates for a given job.

The National Institute of Industrial Psychology has recently devised a series of engineering vocational tests, which has already been applied in a large firm with the object of determining which of 12 branches of the trade each of 250 apprentices is best-fitted or unfitted to pass through. The series includes tests of general intelligence and of spatial judgment (size and shape), motor ability, manipulation and assembly. In the hands of a trained investigator these tests also serve to estimate certain important traits of character, such as impatience, thoroughness, systematic methods of work, etc. Questions bearing on the home and school life and the interests and experience of the apprentice are also asked. Other engineering firms are introducing these tests, realising the saving in time and the gain in efficiency that result from their use.

In his research, for the Industrial Fatigue Research Board, into the qualities and tests required for compositors, Muscio obtained co-efficients of .71 and .80 respectively in the correlation between the ranking by ten tests and by the management in two printing establishments. The tests he employed were—(1) a 'cancellation' test, involving attention, fatigue and speed of action, at which the compositor was engaged for two minutes in cancelling every successive *e* in pages of meaningless French matter submitted to him; (2) a 'substitution' test involving, in addition, memory, in which different numbers had to be pencilled within a series of different geometrical figures according to instructions given at the top of the page submitted to him, *e.g.*, within every circle the number 1 had to be placed, within every triangle the number 2, within every star the number 3, and so on; (3) a 'directions' test of general intelligence, in which the subject had successively to carry out as many different instructions as possible within a given time; (4) a 'match-board' test of dexterity, comprising two tests each

lasting 30", the board being placed in the first at arm's length, in the second much closer to the body, and the subject having to insert into the holes on the board as many matches as possible within the time given. Owing to difficulties in scoring, Muscio had to omit a valuable form board test, in which wedge-shaped blocks, resembling the 'quoins' used by compositors to fill spaces in the compositors' 'case,' had to be inserted into a board from which spaces of corresponding size and form had been cut. Muscio determined by the method of partial correlation the extent to which these different tests involved the same capacities, calculating the correlations between the tests themselves as well as between each test and the composing efficiency. He was thus able to weight the importance of the various tests and to reach the already-mentioned results, which are indeed remarkable seeing that composing efficiency, *i.e.*, the ranking by the management, depends also on such here untested factors as trade knowledge, honesty, duty, interest, ambition, etc.

We have yet to discover the relative values of the three methods of procedure in vocational testing,—by sample tests, by analogous tests, and by tests for specific abilities determined by analysis of the occupation. In regard to tests for motor abilities we have evidence of very low correlation between them, whereas the tests for general intelligence correlate highly with one another. It is doubtless a useful hypothesis to assume that there are a few general abilities, several group abilities, and many specific abilities; but their nature and their number we have yet to ascertain. It is more certain that in many individuals at school-leaving age, those abilities have not become fully developed or completely stabilised, and that consequently provision for vocational guidance and the examinations devised for this purpose need to be continued after the boy or girl has entered on his career. We also need further knowledge as to the influence which practice at this occupation may have on success at the tests devised to estimate his abilities in that direction. But although vocational psychology is so young a science, it is already capable of yielding information fuller and more precise than can be reached by the older unsystematic methods of procedure. Further progress in vocational psychology is only

possible by experience, as in surgery or medicine. Just as the surgery of to-day is far in advance of that of 200 years ago, and is far behind that of 200 years hence, and just as that advance has only been possible by experience, so vocational guidance and selection must depend for their future on the encouragement and opportunities offered for putting their principles into actual practice.

DISCUSSION.

THE CHAIRMAN, in opening the discussion, said Dr. Myers had introduced the audience to a very vast subject in a very interesting way. It was something like 40 years after the teachers had gone into the schools in a public way that the doctors went there. He did not think it would be another 40 years before the psychologist went after the doctor into the schools. Just as every child now underwent a medical inspection in the school, so in the future, probably at the end of his school career, every child would have to submit to an examination by a psychologist. There would be a good deal of trouble in England before that became compulsory, because while Earl Grey had got on the country's nerves occasionally, by depicting the terrors of the next war, those who had followed the tests and the diagrams of the author that evening must have begun to think of the horrors of industrial peace. For his own part he was perfectly happy in having finished his career before he had had to undergo tests of that kind!

It was interesting to think what the science might lead to, when experience was sufficient, compared with the present practice. The practice had been modified in recent years, but speaking generally, it still consisted very largely of throwing every year out of the elementary schools half a million of children on to the markets. These children had to fit themselves in to whatever posts were available. What it would be desirable to see some day was a high correlation between the posts which were available and the children who were fitting themselves into them.

His own interest in the question was due to the fact that it was one section of the problem of what, to him, was the most interesting question of the present day, namely, that of the adolescent. The paper put forward one phase of dealing with the adolescent—giving him expert advice as to the kind of employment for which he was best fitted. It would be found, of course, that just as men hitherto had defied Nature which had dealt unkindly with them, and had overcome all the physical handicaps which Nature had given them, so in the future men would be found who would defy the psychologist, and who, years after they had been rejected by the psychologist for a given post, would become Prime Minister or head of a great line of steamships, despite the fact that they had been turned down by the psychologist at a given stage because they had not

a certain class of ability. There would be those exceptional cases, but he thought there was now clear evidence that the author and his colleagues had got on a line which would become common practice before very many years were over.

