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PROCEEDINGS OF THE INSTITUTE

YORKSHIRE SECTION

Meeting at Bradford, 16th December, 1920.

Mr. GEORGE GARNETT in the Chair.

SOME EXPERIMENTS IN THE MEASUREMENT OF NATIVE ABILITY AND ACQUIRED SKILL

By HENRY BINNS.

Recent legislation has had the effect of bringing educationalists and business men into closer contact. The happiness of each individual is dependent upon a broad interpretation of the aims of education, and it is none the less true that the ability to earn a livelihood is an important factor in individual and national life. Acquired skill in industry is but a continuation of the development of native ability in the schools, and it may be well for business men and teachers to realise, more fully than has been the case in the past, that co-operation is more than ever necessary at those ages during which transference from school to industry takes place.

In respect of young people between the ages of twelve and twenty years, educational-industrial research is needed, in order to find out the true facts on an impartial basis. Much valuable work is being done in various parts of the world, because it is recognised that "some boys and girls are kept back to their lasting injury, occupied with intellectual pursuits beneath their capacity, solely because their parents and teachers are unaware of an inborn aptitude, while others whose powers are below normal are pressed forward and stimulated by reward or punishment to undertake tasks beyond their powers." It is necessary to determine whether a given child is unsuccessful in school because of poor native ability, or because of poor instruction, lack of interest, or some other removable cause.

Ability and skill are built upon intelligence, which is defined by Stern as "the general capacity of an individual to adjust his thinking to new requirements; it is general mental adaptability to new problems and conditions of life." Binet says:—"To judge well; to comprehend well; to reason well; these are the essential activities of intelligence."

In order to reproduce a cloth, it is first necessary to analyse every factor in construction. With the aid of the standard yard and the standard pound, it is possible to compare, with the aid of a microscope, the diameter of an 80's merino with the width of a piece, or the weight of a square inch with miles of fabric. But there are other factors, such as appearance, handle, and colour, which are determined by skill without mechanical aid, and the resulting variations in quotations are often considerable.

An investigator is early driven to effort to find some means of measurement for intelligence, native ability, and skill, so that some comparison may be made between them. An analysis of cloth demands a sound opinion on many properties of raw material, and the analysis of maximum skill likewise demands

a sound knowledge of the raw mental material in the child. For various reasons, school examinations are not acceptable as a basis for research purposes, and the most recent experiments in measurement are more concerned with ideas than response to persons or things. Business life is more concerned with things, production being associated, mainly, with the act of doing. Business men excel in the doing and performing of operations and in responding to persons, rather than in ability to express ideas verbally, or to explain in writing how they do things.

Measurements of ability to perform, therefore, seem likely to be more productive than those associated with language. Just as it is well known that children, according to their degree of intelligence, learn a great deal which is not directly taught in the schoolroom, so in business-life a great deal of skill which has not been technically taught is picked up in course of daily life.

Instead of narrating the invaluable work being done by educationalists and scientists, I propose to confine attention to certain experiments conducted in Bradford.

PART I.: NATIVE ABILITY IN YOUNG CHILDREN.

Taking as a basis the work of Pintner and Paterson on deaf children, certain modifications were made for group testing. Three representative results are given for eight experiments, the average percentage representing the measure of ability to perform. Sharp children are noted by teachers to perform the most elementary things worse than dull children (this is shown in "a" and "c," Table I.), but with increasing difficulty the results are proportionately reversed:—

TABLE I.: TESTS AND PERCENTAGES.

	a	b	c	d	e	f	g	h	Average %
1 (deaf) age 6½ ...	13	10	22	0	28	0	0	0	9
3 (dull) age 8 ...	00	42	06	18	46	12	6	17	34
3 (bright) age 8 ...	50	50	63	43	76	26	23	24	45

PART II.: NATIVE ABILITY IN SCHOOL,

An average result of a series of five types of tests, each of which can be performed by normal persons from eight years upwards, is suggestive.

(1) SIMPLE MOTOR ACTION: Taking what is known as a form board, a person is asked to place ten different shapes into their proper places on the board as quickly as possible. This is repeated three times, and the shortest time recorded as the measure. A deaf child of six took three minutes on the first trial, and reduced the time to 80 seconds on the third. An alert young woman has performed the same operation in 14 seconds, reducing this to 9 seconds. Leaving calculations aside, an observer cannot fail to be impressed with the effects of deafness and mental deficiency, as well as normal and supernormal activities. This test measures a subject's "perception of difference in forms, powers of co-ordination in handling pieces, ability to learn

by the experience of trial and success, and, beyond this, it may afford some gauge of the perception of the relationship of object to object, of parts to the whole—a most valuable faculty in life."

