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The relation between "artistic ability" and "intelligence"

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T H E R E L A T I O N
B E T W E E N
" A R T I S T I C A B I L I T Y "
A N D
" I N T E L L I G E N C E " .

by EWART MEWSE. M.Sc.,

THESIS PRESENTED FOR THE DEGREE OF
MASTER OF EDUCATION
IN THE UNIVERSITY OF DURHAM.

ARTISTIC ABILITY AND INTELLIGENCE.

This enquiry was undertaken with the object of investigating the relationship between general intelligence and artistic ability.

There are many considerations which indicate this to be a useful and indeed a valuable topic for investigation. Those who are concerned with the constitution of the curricula of our schools are aware that the subject of Art occupies rather a peculiar position. Speaking particularly of Secondary Schools, it must be admitted that Art has occupied in the past, and still occupies in many schools what can be fairly described as a position of less importance than that given to other subjects of the school curriculum. While some headmasters would be willing to admit, and indeed to defend, such preferential treatment of school subjects, others would stoutly deny its existence. In this matter of the relative importance attached to various school subjects a good deal of contention may be successfully avoided by the device of comparing the length of school time allotted to the various subjects. Such a comparison will reveal that art is still a long way from being admitted to be of equal value with other subjects. The struggle to secure the recognition of art as a subject in the School Leaving Certificate examination¹ is a further illustration of the subordinate position that art was considered to occupy. It is easily possible today, to find educationists who are still of the opinion that art (in common with other group IV subjects in the School Leaving Certificate examination.) constitutes a 'soft option' for those who have not the necessary intellectual ability to pass in the 'harder' subjects.

¹ Under the Durham Examining Board, Art has always been a certificate subject but originally on the rating that a distinction in Art was equivalent to a credit in any other subject. Art now ranks as a subject with matriculation value in the Durham Examination but has not been given the same recognition by other authorities.

It will be observed that the attitude adopted, where such opinions are held, is that the ability necessary for success in certain school subjects is superior to the ability needed for success in art. That artistic ability is different from that needed in other subjects may be true enough, and it is the object of this investigation to submit definite experimental evidence on this point, but to assume that it is necessarily therefore inferior is to take up a position which, I believe, has already done a great deal of harm in educational practice.

Further illustration of the peculiar attitude adopted towards artistic studies is afforded by that group of educationists who appear to find in the study of some form of artistic handwork an unfailing remedy for the treatment of those who show intellectual weakness. With increasing frequency in recent years one has heard the view expressed that the boy who has shown himself lacking in intellectual ability is fit only for some form of art or handwork. It surprises me greatly that those who are concerned with the development of artistic ability have not turned wrathfully upon the exponents of the above view and hotly repudiated the slight that has thus been made against the study of art. The virtue of forbearance must indeed have been exercised here in an unusual degree. Although I have seen no evidence in print I have at least heard the righteous indignation of teachers of art expressed verbally.

We come finally to those people who readily admit, often with every sign of satisfaction, that they are quite incapable of producing a drawing even of the very slightest artistic merit. It is rarely, if ever, that one meets a man who is ready, and pleased to admit his inability to, write a clear and connected statement, add up a column of figures correctly, solve a simple algebraic equation, or leap any other of the thousand and one intellectual hurdles which are the schoolmaster's stock in trade. Such

inability would only be admitted with shame. Why is it then that no such feeling of inferiority assails him when he lightly confesses to a complete lack of artistic ability? I hope I will escape a charge of cynicism when I suggest that he really has a theory (which, in fact, he is generally ready to expound) that artistic ability is entirely divorced from intellectual ability and that (by implication) the man who cannot draw well is probably an intellectual giant of the first order. It is to be noticed further that those who confess to a lack of artistic ability in an executive sense are rarely so ready to admit a similar deficiency in the matter of appreciating an artistic performance. Executive ability and appreciation are thus implied to be separable.