Experience up to the present had carried the investigators in the subject only a certain distance. There might be more than just the ignorance of that foreman to which the author had referred. The failing of that foreman might have been due to the fact that there were certain people who could become more expert at a job after a little experience than others who were successful at the beginning, on account of the fact that they had character. They had such a character that they would succeed in anything, and it was possible that the foreman in question had not realised that at first, but had seen it afterwards when he had had five or six weeks' experience of his particular apprentices. There were also certain racial characteristics which had to be taken into account. There was the quick wit and nimbleness of the Irish boy. He had seen the Irish boy at work, and had compared him with the slow but long movement of the Aberdeen boy, out of whom at 14 years of age it was extremely difficult to get anything, but who had the stuff in him all the same, and who would show it later on in life. Things like that could not be measured perhaps in the early stages.

It was very difficult for those who were not engaged in applying the tests and working on them day after day to offer any criticism. One could only talk in the most general way about such a new science, and discuss with some of the investigators particular tests; but the author had said one thing which no doubt would be very pleasing to some adults, namely, that too high an intelligence often led to as much unhappiness as too low an intelligence. Those who prided themselves on their intelligence might be gratified to reflect that if they were unhappy in their job this might be due to their having too high an intelligence!

In London for a long time past there had been in the schools what was called a conference; that was to say, a month or so before a child left school the teacher brought to that conference the child's school record. The parent was there to say what he wanted and what he knew about the child, and other persons were there to give advice. There had not yet been brought into that little group the psychologist, but he would come in some day, and then it would be known much better for what the child was fitted.

The author remarked that "Just as the surgery of to-day is far in advance of 200 years ago, and is far behind that of 200 years hence, so with regard to psychology." That was true, but he hoped the psychologist would not forget that in the process of getting their experience the surgeons had killed a great many people!

MR. C. G. WATKINS said he had come from a truly rural part, *viz.*, Buckinghamshire, to learn something, and he had not been disappointed. How

the science was to be applied in rural areas he did not know, but he hoped they would in time follow the good example of London and have their own psychologists.

MR. LEON GASTER asked whether the tests were applied under ideal conditions or ordinary working conditions, and also what was the best age at which to apply the tests. He had come across cases of children who had not shown of their best up to a certain age, and who up to about 14 or 15 years of age had hated their lessons. Yet those children in after life had turned out to be quite successful.

MR. MORLEY DAINOW remarked that he highly appreciated Dr. Myers' paper, but as the title of it was "The Use of Vocational Tests in the Selection of a Vocation," he would like to be permitted to describe some other work which was being done in this country. He noticed there was a tendency on the part both of the Assistant Director of the National Institute and of the Director himself to refer only to work that was being done on the subject by the National Institute; but work on the subject had been done, and was being done, in this country on a very important scale by independent psychologists. In 1920 he himself as a psychologist had devoted himself to certain occupations which were beyond the scope of the present paper, for instance, the occupation of salesmanship. He had devised a scheme for Selfridge and Company, which consisted of a series of tests, some not unlike the tests which the author had described, and others, new ones, and only the other day he had received a letter from the Departmental Head of Selfridge and Company to the effect that, in regard to 50 juniors who had been examined by psychological tests, when they compared the records of anticipation by psychological examination with the records of achievement behind the counter, in the office, or in the workshop, they found a marked similarity between the anticipation of the psychologist and the subsequent achievement of the examinees.

In *The Times* of yesterday the following advertisement had appeared: "Exceptionally able man, 35-40, required immediately, experienced in textiles retail distribution, possessing judgment and organising ability; salary up to £2,000. Selection based on psychological tests." That was the first occasion on which any great employer of labour in this country had come to a psychologist in order to be able to find a man who possessed real leadership. Dr. Myers' paper might be described as vocational selection for the workers, for the masses; but there was needed, even more importantly, vocational selection for the leaders, for the classes. Most of the tests which the author had submitted had been tests much more of the mental than of any other side; but there were at least three other sides besides mental, namely, disposition, character and personality. Again, most of the tests put forward by the author that night had been tests for technical work, but there were at least

three other kinds of work, namely, administrative, professional and commercial. He suggested, therefore, that the Director of the National Institute of Industrial Psychology should pay some attention to the work which was being done by other psychologists, to the work which was being recognised by heads of commercial and industrial concerns, and to the work which was being applied practically, and which was not merely in the theoretical stage.

MR. T. LI. HUMBERSTONE said that he was glad the author had referred to the value of the interview pure and simple as a test for efficiency. At the present time the boy candidates for the navy were being selected almost entirely by interview, and he had always argued that that was a defective method. During the war he had been concerned with the selection of candidates for commissions in the army, and he had noticed one thing which many people who were concerned in the same work had noticed also, viz., that some of those selected who did not appear to show evidence of those high qualities of leadership and personality which were so essential for officers of the Army, often showed marvellous and extraordinary bravery and attained high distinction in the war.

One difficulty he saw with regard to the subject matter of the paper was that selection was made at a point of time, and one could not tell what the efficiency would be in ten or twenty years' time.

Another point was whether there was any possibility of forestalling the "crammer." If psychological tests were to be employed as a method of selection, boys and girls would be crammed for them just as they were crammed for examinations.

A further point was that the tests gave the state of efficiency under normal conditions, but not the efficiency in an emergency. One wanted the man who would pull the right lever when the catastrophe was on him, and not merely the man who would pull the right lever when there was plenty of time to think about it.