(2) **QUICK, THOUGHTFUL ACTION:** With same sized board, and with still ten pieces, the subject is asked at a given signal to take the ten pieces from an envelope and make each fit into the board in the least possible time. For greater stability, the average of three different tests is taken for measurement. The ability to deal with an unknown but simple problem varies from a final average percentage of 21 in a sharp girl of 8 years, to 75% in a brilliant university student. Six backward boys of 12½ years averaged 31%, whilst six good at school work averaged 43% at the same average age. A boy of 14 years, who could not read, scored 31%. Although attempts have been made to discriminate between full and half-timers by this means, no evidence for or against is available, native intelligence appearing to be the governing factor.

(3) **PROBLEM ACTION:** A problem action is introduced with same sized board and ten pieces. The subject thinks he sees the solution instantly, and acts, but finds the pieces do not fit. Some persons immediately see the impossibility and begin again, ultimately finding the correct solution. Others, after ten minutes' study, still fail to see the absurdity of the position. It has seemed to me that, for some reason which needs explanation, the children in an elementary boarding school respond better than the children in the elementary day schools. In four classes in such a boarding school, the averages were as follows:—

Age	10	..	12	..	13½	..	13½
%	9	..	31	..	38	..	51

The highest score in several day schools has been 32% for a boy aged 14. In a group of 18 children, aged 12½, not one score was made, and these facts give us something that requires explanation.

Constructive problems of the same type seem to be impossible of solution in any elementary school, but are useful in connection with secondary and technical training. These appear to discriminate in favour of a constructive and engineering type of mind. "Factors best described as intelligence factors contribute primarily to superior ability in complex motor tests. Although the intelligence elements function in these reactions, they do so largely in an unconscious manner."

(4) **CAPACITY TO FOLLOW INSTRUCTIONS:** On entering business-life, a boy or girl has first to understand the necessity of following instructions without continual repetition of them. This type of measurement takes a prominent place in all recent investigations, and seems to have a greater bearing on business-life than on school-life. A subject is told on a given signal to turn over a sheet of paper, on the reverse side of which is printed matter with 25 blanks, each one of which he has to fill in as instructed. Remarkable differences in individuals, both in accuracy and time, are noticed. Sharp children of 8 years have recorded 39%, and smart business men 78%, with occasional scores up to 87%. But age appears to have little to do with this type of ability. Six backward boys, already referred to, varied from 0% to 52%, with an

average of 33%; six good at school work, of the same age, varied from 51% to 86%, with an average of 71%. Observation in this connection leads one to appreciate the patience exhibited by teachers. Just the same difficulties as business men complain of seem to be present in the schools, and it may be that the teacher can no more produce a normal mind in some children than a business man can make a manager of every boy entering his employ. On the other hand, the exceptionally keen and alert to such tests appear to be those one would like to employ in business.

(5) **FIXITY OF ATTENTION:** It is next desired to measure the acts of discrimination involved in selecting certain chosen digits from a sheet of mixed figures, and also the motor action in marking the digits with a pencil. Teachers agree, and the tests seem to show, that at 12 years of age there is a maximum speed and accuracy ability. Twenty children of this age averaged 79%, whilst similarly trained children at 13 and 14 years averaged 73% and 76%. Exceptional adults have gained 84%. Backward boys of 14 reached 66%, against 71% by normal boys. Simple acts of discrimination, repeated, show little variation between dull and normal children. Many operations of this nature do not call forth the mental problems involved in Tests 2, 3, and 4, but they do demand fixity of attention.

FINAL RESULT: The average of five types of test represents the intelligence employed in manipulating things as distinct from response to ideas or to persons. Language is only used in one test, and, though it seems to separate knowledge from intelligence, the knowledge factor is almost entirely absent. From a normal child of 8 years with a percentage of 25, gradations can be measured to about 70% for a good adult, and 80% for a very good adult, whilst 90% would be super-normal. The literary mind may be high in school-work, but low to such tests. Some, with less literary ability, may accomplish practical work very well. Children requiring a second period to qualify for promotion stand high in school marks at the end of that second period, but these particular tests measure their native ability, and their scores are low. Broadly speaking, there are all-round students who do very well at both literary and handwork, and those who do badly at both. The former cannot be held back, nor the latter pushed forward; but the majority, being neither the one nor the other, might be considerably helped by their teachers if more accurate measurements of abilities were available, and school-leaving reports could be made more useful from the business point of view.