It is clear, from what has been said, that there are many unsolved problems, some of a profound nature, associated with artistic ability. The position of art as a subject of study in an educational course, cannot be clearly defined, until these problems are, in the main, solved. It is the belief of the writer that similar unsolved problems exist in relation to other subjects of the school curriculum. That there may be a special ability operating in relation to performance in art finds more ready acceptance than the view that special abilities exist also in relation to science, history, mathematics and so on. This may be due to the case of art being outstanding, though not unique. I am aware that a great deal of research has been carried out concerning the existence of group factors in the abilities used in school subjects and that there is little evidence in favour of the existence of special abilities such as could be called, literary, scientific, mathematical and so on. Those who are familiar with school work, however, know the powerful teaching influences which are brought to bear on pupils, with the object of forcing them all to reach a minimum standard of performance in all subjects. These influences (which may be recognised as due to the existence of a School

Leaving Certificate Examination) clearly tend towards the suppression of individual differences in school subjects such as mathematics, French and history and work in such a manner as to hide the special abilities whose existence has been suggested. Researches based upon school marks (and that is the usual procedure) must be affected by these levelling influences. If this argument be sound, the discovery of these special abilities awaits the developement of special tests to replace the ratings obtained by subjectively marked school examination papers. Just as it has been the object of intelligence testing to evaluate mental ability as distinct from mental achievement so, it would seem we need special tests to measure ability in various school activities as distinct from present attainment therein which of course may be affected by factors other than ability. In this way alone would special ability be revealed since individual differences in achievement are prevented and reduced rather than fostered under a system of mass education adjudged by a rigid, external examination system.

In his recent book "The Reliability of Examinations"¹ Prof. Valentine lays great emphasis upon the fact that the merit order of boys who have completed one year in a secondary school bears little resemblance to their order at entrance. The order fixed at the end of the first year however, undergoes but little change in the three years which follow. These facts he ascribes (p. 165. loc. cit.) to the existence of special abilities in the entrants which they were called upon to use in their first year's work (and subsequently) but which were unable to exert any influence in the kind of test (which frequently

REF.

1. The Reliability of Examinations.
By C.W.Valentine. Univ.of London Press 1932.

includes a mental test) employed at entrance. A more complete knowledge of the relative worth of the entrants (and also some who failed to gain admission) will become possible when there are available tests capable of measuring such special abilities as are required in the wider curriculum of the Secondary School. This digression, on the question of special abilities, has been made since it includes the particular case of artistic ability if such a special ability is shown to exist.

The particular problem concerning artistic ability which it is the purpose of this thesis to elucidate, is regarded as being of fundamental importance. It is a matter of great significance for educational purposes to know whether artistic ability is, generally, to be found in company with intellectual ability or whether the possession of marked intellectual ability serves as no guide concerning the nature of a boy's artistic ability. Whether, in fact, artistic ability correlates closely with general intelligence or whether it is to be regarded as a special ability whose distribution is independent of the distribution of intelligence.

It is clear that the terms "general intelligence" and "artistic ability" are both capable of a wide range of interpretation. It is necessary, therefore, to define clearly the meanings that are to be attached to these expressions throughout this investigation.

By "general intelligence" is meant that ability which is necessary for success in intelligence tests of the type which have now, to a very large degree, become standard. Tests of the type employed in such well known scales as the Otis Intelligence Scale, the Cattell tests, the Northumberland group tests of intelligence, Spearman's "Measure of Intelligence" and so on, are known to measure, to a high degree of reliability, some mental ability to which the term "intelligence" may be attached. It may be objected that the interpretation here placed

upon the word intelligence is extremely narrow and must reduce the importance or at any rate the extent of applicability of the conclusions reached in the investigation. It is contended, on the contrary, however, that such narrowness as results from thus defining the meaning of intelligence is not only desirable but necessary if we are to be able to attach any significance to our results. "Intelligence" defined in the manner just indicated is often regarded as a 'central intellectual factor'. This factor is considered to function, and to be mainly instrumental in determining success, in all intellectual activities. When referred to in this sense, Spearman's method of indicating it, in a non-committal manner by "g", is frequently adopted.