In all psychological tests it seemed to him the margin of error should be recognised. It ought to be admitted frankly that it was impossible to pick the most efficient. One might pick two, three or four individuals and say that probably the most efficient of the larger group was among those three or four. Perfect selection could not be obtained by any such methods as psychological tests or examination tests.

MR. P. ABBOTT said it had been his lot to apply a great many psychological tests, and the one feature in which he thought that at present they failed was that they did not bring out sufficiently strongly those traits of character which were so very important in after life. He had applied the intelligence tests on boys in various ways, and had made selections in consequence of them, but afterwards he had been disappointed in a great many cases, because there was not present in those boys the character necessary to give full effect to the

intelligence which had been evidenced in the tests. The author had provided one method of getting over that difficulty, namely, by the interview, but he had added that the interview, if it was to be successful, should be conducted upon scientific lines. Personally he suggested, however, that the ordinary individual at the present time did not know how to conduct an interview scientifically. No doubt the author would answer, "Bring in a psychologist to the interview," but that could not be done on all occasions, and one had to rely upon oneself in many instances to take the part of the interviewer. He therefore suggested that the psychologist should state how an interview should be scientifically carried out.

MR. R. à-ABABRELTON said that there had been for 50 years a class of people who professed to be able to state what an individual was most fitted for, namely, the phrenologists. After all, boys and girls' heads were things more fixed than those things which had been subjected to the author's tests, and the author himself had admitted that there were many cases where the actual results had not borne out the tests.

MR. ROBERT STELLING said the subject was of real importance at the present time when we were doing all we could in this country to revive industry and commerce, which was in so deplorable a condition. One thing he felt nervous about in dealing with the question of vocational selection and vocational guidance (although he yielded to no one in his appreciation of its importance as a phase of the science of management) was the premature introduction of vocational selection to specific trades. There was an enormous waste through boys drifting in to the wrong class of occupation, but the trade unions were saying, "Are you going to use these tests to keep people out of our industry? If you are we are going to have nothing to do with it." The answer was, "No; we are trying to fit people to the trades." But he was afraid there was a long way to go yet before the trade unions could be convinced that that was the purpose of the tests.

Another important point was that the conditions in our industries to-day were not standardised. The methods certainly were not standardised, and particularly he would refer to the working conditions. He had in mind the case of a skilled turner who worked for many years under a gallery, and whose only source of illumination was a small gas jet. The man had been working on a second-hand lathe for seven years. The works were then suddenly moved into a large modern shop with perfect lighting, and the man was put on to a lathe right out in the open. The result was that he could not work under those conditions, and went back again to a little shop in a back street, where the conditions were more like what he had always been used to. That showed the necessity for standardising methods and for standardising working conditions. He ventured to suggest that if much was going to be done in the way of

useful advice to the youth about to enter upon his life's work in a trade, the conditions of that trade must first of all be studied and analysed and be brought as near perfection and simplicity as possible. Recently a firm in the north of England had been making very elaborate changes and investigations into certain of their methods. As a result of those changes they had been able, with greater comfort to the workers, to increase the output of the department by something like 55 per cent. The extraordinary thing, from the point of view of the matter which was being discussed that night, was that, whereas the skilled workers did not make so tremendous a headway, their wages only going up in fact from 40/- to 45/-, the principal increase of output was among the lesser skilled workers, who had been earning only 30/- or 32/-, and the average wage had gone up in that department from 34/- to 42/- during that period. That seemed to show that if the methods were standardised the work was made open to a far greater number of people, and far more people were able to enjoy the work, to do good work, and to earn good money. He suggested, therefore, that the National Institute should take every opportunity possible for collaborating with industrialists, and particularly that new branch of industry, the industrial engineer, in order to ascertain what were the best ways in which the job could be standardised and analysed, so that they could combine to find the happiest and most suitable work for our youth entering industry to-day.

MR. G. HARRISON said Great Britain was an industrial country. Many thought that it was very much over-industrialised. Consequently the great bulk of the children leaving the elementary schools were fated to take part in monotonous industrial work, whether they liked it or not, and whether they were fitted for it or not. He desired to ask the author whether he had found in the course of his tests that there was any proportion of human beings worth speaking of who were really fitted to pursue, for the course of their lives, a monotonous task of that kind. It had been suggested that the author had not laid any particular stress upon character, and that his tests were merely intelligence tests. He would like to submit, that even from the point of view of an intelligence test, a test of the capacity of a child or a man to go through a monotonous task was not really an intelligence test, and that if it was found that there was a sort of rebellion or resentment against pursuing such a thing, that would be an indication not of a bad character, but of an exceptionally good one. What the psychologist was after in his tests was to try to make human beings fit into a particular system, and personally he doubted very much whether the psychologist would be able to do it.

MISS S. D. LOWE asked what was the best stage of adolescence at which to apply the tests. She happened to be closely connected with juvenile employment, and found that a tremendous develop-

ment or deterioration of character, as the case might be, among adolescents occurred during the time just after they left school, and were freed from the discipline of school life. Character developed or deteriorated rapidly between the ages of 14 and 15. Therefore, would the author state whether the test should be applied just before the children left school, when they were still under discipline, or should it be applied after they had left school, say, at the age of 15, or should it be applied at both periods in order to form a correct opinion?