Some group averages are appended for comparison:—

TESTS AND PERCENTAGES.							Average age %
	Age yrs.	1	2	3	4	5	
Day School:							
Girls (bright).....	8	50	26	0	80	00	35
Boarding School:							
Boys and Girls	10	48	28	9	47	41	35
"	12	62	44	31	65	79	56
Day "School":							
Boys (backward)	12½	50	31	3	33	00	38
Boys	12½	52	35	0	55	08	42
Boys (sharp)	12½	64	43	8	71	71	52
Boarding School:							
Boys and Girls	13½	66	53	38	66	73	59
"	13½	65	55	51	78	76	65
Deaf "Boys" and "Girls"	15	49	38	10	36	43	35
Matriculated Girl	16½	62	63	83	79	75	72
Matriculated Boy	17½	68	75	70	87	84	77

PART III.: NATIVE ABILITY AND ACQUIRED SKILL IN THE WOOL TRADE.

Whatever opinion may be formed about the mental age level of children or adults, it is "improbable that development as a whole is completed at any particular age, either for individuals or on the average. Emotional development, maturity, skill, acquisitions, aptitudes, and the like probably continue to develop indefinitely." Training and experience have the effect of merging native ability into acquired skill until, finally, they are difficult to separate.

WOOL QUALITY STANDARDS: Measurements of acquired skill on wool and its fabrics are complicated by reason of the fact that there are several standards:—(1) the nominal trade standard; (2) the firm's standard; (3) the individual's standard; (4) variations within the individual due to physical and mental changes. In ordinary trading there is no physical standard by which quality or yield can be definitely ascertained. It was necessary, therefore, to accept some nominal trade standard. The War Department Quality and Country of Origin answered this purpose, the Bradford Conditioning House standard tests for yield being also adopted. Fifteen qualities from 40's to 80's were judged in the greasy and scoured states, two of these samples being specially selected because of their sandy and deceptive nature. In order to show measurements of judges accustomed to handling a specific type of wool, five merinos were selected as an example for comparative purposes, and a final measure in percentage given, based on one quality, representing 20%.

In one case of great accuracy of judgment during dry weather (96%) the percentage was reduced to 84 in wet weather 14 days later. Again, a taker-off of 17 years' experience with high accuracy (again 96%) had working with him two sorters of 13 and 7 years' experience respectively, the former showing an under-estimation in every instance, amounting to about 20%, and the other an over-estimation to about the same extent.

In the case of an individual holding a most responsible position, the wearing of glasses appeared to alter judgment considerably, whilst in another case judgment was very much improved by a subsequent visit to an optician. In the case of a student of 3 years' experience, 92% was recorded, whilst a student with one year of experience (intensive) reached 94%, but a qualified man who had ceased practising for 18 years only recorded 74%.

Yield already allows of measurement by percentage, which need not be laboured here. The highest skill was represented by the steadiest yields on qualities familiar to the judge, who, however, made wider estimations on unfamiliar qualities, as might be expected. Students and woolsorters without experience (practical) averaged from 10% to 14% error.

COUNTRY OF ORIGIN: Ability to decide the country of origin is most valuable. One judge named all samples correctly; 85% to 90% seems to be very sound judgment. A good "quality" and "yield" judge only recorded 66% on "origin," whilst an inexperienced student judged 53% accurately.

GREASY AND SCOURED WOOLS: Though admitting that group averages are most deceptive, they serve

as an indication of tendencies. The following show the variations:—

(a) selected individuals on selected qualities,

(b) all individuals experimented upon every quality with which they were unfamiliar, as well as their specialities, students being placed in their own groups.

	(a) Selected Groups.		(b) All.	
	Grease.	Scoured.	Grease.	Scoured.
Worsted Buyers	90	74	76	66
Top Makers	89	85	78	73
Sorters	86	79	61	66
Woollen Buyers	87	88	76	71
Students	87	87	—	—
Average	88%	83%	73%	69%

JUDGMENT ON GREASE AND SCOURED: Buyers for worsted do not handle scoured wool, whilst buyers of woollens do so in varying degree. Thus a worsted buyer scored 92% grease and 54% scoured, against 76% grease and 92% scoured by a woollen buyer. Top makers' records were steadier for the reason that they handle wool in both states. The records showed that the general level of quality accuracy is increased by experience on specific types of wool.

NATIVE ABILITY v. ACQUIRED SKILL ON SCOURED WOOL: Scoured wool gives an opportunity for comparison between native and acquired ability. In the case of the skill now enumerated, allowance should be made for the fact that most of the judges had been accustomed to greasy wool. The native ability recorded is by children of 12 years of age to ladies of 40 years, all inexperienced in handling wool. The test consisted in (a) grading ten scoured qualities of War Department Standard, 40's to 80's; (b) replacing selected samples on their proper qualities; and (c) grading by touch alone.

S.	N.	(a) Grading.		(b) Selection.		(c) Touch.	
		Skill	Native	Skill	Native	Skill	Native
1	2	80	80	70	50	90	70
3	4	90	80	90	90	70	90
5	6	90	80	90	90	80	50
7	8	90	40	75	85	60	10
9	10	70	70	70	65	80	80
11	12	100	100	70	70	70	30
13	14	90	60	80	50	70	90
Average %..		87	73	78	71	74	60

CHARACTERISTIC DIFFERENCE IN SKILL: The average differences are not so great as might be expected. A familiar tendency in all experiments is again noted, e.g., that the highest skill shows a steadiness not present in the untrained. The differences between the maximum and minimum scores in each group are:—

	Group (a).	Group (b).	Group (c).	Average %
Skilled	20	20	30	23
Native	60	40	80	60

TOPS: Tops were again standards from the War Department qualities, 30 samples being judged for sight, touch, sight and touch together, and "full trade" judgments. Two officials of the Department ("a" and "b"), who were in daily touch with the majority of the goods experimented upon, very kindly assisted. A good many experienced buyers and some students also gave time. For the purpose of this enquiry, the judgments of six persons were taken, the total accuracy being represented in percentages, together with over (plus) and under-estimation (minus)

of War Department standards. "A" undertook experiments when mentally disturbed, and also when in a good buying humour. Seconds per unit of judgment are also appended.

	Sight	(T*)	Touch	(T)	Both	(T)	Full	(T)
(a) Worried Judgment—experienced.	76+10 -14	23	74+12 -14	14	83+8 -8	46	+4 96-0	16
Calm Judgment	88+7 -5	16	73+1 -26	0	91+5 -4	11		
(b) Experienced	89+8 -3	16	86+3 -11	16	88+10 -2	16	90+10 -0	32
(c) Experienced	89+3 -8	14	65+0 -35	13	88+4 -8	12	94+4 -2	14
(d ¹) Experienced (weak eyes all)	71+1 -28 with glasses	61	76+10 -5	34	77+10 -4 without glasses	50	72+4 -24	13
(d ²) Speciality Merinos (weak eyes) ..	62+0 -38 with glasses		78+6 -16		84+4 -12 without glasses			
(e) Moderate (father)	60+30 -1	18	74+24 -2	17	66+32 -2	13		
(f) Student one year (son)	77+21 -2		74+20 -6		70+24 -0			

* T—Time in seconds per unit of judgment.

of repute in the district. These were judged for quality, counts, and turns per inch. In the initial experiments, the yarns were taken in haphazard manner, but shortly afterwards methods suggested by Mr. Bartlett, in connection with the Admiralty submarine work, were adopted with advantage. Commencing with the lowest quality, an irregular rise to the finest quality was presented, followed by a downward movement. Duplicates of the first samples were inserted at intervals, in order to check judgment. A selection of five qualities and duplicates taken from the complete list may serve to illustrate the results obtained.