MR. J. F. BUTTERWORTH thought the time was not far distant when there would be established in this country, in all the big cities, departments which would be able to furnish psychologists and physiologists to test children for their fitness for work, just as at the present time doctors tested them for their health. The question of psychology undoubtedly was one of the most important features in industry to-day, and he was sorry to say that up to the present time this country had perhaps been the most backward of the big countries in taking it up. Many years ago he had had a friend who had been a psychologist without knowing it. His friend had employed at various times in America over ten thousand workers, and in a country such as America, the most polyglot nation in the world, he very quickly found that if he put his men together in huge gangs, he got merely average results, but that when he divided them up into gangs of Irishmen, Scotsmen, Hungarians, Italians, Germans and Englishmen, he was very easily able to set up a fierce competition between the gangs. His friend used to put up a score board saying what the output of each gang was, and directly the excitable Irishmen saw their figure was being exceeded by another gang, they went to work to beat it. The result was that his friend obtained results which were absolutely marvellous: he had undoubtedly applied his psychology in a practical manner. His friend had also very quickly found that when he had been commissioned to build a Wesleyan Chapel, he did not get the best results from Roman Catholic workmen, or that if he had to build a saloon, he did not get the best results from teetotalers. That was a practical application of psychology.

THE AUTHOR, in reply, said it was not the psychologist's object, as a result of vocational guidance, to force anyone to go into a particular occupation. The psychologist here merely advised. The ideal of vocational guidance was to get the subject to believe that it was his own decision. That could be done by successful advisers, and in that way the best results were obtained.

Mr. Gaster and Miss Lowe had both asked the very difficult question, namely, at what age the tests should be applied. It had to be remembered that the tests were being used as a supplement to the interview, so that it was extremely difficult to answer the question. There had been too much supposition that night that in the tests there was

something absolutely new—a revolutionary thing which was going to alter the whole course of the child's existence. What he desired the audience to bear in mind was that he was urging the tests as something supplementary to the interview. The interview must always be there, so that the question as to when the tests should be applied was like asking, when should the child be advised as to what he should go in for? That must depend on a vast number of things.

With regard to Mr. Gaster's question as to whether the tests were applied under ideal conditions or working conditions, that varied a very great deal.

Mr. Dainow had alluded to the question of salesmanship. He was glad to hear that Mr. Dainow had been so successful. He only wished he had known about it at the time when he had been preparing the paper. All he had made use of was, so far as possible, the data in this country and abroad which had appeared in print.

He had been interested in Mr. Humberstone's remarks, first with regard to cramming. That had always been urged against the intelligence tests, but it did not in practice appear to be a very important objection. He himself had gone through the intelligence tests some little time ago, after having had a general knowledge of their nature, and he had been almost as flustered as he would have been if he had never known anything about them.

Mr. Abbott had said that the tests did not bring out character enough. They were not devised for that purpose; as he had stated before, they were merely a supplement to the interview. If the help of the psychologist was asked so that the interview could be conducted in a more scientific manner, he felt that a great deal could be done in that direction.

Mr. Stelling had stated that the trade unions were likely to be against vocational guidance and selection. Personally he had had a good many talks with trade unionists and all sorts of workers, and he had found that the problem of vocational psychology was one in which they were most interested. He had never received any unfavourable comment about it from that class of people. Its object was to get the best people in those jobs for which they were best suited, and to save them from having a wrong job. In Berlin he had been informed that the Engineers' Union had gone so far as to support the Charlottenburg Laboratory financially, in order that they might not have "duds" getting into their Union. He could assure Mr. Stelling that, so far as his experience went, there was not likely to be any opposition from the trade unions.

With regard to another speaker's remarks, the Institute had also found that, with the improvement of conditions, it was the least expert workers who were most affected. It took a very great deal to improve a really expert person a little more.

Mr. Harrison had asked a very interesting question with regard to the fitness of people for monotonous tasks. There was a good deal of

work going on now in that particular subject, some of which had been published in the Institute's *Journal*, and some of which had been carried out partly by the Fatigue Research Board.

Votes of thanks to the Author and Chairman concluded the meeting.

OBITUARY.

PAUL GREGORY MELITUS, C.S.I., C.I.E.—Mr. Melitus, who, as a member of the Indian Civil Service, had a long and successful career in Bengal and Assam, died on February 23rd. Born in 1858, he was educated at Marlborough and Balliol College, Oxford. Having passed the I.C.S. competitive examination he went to India in 1880, and became an Assistant Magistrate and Collector in Bengal. From 1886 to 1891 he filled respectively the offices of Assistant and Deputy Commissioner, Assistant Secretary to the Chief Commissioner of Assam, and acting Postmaster-General of Bengal. He was then appointed Under-Secretary Home Department, Government of India. Subsequently he was Secretary to the Chief Commissioner of Assam, and later Judge and Commissioner Assam Valley Districts. In 1905 he was chosen for a seat on the Board of Revenue, Eastern Bengal and Assam, afterwards becoming its First Member. His last post in India was that of Commissioner in Bengal, and he retired in 1913. He was made a Companion of the Order of the Indian Empire in 1894, and a Companion of the Star of India in 1912. He had been a Fellow of the Royal Society of Arts since 1906.

CORRESPONDENCE.

THE TREATMENT OF THE DEATH-WATCH BEETLE.

I regret I was unable to attend the reading of this paper by Professor H. Maxwell-Lefroy, to make the following suggestion.

The beetle breathes and, therefore, can be, as I have verified by experiment, exterminated by periodical "gas attacks." The labour and cost of this is nothing like so heavy as the inefficient use, when practicable, of fluids.