Six judgments by each of two buyers, agents, and technically trained spinners, give a representative idea of trade skill. The final results of measurement in percentages, showing the deviation from (1) the person's own judgment, (2) the firm's standard, and (3) response to personal suggestion, are as follows, and attached is also the individual's estimation early in the test, compared with his estimation towards the close :—

FINAL JUDGMENT ON 80's, 70's, 64's, 40's, AND 36's

	Qual.	From Own Standard.	Counts	Turns	Average %	Resist- ance to Sugge- stion.
1. Experienced Yarn Buyer	88	86	92	89	90	
2. Agent	88	78	80	82	90	
3. Technically trained spinner	88	72	86	83	90	
4. Do. Do.	88	78	84	86	95	
5. Agent	96	80	94	85	80	
6. Inexperienced Buyer ..	28	68	56	50	70	

	Qual.	From Firm's Standard.	Counts	Turns	Average %
1. Experienced Yarn Buyer.	89	87	74	83	
2. Agent	84	80	85	86	
3. Technically trained spinner	87	78	91	85	
4. Do. Do.	82	77	73	77	
5. Agent	88	88	57	78	
6. Inexperienced buyer	50	16	36	34	

INDIVIDUAL DIFFERENCES IN JUDGMENT: The following observations are suggested by the foregoing records :—

(a) The difference between worried and calm judgment is represented by a narrowing of extremes of error; by greater accuracy; quicker time.

(b) A very sound judge, because of the independent accuracy of the senses in conjunction with a good full judgment. This would be valuable in adverse climatic and mental conditions.

(c) A very accurate full judgment, but decidedly weak on touch.

(d¹) Was disturbed by lower qualities with which he was not familiar; and on his speciality (d²) his glasses appeared to affect judgment, whilst his touch was high.

(e) and (f) Father and son trained quite independently and only have relationship in common. Show characteristic over-estimation, possibly the result of a temperamental, optimistic spirit. Touch in (e) is higher than sight or both; a keen hobby has doubtless trained touch.

Experiments on born-blind ladies over the same samples showed remarkable discrimination as to fine differences, merinos being placed exactly in order of quality, though this does not seem possible by touch alone in the trade.

YARNS: Thirty samples, ranging from 2/16 32's to 2/60 80's were willingly supplied by three large firms

CHARACTERISTICS OF GOOD AND POOR JUDGES: It may be observed that :—

(1) Two measures are possible—one showing the deviation from the standard, and the other from the judge's previous opinion. In both cases, the over and under-estimation are recorded :

(2) There are obviously five good judges, and one poor.

(a) 88% to 96% good, and 28% poor from own judgments.

(b) 82% to 89% good, and 50% poor from the standard range.

(3) There is a very high correlation between good judgment of the standard and one's own judgment, and a very low correlation in the case of the poor judgment.

(4) **TURNS:** In the estimation of turns, there is a marked tendency to over-estimate the standard. No. 3 has special knowledge of turns, being a practical and technical expert. Probably, mechanical testing has reduced skill in turn estimation.

(5) **FATIGUE:** On quality, the figures show a tendency, in the sound judgments, to be higher or lower as fatigue sets in according to individual differences.

(6) **SUGGESTION:** Good judges are not suggestible. In business life, No. 6 could readily be made to believe a sample one quality better than it was. On the other

hand, No. 4 would be especially difficult to influence as a buyer.

DYED CLOTHS: The samples used were most carefully produced under controlled conditions, and were examined by fifty persons in ten trade sections. Though woven and dyed alike, the samples showed very minute differences caused by combing, drawing, and spinning only. As this constitutes a basis of another enquiry, details may with advantage be omitted on this occasion.

Three good and three poor judges of observation and technical knowledge are contrasted in what can be regarded as a most difficult test.

Observation.		Technical Knowledge.	
Good.	Fair.	Good.	Fair.
92	77	71	37
96	83	65	33
95	70	64	37

As in other experiments, good judges show high figures, whilst indifferent judges are not able to discriminate in regard to minute differences presented. Several ladies and gentlemen not in the trade attempted to grade the samples, but all found it impossible. Acquired skill far exceeded any native ability.

BURLING AND MENDING: This serves as an illustration of native ability, on which acquired skill may be based. The experiments were intended to measure accuracy and neatness of aim, speed of action, quick colour judgment.

The subjects were instructed (1) to pull pins from a cushion with burling irons as quickly as possible; (2) to sort a pack of cards having ten different tints; (3) to name each colour aloud from a card, and, at the same time, to touch the same colour placed on the table; (4) to prick certain points on a paper with a pin.