A. E. PARNACOTT,
M.I.A.E.

RECENT DEVELOPMENTS IN NAVAL ARCHITECTURE.

SIR EUSTACE W. H. TENNYSON-D'EYN COURT, Director of Naval Construction and Chief Technical Adviser to the Admiralty, recently delivered the Watt anniversary lecture before the Greenock Philosophical Society, upon this subject.

The developments in naval architecture down to

the present time, he said, could only be appreciated properly if one considered for a moment the conditions under which ships were designed and constructed before the days of James Watt and the steam engine. British warships were standardized by the Admiralty in their principal dimensions, and consequently could not be departed from. All the useful knowledge was kept secret; and as a result there had been little real progress in the science of naval architecture since the days of Queen Elizabeth. The opening of the first English school of naval architecture at Portsmouth in 1811 was the first real step taken whereby the study of the science was inaugurated and encouraged. Referring to the introduction and utilization of the mine, the torpedo, the aeroplane, the use of wireless telegraphy, and all other adjuncts which have been developed, the naval advances of the nineteenth century had yet to be determined by actual warfare, and the Great War was the acid test of all the modifications in naval design.

The aeroplane must play an enormously important role in any future war; the mine was used with effectiveness by both sides in the recent war; the torpedo was made the most dreaded weapon on that occasion; and the development and use of the submarine was one of the most unexpected features, and necessitated the design and construction of vessels for the purpose of hunting and destroying this new form of torpedo craft, and developing devices for detecting the presence of the submarines and to accomplish their destruction. In naval architecture itself there had been striking improvements in the designs of ships and their propulsive qualities; and research work had enabled the naval architect to take full advantage of the improvements in materials which had been offered him by the metallurgist and the steel-makers. At the present time, armour capable of withstanding the attack of modern shells could be produced of half the thickness and weight which was required 40 years ago to resist the much inferior attack of that date. Within the last year or two marked improvements had been made in the qualities of structural steel; and recent processes would enable appreciable reductions to be made in the weight of the structure of new ships. The improvement which had taken place in the various types of engines had been steadily maintained by the introduction of the steam turbine, the utility and economy of which had been further developed by the introduction of gearing which had had marked results in improving the propulsive co-efficient of vessels.

Concurrently with an improvement in the engines there had been introduced more economical methods of raising steam, and fuel economy had been improved by the various developments in machinery and boilers, and assisted by the use of the geared turbine. A striking advance in this direction had resulted from the introduction of the internal combustion engine, but it had been found so far impracticable to introduce this type into warships for propelling purposes. These engines were installed for driving dynamos, with the

consequent advantage that steam need not be raised when in harbour. The introduction of oil fuel for steam raising had had a most marked effect on the design and construction of ships during the last ten years. Its adoption contributed in no small degree to the successful operation of the Fleet during the war. Without its use we could not have approached the power required for the high speeds of our torpedo boat destroyers and light cruisers. Our warships had demanded larger complements, both of officers and men, by the introduction of these and other appliances, especially wireless telegraphy. There was a great increase in the number of vessels constructed for the Navy during the war, the tonnage being 2,000,000.

The effect of the war upon designs had been great, and had brought about striking developments. The ever-increasing size was, of course, remarkable, and the steady increase of the use of internal combustion engines was a great feature of recent developments. That this would continue there was not the least doubt. In concluding, the speaker said that the present position as regarded the provision of facilities for obtaining the highest training for naval architects and marine engineers might generally be regarded as very satisfactory, and the continued development of naval architecture was thereby assured.

PIG BREEDING IN SCOTLAND IN 1923.

There has been continuous progress in pig breeding in Scotland during the year 1923, notwithstanding the fact that there have been many disappointments for the pig-breeder. It is satisfactory, however, to be able to put on record that the pig population in Scotland as at June 4, 1923, showed an increase of 35,143, or 23.29 per cent. over the previous year. The total population of pigs at that time was 186,027. This figure, although a satisfactory one from the point of view of Scotland, compares very badly with the figures as applied to other parts of the world, the total pig population of Great Britain being $2\frac{1}{2}$ millions, and if the whole of Ireland is included, $3\frac{1}{2}$ millions, out of a total pig population in Europe of some 55 millions.

The increase in the pig population of Scotland is highly satisfactory, as it would seem to indicate that the business of swine husbandry has now become an essential part of agriculture; and, indeed, this fact is brought out from an examination of the details giving the numbers of pigs bred in each Scottish county. The figures show, amongst other things, that the ancient prejudice against pig breeding in the Scottish Highlands has disappeared. There was a time when one of the names which the Gaelic-speaking population of Scotland gave to the devil was "The Big Black Pig;" but at present there are something like 100 herds of large black pigs in Scotland, pretty evenly distributed all over the country, and some of the more notable of these are situated in the Western Highlands.

Unfortunately, the number of breeds of pigs which are recognised in Great Britain as pure breeds is still increasing, and it looks as if the number would increase to fifteen pure breeds in all. This multiplying of the breeds is not regarded favourably by the bacon curer, as it in nowise contributes to the production of the bacon pig, which, after all, is the natural corollary of pig breeding. The cross-bred pig, it would seem, is preferred by the bacon curers before the pure-bred animal. But it is quite a mistake to suppose that a cross-bred pig is any better than a bacon pig derived from a pure breed. It is altogether a question of selection and feeding.

The Scottish pig breeders have pretty generally come to the conclusion that the cross-bred pig seems to mature earlier, and undoubtedly commands a readier sale for bacon purposes than the pure-bred animal. In corroboration of this view, it may be mentioned that, at the last Smithfield Show in London, the championship for the pig best suited for the manufacture of bacon was awarded to a cross between a large white boar and a large black sow. At the age of 5 months and 3 weeks this particular animal scaled 2 cwt. 5lb., live weight, without being in the least degree too fat for bacon curing purposes.

A good many Scottish breeders are at present trying to cross with the large black sire and the large white sow. Others, again, are trying the large black sire on the middle white sow. The results in either cases have been quite satisfactory, as have many other crosses in which the large black sire is being used.

The sire is undoubtedly pre-potent in the breeding of pigs, and, for that reason, it is always desirable to have a pure-bred sire where cross-bred pigs are produced. Experiments have shown that the use of a pure-bred boar has, by comparison, shown an increase in pig production of 40 per cent. over the common nondescript boar. This, then, must be one of the principal objects of the pedigree pig breeder—namely, to supply pure-bred sires of whatever breed may be particularly fancied.

Pig breeders in Scotland have had some serious misfortunes during 1923. First of all came the foot-and-mouth disease, which has practically stopped all movement of swine throughout the country; and the great exhibition of pigs which was to have taken place at Glasgow Dairy Show was prohibited. Similarly, and for the same reason, the Edinburgh Fat Stock Show did not take place, and the entry there would have been a record. Then, during the latter part of last year, there was continuous rain; and, latterly, extremely cold and wintry weather, so that the outdoor system of raising pigs has to be carried on under the most trying weather conditions. Farrowing in winter in Scotland, at all times, is a risky business; but, during the later months of the year it was necessary to provide heat in the farrowing styes, as otherwise the piglets would have received a setback from which they would be unlikely to recover.

LOUDON M. DOUGLAS.

COTTON AND RUBBER IN PERU.

The principal products of Peru, writes the British Vice-Consul at Callao, are cotton, sugar, wool, hides and skins, rubber, rice and coca.

Cotton.—The total production of cotton in Peru in 1921 was 40,769 metric tons and in 1922 probably more than 42,000. The year 1923 may show an increased production of perhaps 10 per cent. over the preceding year. The production of Tangüis (named after the discoverer of this highly successful blend of rough and smooth cotton) reached about 40 per cent. of the total, and as a good price was obtained, it has led to a more extended sowing of this class of cotton. Its woolly nature lends itself to admixture with wool in the manufacture of woollen goods. Last year over 90 per cent. of the Tangüis went to Liverpool. Of the export of 39,952 metric tons (gross) in 1922, England took over 34,000 tons and the United States nearly 5,000 tons. In the first half of 1923, 8,890 tons were exported, against 13,601 tons in the same period of 1922.

In the regions of the upper reaches of the Amazon, the crop in 1922, although a disappointing one owing to the destruction done in the cotton-growing areas between the Huallaga and Ucayali rivers during the revolution in 1921, showed an increased return on the previous year. In 1922 the exports from this region amounted to 1030 metric tons, all rough and semi-rough qualities. Much larger areas were put under cotton in 1923.

Rubber.—Wild rubber abounds in the Amazon regions, its original home, and whence the Far Eastern product was transplanted. The export, which had been only 137 tons in 1921 (the official figure, which probably did not include December), increased to 602 tons net in 1922. An examination of the possibilities of creating in the Amazon district an independent source of supply of plantation rubber for American consumption is about to be made by an American Commission. The sum of half a million dollars has been voted in the U.S.A. for investigation in the Philippines and Central and South American States, and the latter are vying with each other in offering inducements. The restriction on production—under the Stevenson arrangement—of Eastern rubber has led the United States, which require over 70 per cent. of the world's output, to contemplate a time when the supply from the present sources may not be sufficient to meet their needs. There are, it is stated, many millions of trees in the Peruvian rubber forests, but the wild rubber cannot be collected profitably, and the trees would be cleared for the proposed plantation. As it would require some seven years before any rubber could be produced from the latter, it is thought that the proposed railway from the Marañon to the Pacific might be available. In this case the product from the eastern side of the Andes could be landed in New York *via* the Pacific coast and Panama Canal in a fortnight. The alternative—and present—means of transport is *via* the Amazon rivers for nearly three thousand miles to the Atlantic. The Peruvian Government, eager to attract a new industry,

offers the Commission very large tracts of land free, together with many other advantages, such as duty free imports of materials, etc. It is considered that the lack of a supply of labour in these regions, necessitating contracting labour from abroad, will militate against the success of this scheme.

GENERAL NOTE.

SUMATRA RUBBER.—Attention has been called in *Tropical Agriculture* to the amount of native-owned rubber in Sumatra—an island which is more than twice the size of British Malaya, to the south-west of which, in the Indian Ocean it is closely situated. It is estimated that the natives own some 50 million trees, which, under good management, should yield 80,000 tons of rubber per annum—an amount quite capable of influencing the world's market price. This might be important at times when attempts are made to raise the price of rubber by restriction of Company operations. Influence of this kind was actually experienced in the initial stages of restriction in the Federated Malay States in 1920. It is, therefore, important that statistical data should be obtained and studied in respect of native cultivations. Regarding the quality of Sumatra native rubber it would appear that for the most part it is equal to off-quality smoked sheet.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

MARCH 26.—NEAL GREEN, "The Fishing Industry and its By-Products." PROFESSOR E. W. MACBRIDE, D.Sc., F.R.S., will preside.