The tests show that a qualified teacher of burling and a highly skilled burler compare very favourably with slow or indifferent, but practised, burlers. The records of five individuals are as follows:—

Test	1	2	3	4	Average %
(a) Qualified teacher of burling and mending .	77	73	75	75	75
(b) A skilled burler	75	72	76	75	74
(c) Good burler, with 9 months' training	65	65	66	77	68
(d) Experienced, but poor, burler	70	52	62	58	60
(e) Well educated lady without experience, but of known ability, accuracy and speed. (Latent ability.)	73	76	83	83	79

Without wishing to draw hasty conclusions from these figures, they do appear to represent variable trained ability in *a*, *b*, and *c*, with lack of native ability in *d*, and known native ability in *e*. The erratic movements of *d* were in strong contrast to the steady and graceful movements of *a*.

COLOUR MATCHING: This was tested from two excellent trade Shade Cards of non-mercerised cotton, issued to the trade by Messrs. J. & P. Coats Ltd. From one of these cards, twenty difficult tints were selected, and mounted on a separate card. Twenty-five persons, viz., (1) teachers of art; (2) wholesale and retail buyers, manufacturers, dyers, agents, merchants; (3) ladies not in the trade; and (4) elementary school

children. Each person selected twenty tints from a total of 320 on the shade card. The test may be regarded as a difficult one. Counting 5% for each accurately selected, and 2½% for acceptable trade substitutes, there was a maximum limit of 90%, and a minimum of 47%. Time occupied varied from 17 seconds per unit of judgment to 72 seconds. The highest and lowest records in percentages in each group were as follows:—

	Accuracy: %		Time. (Secs.—same persons.)	
	Highest.	Lowest.	Highest.	Lowest.
Art	85	72	24	45
Trade	90	47	36	57
Ladies	80	65	20	30
Children	72	47	70	72

It will be noted that accuracy and time do not necessarily go together. In the case of one person of known ability, an unaccountably low score of 47 was made, which was found out six months later to be an indication of the beginnings of a nervous breakdown. This effect has been noted in connection with other experiments, and opens up a medical question of some interest. On the other hand, a girl of 12 years of age, with known artistic ability, recorded 72%, which encouraged the headmaster to secure her admission into an art school.

THE INVALUABLE MEMORY: Experiments on the highest skill continually reveal the importance of memory as against comparative judgment. The tendency of the practical mind is to act rapidly, which, in effect, means relying on memory; the scientific mind seeks a physical and exact standard, which, obviously, is a slow process. It would be folly to under-rate the value of mechanical appliances. Wherever they can be employed, the better will be the result. But circumstances, in the main, favour rapid action. The analytical constructor of cloth must, of necessity, make every use of such appliances, but the wool-buyer and commercial traveller, for example, would be hampered by their use.

TESTS FOR SIGHT-MEMORY: Tests on minute differences of sight-memory reveal striking features. The general level in the trade is about 65%, with variations downwards to 45%, and upwards, in very exceptional cases, to 95%. One person with an extraordinary visual memory scored 100%, and three hours afterwards 95%, without the knowledge that the test would be repeated. Similarly, mind-memory is revealed daily by many of our leading business men, who do not make the copious notes so common with others. The value of memorising as to touch and smell is also obvious.

MEMORY TRAINING: Such experiments call attention to the necessity for training in these different types of memory. Business men with excellent memories for standards, and who are temperamentally quick, are, to say the least, most difficult to compete with.

PART IV.: RESPONSE TO PERSONS.

The previous allusions to suggestion indicate in a very small way the re-action of one mind to another. The practical application of this in business is too well known to Bradford gentlemen to need emphasis. As buyers, a strong resistance to suggestion is most

important, but, as sellers, the future may require abilities of persuasion as well as knowledge of goods.

CHARACTERISTICS OF COMMERCIAL TRAVELLERS: A few experiments made with gentlemen whose sole occupation is selling show a rapid response to a great variety of awkward and difficult situations. One experiment consisted in the careful preparation of 25 brief questions, which were to be answered instantly and without time for thought. One clever commercial gave 24 answers which could be accepted as correct; some were not the stereotyped answers expected, but were of such an original nature as would have met the circumstances admirably.

RAPID OBSERVATION AND ADAPTABILITY: Tests on memory—individuals suddenly asked to close the eyes and describe surroundings—indicated that observation, consciously or unconsciously, had been acute. Similar tests on men with only slight experience showed an accurate response to only 5 to 10 questions, with no originality or adaptability. Observation was very superficial also.