APRIL 2.—SIR LYNDEN MACASSEY, K.B.E., "London Traffic." LORD ASKWITH, K.C.B., K.C., D.C.L., Chairman of the Council, will preside.

APRIL 9.—FRANK HOPE-JONES, M.I.E.E., Vice-Chairman, British Horological Institute, "The Free Pendulum." PROFESSOR C. VERNON BOYS, F.R.S., will preside.

APRIL 30.—BRIGADIER-GENERAL SIR HENRY MAYBURY, K.C.M.G., C.B., Director General of Roads, Ministry of Transport, "The London Dock District and its Roads."

MAY 5 (Monday).—T. THORNE BAKER, "Photography in Industry, Science and Medicine."

MAY 7.—J. ROBINSON, M.Sc., Ph.D., F.Inst.P., Head of Wireless and Photography Department, Royal Aircraft Establishment, Farnborough, "Wireless Navigation." ADMIRAL OF THE FLEET SIR HENRY

JACKSON, G.C.B., K.C.V.O., F.R.S., will preside.

MAY 14.—

MAY 21.—PROFESSOR C. VERNON BOYS, F.R.S., "Calorimetry." (Trueman Wood Lecture.)

MAY 28.—MRS. ARTHUR MCGRATH (Rosita Forbes), "The Position of the Arabs in Art and Literature." LORD ASKWITH, K.C.B., K.C., D.C.L., Chairman of the Council, will preside.

INDIAN SECTION.

Friday afternoons, at 4.30 o'clock:—

MAY 2.—JOCELYN F. THORPE, C.B.E., D.Sc., Ph.D., F.R.S., F.I.C., F.C.S., Professor of Organic Chemistry, Imperial College of Science and Technology, "Chemical Research in India."

Date to be hereafter announced:—

BHUPENDRA NATH BASU, M.A., Vice-Chancellor of Calcutta University, "The Vedantic Philosophy of the Hindus."

DOMINIONS AND COLONIES SECTION.

Monday or Tuesday afternoons, at 4.30 o'clock:—

MAY 27.—C. GILBERT CULLIS, D.Sc., M.I.M.M., Professor of Economic Mineralogy, Imperial College of Science and Technology, "The Geology and Mineral Resources of Cyprus."

June 16.—C. V. CORLESS, M.Sc., LL.D., "The Mineral Resources of Canada: The Pre-Cambrian Area."

COBB LECTURES.

Monday evenings, at 8 o'clock:—

DR. T. SLATER PRICE, Director of Research, British Photographic Research Association, "Certain Fundamental Problems in Photography." Three Lectures. March 24, 31; April 7.

SYLLABUS.

LECTURE I: MARCH 24.—Colloids. Suspensions and emulsions. Gelatin as an emulsoid and amphoteric colloid. Isoelectric point and properties of isoelectric gelatin. Combination of gelatin with silver nitrate and other salts.

Effect of gelatin on reactions involved in making a photographic emulsion. Ripening of silver halides; effect of various reagents. Physical processes involved in development. Development in hot climates and prevention of swelling. Reti-culation.

LECTURE II: MARCH 31.—Hardening of gelatin. Ordinary fixing and acid fixing baths.

Medium free silver halide. Gelatine as a retarder of development. Black and grey silver images. Coloured silver images and silver colour scale. Production of coloured images. Gelatine as a sensitiser.

LECTURE III: APRIL 1.—Photohalides and the visible image. Sensitising action of silver ions. Latent image. Duplication of light action by chemical agents. Silver halide grain as the unit. Sensitive centres on the grains. Nucleus exposure. Nature of the sensitive centres.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, MARCH 24 ... Geographical Society, 135, New Bond Street, W., 8.30 p.m. Dr. L. Koch, "Northward of Greenland."

Mechanical Engineers, Institution of, Storey's Gate, S.W., 7 p.m. (Graduates' Section). Informal Discussion on "Failure in Metals."

Victoria Institute, Central Buildings, Westminster, S.W., 4.30 p.m. Mr. W. E. Leslie, "Telepathy."

Architectural Association, 34, Bedford-square, W.C., 7.30 p.m. Miss M. Jourdain, "The Architect as Designer of Furniture."

University of London, at King's College, Strand, W.C., 5.30 p.m. Dr. R. W. Seton-Watson, "A Survey of Bohemian History." (Lecture VIII.)

5.30 p.m. Senhor Rangel de Castro, "The Civilisation of Brazil." (Lecture II.)

TUESDAY, MARCH 25 ... Automobile Engineers, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 6.30 p.m. Mr. H. S. Rowell, "The Balancing of Automobile Engines."

Marine Engineers, Institute of, 85, The Minories, E., 6.30 p.m. Mr. J. Ward, "Some Notes on the Theory of Lubrication with particular application to the Mitchell Thrust."

Colonial Institute, Hotel Victoria, Northumberland-avenue, W.C., 4 p.m. Rt. Rev. Bishop G. Jones, "The Nile Route to Uganda."

Photographic Society, 35, Russell-square, W.C., 7 p.m. Mr. J. D. Johnston, "Developments of Pictorial Photography in England and America."

Royal Institution, Albemarle-street, W., 5.15 p.m. Prof. G. Gordon, "Ballads." (Lecture I.)

University of London, at King's College, Strand, W.C., 5.30 p.m. Prof. Smal-Stotsky, "Shevchenko and Modern Ukrainian Literature."

WEDNESDAY, MARCH 26 ... London County Council, at the ROYAL SOCIETY OF ARTS, John Street, Adelphi, W.C., 5 p.m. Sir Napier Shaw, "Modern Meteorology." (Lecture IV.)

Literature, Royal Society of, 2, Bloomsbury Square, W.C., 5 p.m.

British Academy, at the Royal Society, Burlington House, Piccadilly, W., 5 p.m. Dr. T. Borenius, "English Primitives."

Oriental Studies, School of, London Institution, Finsbury Circus, E.C., 5 p.m. Miss E. D. Edwards, "Manchuria."

United Service Institution, Whitehall, S.W., 3 p.m. Rear-Admiral H. L. Mawbey, "The Past and Future of the Royal Indian Marine."

Glass-Painters, British Society of, at the Art Workers' Guild, 6, Queen Square, W.C., 5.30 p.m. Dr. T. M. Legge, "Specimens of 15th Century Stained Glass"; Mr. F. S. Eden, "Ancient Stained Glass in London."

University of London, University College, Gower-street, W.C., 6 p.m. Prof. K. Pearson, "The Current Work of the Biometric and Eugenics Laboratories." (Lecture VII.)

5.30 p.m. Dr. W. Seton, "The relations between Scotland and England in the Sixteenth Century." (Lecture V.)

At the Royal College of Music, Prince Consort Road, S.W., 5 p.m. Sir Henry Hadow, "English Composers of the Tudor Period." (Lecture II.)

Microscopical Society, 20, Hanover Square, W., 8 p.m. 1, Mr. G. O. Searle, "Methods of Mass Production in Sectioning Flax Stems." 2, Dr. H. Wrighton, "Microscopical Metallurgy." 3, Demonstration of "Technical Microscopy." 4, Mr. J. E. Barnard, "The Setting up and Adjustment of a Microscope."

Japan Society, 22, Russell Square, W.C. Mr. Hugh Byas, "The Press in Japan To-Day."

THURSDAY, MARCH 27 ... Royal Society, Burlington House, Piccadilly, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, Piccadilly, W., 8.30 p.m.

Electrical Engineers, Institution of, Victoria Embankment, W.C., 6 p.m. Lieut.-Colonel H. E. O'Brien, "The Future of Main Line Electrification of British Railways."

Industrial League and Council, Caxton Hall, Westminster, S.W., 7.30 p.m. Sir George Paish, "Trade Depression and its Remedy."

Auctioneers and Estate Agents Institute, 34, Russell Square, W.C., 7.30 p.m. (Junior Members' Meeting). Mr. H. A. Robertson, "Some Notes on the Assessment of Delapidations."

Royal Institution, Albemarle Street, W., 5.15 p.m. Prof. D. S. Watson, "Evolution To-day." (Lecture II.)

Mechanical Engineers, Institution of, The University, Edmund Street, Birmingham (Midland Section), 7.30 p.m. Mr. O. H. Petford, "Economic Considerations on the Generation of Steam for Power Purposes."

University of London, King's College, Strand, W.C., 5.30 p.m. Prof. W. W. Buckland, "The Classic Roman Law: Recent Investigations." (Lecture II.)

Chemical Society, Burlington House, Piccadilly, W., 4 p.m. Annual General Meeting. Address by the President, Prof. W. P. Wynne.

FRIDAY, MARCH 28 ... Engineering Inspection, Institution of, at the ROYAL SOCIETY OF ARTS, John Street, Adelphi, W.C., 8 p.m. 1, Annual General Meeting. 2, Mr. H. B. Spencer, "Inspection Clauses in Engineering Specifications."

Mechanical Engineers, Institution of, Storey's Gate, Westminster, S.W., 6 p.m. Joint Meeting with the Institution of Civil Engineers to discuss report on "Standard Tests for Hydraulic Power Plants."

Royal Institution, Albemarle Street, W., 9 p.m. Dr. H. Maclean, "Insulin."

Chadwick Lecture, Council Chamber, Old County Hall, Spring Gardens, S.W., 8 p.m. Mr. J. T. Quinton, "The Sanitary Inspector in the Machinery of the Public Health Service."

Photographic Society, 35, Russell Square, W.C., 7 p.m. Capt. A. G. Buckham, "The Way of the Lovely Sky."

Physical Society, Imperial College of Science, South Kensington, S.W., 5 p.m.

Engineers, Junior Institution of, 39, Victoria Street, S.W., 7.30 p.m. Mr. A. J. Simpson, "Wood Wall: its Manufacture and Application."

Chemical Industry, Society of, at the Institution of Civil Engineers, Great George Street, S.W., 6 p.m. Mr. L. Andrews, "Kinetic Electricity." (South Wales Section). Technical College, Swansea, 7.15 p.m. Address by Captain H. Vivian.

(Glasgow Section), 39, Elmbank Crescent, Glasgow, 7.15 p.m. Dr. J. A. Cranston, "The Influence on Chemistry of the Recent Knowledge gained from Atomic Structure."

SATURDAY, MARCH 29 ... London County Council, at the Horniman Museum, Forest Hill, S.E., 3.30 p.m. Mr. S. H. Warren, "Prehistoric Man and the 'Land of Lyonesse.'"



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