If such experiments were extended, it might lead to more attention being paid to selling ability, both native and acquired. Whilst it is, perhaps, perfectly true that travellers are born and not made, that is all the more reason why we should find the born ones.

CONCLUSION:

Fine discriminations require accurate measurements, and are not of much value on a rapidly fluctuating market. But when values are steadier, and the difference of a small percentage in efficiency is important to this country, then some of the methods suggested may be worthy of consideration. The status of skill has declined, and any means of restoring it should be welcomed.

The cost of education has increased, and will continue to increase. One remedy may be found to be in increasing the individual ability to produce the most perfect goods, and, at the same time, by education and other means, to widen the outlook on life for leisure hours. Combined educational-industrial research should result in better use being made of native ability and acquired skill, and, thereby, in the reduction of the per-head cost of national education. The attitude of the Bradford Education Committee, by encouraging such work amongst teachers, is an indication of the importance attached to independent inquiry.

May I pay a most heartfelt tribute to the courtesy and unfailing kindness with which an amateur's experiments have been received. It would be impossible adequately to express in words the feelings of sympathy which both teachers and business men have shown. Beneath an apparent determination to look after the more material affairs of life only, there is a far wider appreciation of knowledge for its own sake than many people suspect, and which must be a valuable national asset in the future.

DISCUSSION.

The CHAIRMAN said the lecturer had given an excellent survey of a most important study, and his remarks had been immensely interesting.

Mr. BINNS said it seemed to be agreed that in the day schools, with the larger classes, the instruction must necessarily be more in the character of drilling, with the consequence that in the mechanical things of life they got better results from the elementary school children. When they came to the difficult and complicated problems, however, and the children had to solve them for themselves, the boarding school children appeared to come out best. He was told that it was exceedingly difficult to get the elementary day school teacher to fit in with the boarding school scheme.

A speaker stated that the better boarding schools trained their own teachers. Pupils were sent to the University, and later they returned to the schools as probationers for a year or so. They were then taken on the teaching staff or were appointed to a similar school. The procedure was very similar to the pupil teacher system of the elementary schools. He had found that the atmosphere of the boarding school was very different to that of the day school.

Prof. EWART (Edinburgh) said that in Scotland they were of opinion that day-school children had a better idea of things than had boarding school children. He would be glad to know what the lecturer intended by the term "native" ability. Did he mean Bradford ability, English ability, or in-born ability?

The LECTURER replied that the term implied "in-born" or "inherent" ability. At the same time, he was of opinion that there was a latent ability to be found in the woollen districts that would not be found, say, in a district given over to engineering.

Questioned as to whether he had found any difference between boys of sixteen who had started work as half-timers, and boys of the same age who had attended school full-time, the lecturer said he dealt with boys and girls as half-timers, and thought that if they took a very sharp boy as a half-timer he would be very sharp as a full-timer. It was determined largely by intelligence.

Mr. F. W. RICHARDSON, F.C.S. (Bradford), referred to the experiments regarding burling and mending, and said the question of eyesight was one of the chief factors. If they took two equally intelligent girls, one troubled with astigmatism and the other with good eyesight, they would give very different results when tested. It would have been better to have reduced them to an equal by giving them the proper glasses before the experiment. The girl with the good seeing eyes would be able to spot the things at once and be in a good position.

A speaker said he had noticed that in a number of cases where boys and girls had been supplied with glasses they had developed an impatience, and had become bad spellers.

Prof. EWART (Edinburgh) said it was an experience of American teachers that black boys were sharper than white boys up to a certain age, but that afterwards they fell right away.

The CHAIRMAN remarked upon the difference between the English and German systems of education, which seemed to give to the German that closer application to patient, scientific work.

The LECTURER, in reply to further questions, said his experiments were yet only in the initial stages.

Mr. G. R. GAUNT (Farsley) proposed a vote of thanks to the lecturer, and Mr. JOHN F. WHITE (Bradford) seconded, and said the experiments Mr. Binns had made might point out lines on which other investigation might be carried out.

The vote was heartily accorded, and Mr. BINNS, in reply, said that if his remarks had stimulated thought upon the lines he had taken he would be exceedingly glad. Anything they could do for the benefit of industry would be done. There was a tremendous amount of enthusiasm existing on all sides, and this fact was now being more fully realised.

GENERAL PROCEEDINGS, AND REPORTS

EMPIRE COTTON GROWING COMMITTEE: FUTURE ORGANISATION

The Empire Cotton Growing Committee is now in a position to outline the executive organisation it considers necessary to carry out the objects recommended in its main report published in January, 1920 (Cmd. 523). Most of the funds will be spent abroad in cotton growing countries, and in order to carry out adequately the work which the Committee is convinced must be done to stimulate cotton cultivation, an annual sum of £200,000 is needed.

The work which, according to the report of January, 1920, must be done, falls into three groups. Group I. will be mainly administrative in character and will include:—Questions affecting general policy, finance and establishment; correspondence with, advice to, and information from Government Departments, Local Administrations, Agricultural Departments and individual planters in cotton growing areas; organising and carrying through pioneer work in suitable areas and bringing cotton growers and other workers on cotton growing together by dissemination of information and by providing them with facilities for keeping abreast with progress and development throughout the world. Group II. will include:—Keeping abreast of, indexing, &c., information on all scientific and experimental work on cotton growing; collecting full knowledge of the characteristics of all varieties of cotton; keeping in close touch with the British Cotton Industry Research Association and fostering actual research on cotton growing by establishment of cotton research stations abroad and staffing these; work of a commercial character, such as valuing cottons and keeping in touch with all markets, where advisable guaranteeing prices to growers, taking the necessary measures to secure to growers better prices for better cotton, where desired ginning and marketing cotton and spending money on the promotion of the growing of cotton as compared with other crops.

A Central Office will be located in Westminster to co-ordinate work and to undertake the general direction and control. This office will maintain close liaison with the Overseas Governments and the Departments of the Home Government associated with them, and will also establish a journal. The Central Office will also select four Travelling Commissioners who will keep in touch with local development by systematic touring.

Further, the Committee propose engaging a staff for supplementing the staffs of agricultural departments overseas and pioneering. In working any such proposals the greatest stress is laid on the fullest co-operation with the local agricultural departments. The Committee also propose to assist in providing facilities for training men at the Universities for the various agricultural services abroad; such a staff will be of service to all industries using tropical vegetable products, and it is proposed to endeavour to co-ordinate

these industries in a common effort for this purpose and to provide funds to increase the University staffs in this country.

The annual financial requirements of the Committee are estimated approximately at:—£25,000 for the executive work, Central Office and Journal; £20,000 for research stations abroad; £115,000 for supplementing staffs overseas and pioneering; £12,000 for education. To this must be added the commercial handling for which no estimate has been framed, but which will require funds.

—L. M. S.

DEFECTS IN DYEING

Dr. L. L. Lloyd, in the course of an address before the West Riding Section of the Society of Dyers and Colourists, at Bradford, on the 23rd December, dealt with defects produced by sizing. In some cases, he said, animal size led to defects through careless preparation and through insufficient cleaning to remove the size before dyeing. In flour sizing, the defects were mainly caused by inefficient methods of treatment and unscientific methods of blending. The greatest difficulty was produced by unskilful blending of materials for antiseptic purposes. The majority of the antiseptic materials contained formaldehyde, and the effect of the formaldehyde was to convert into almost insoluble nodules the little lumps of size on the warp, which rendered uneven dyeing very probable. If the treatment were combined with any of the diastatic or tripace preparations, the possibility of defects was greatly reduced.

Another source of trouble was the use of soluble oils by the warper in order to reduce the time of conditioning. The temperature in crabbing was sufficient to polymerise soluble oil, and he had found that less than one-tenth per cent of oil left on the piece was sufficient to cause patchy dyeing. Fairly level results could be obtained with acid colours, though the defect would be visible, but with mordant colours the defects became very obvious. Indigo was perfectly level, and indigo bottoming, even to a very light shade, enabled either acid or mordant colours to be used satisfactorily. The cause of the defect was that the conditioning box from which the soluble oil was conveyed to the material was left in charge of a girl, and he had found in some cases no oil in the box, whilst at other times it was full. If the oiling were regular and constant, he did not think there would be any reason to object to the process.

The Chairman (Mr. H. Jennings) suggested that if they could standardise the sizes and other materials used in treating goods the dyer would be in a better position to know how to deal with them.

Dr. Lloyd said he did not see why the Society should not be able to co-operate with some other Society in order to get sizing standardised.

Mr. G. G. Hopkinson said the discussion indicated that there were many faults in the trade which could be obviated by a little co-operation.

—M.