In defining the meaning of 'artistic ability' no such method as has just been applied in the case of "intelligence" is available, since this ability has not yet been subjected to the same degree of investigation. Indeed one may reasonably doubt the possibility of ever being able to define and measure artistic ability in this way. Attempts to do so are frequently met with scorn, particularly on the part of those who possess artistic ability in an outstanding degree. The association of "scientific measurement" with so delicate and indeed so "spiritual" a quality as artistic ability is strongly resented. The objections would carry much greater weight if they were not so clearly the same as were previously advanced against the measurement of intelligence by means of mental tests. Whatever may be accomplished, ultimately, in this direction, the situation at present renders impossible the definition of artistic ability in the manner just discussed. When applied in its widest sense, artistic ability may be used to refer to the visual arts, music, poetry and drama. It is clear, from what has already been said, that, of these, it is only intended to refer to the visual arts. Even this reduced statement is much too general since no attempt will be made to estimate ability in

modelling and craft work generally. The precise elements of artistic ability which it was considered possible to measure are discussed later (pages 60-64) Here, we may say that 'artistic ability' is used to mean the ability to execute or simply to appreciate a drawing, where the term drawing must be understood to include representational drawing, imaginative drawing or a design and may be in black and white or in colour. While this statement greatly restricts the full meaning that may be attached to 'artistic ability', it is yet sufficiently comprehensive to cover those aspects of artistic ability which normally receive attention in our educational system.

The purpose of our enquiry may now be re-stated as an attempt to discover the relationship between 'general intelligence', "g", on the one hand and artistic ability (of the type exhibited in the usual school artistic activities) on the other.

Concerning the relationship of artistic ability with "g" there is very little published research. An extensive search through educational and psychological publications has revealed only slight information on this problem.

On the related topic of the correlation of artistic ability with abilities in other school subjects, there is considerable information, though not always of a reliable nature. Since certain school subjects correlate fairly highly with 'intelligence', a knowledge of the correlation of artistic ability with these subjects may throw some light indirectly on our own problem. For this reason these researches have been considered.

Previous researches concerning the intercorrelation of artistic ability with "general intelligence".

An attempt to measure "Art Appreciation" was made by T.F.Karwoski and E.O. Christensen in 1926.¹ They constructed appreciation tests of the type in which the better of two pictures has to be selected. These tests were given to 505 testees comprising (a) 222 General University Students
(b) 120 General Art Students
(c) 136 Advanced Art Students and
(d) 27 Art Instructors,

and lead them to form the conclusion that "the test selects those students who have art appreciation and that art appreciation may be measured"(p.190). 80 girls and 51 boys who were given these tests were given also the Thurstone Psychological test, Number 4, and "art appreciation" was found to correlate with "intelligence" to the extent of .299 for the girls and .264 for the boys. No evidence concerning the reliability of their tests is given.

More recently, in 1932, two other investigators undertook the task of estimating "art appreciation" and examining its relationship to "abstract intelligence".² In this research the tests used for art appreciation were those known as the Meier-Seashore tests and the McAdory tests. Now, the reliabilities claimed for these tests by their originators are respectively .71 and .93. The writers obtained reliabilities (a) for the Seashore tests, .78 (by odd and even scores) and $.61 \pm .06$ by a retest after one year and (b) .82 for the McAdory tests. The intercorrelation of the results of the Seashore and McAdory tests was then calculated and gave the surprising figure $.27 \pm .06$ (N= 111). We are forced to

1. "A Test for Art Appreciation" by Theodore F. Karwoski and Erwin O Christensen. Journal of Ed. Psych.Vol.XVII 1926.
2. "Abstract Intelligence and Art Appreciation" by Herbert A.Carroll and Alvin C. Eurich. Ibid. Vol. XXIII 1932.

conclude from this that both tests cannot be measuring the same thing. The tests were examined further by correlating their results with the known artistic achievements of art students. Resulting correlations were:-

(a). Seashore $.26 \pm .07$

(b). McAdory $.24 \pm .06$.

The writers appear then to have shown that these two tests agree neither with each other nor with the known artistic ability of the testees.

Finally, the results of the appreciation tests were correlated with the results of an "intelligence test (Miller's Analogies Test)" with the following results:-

Miller's Analogies v. Seashore	$.26 \pm .02$	(N=.874)
" " v. McAdory	$.10 \pm .05$	(N=.203)

In his "Examiner's Manual" Meier gives a correlation of $-.01 \pm .09$ between art judgement and general intelligence as measured by the Thorndike Mental Examination (N= 53)

The information, just reviewed, is all that has been found relating precisely to artistic ability and "intelligence". It can hardly be considered to throw much light on our problem. In the first place, only one aspect of artistic ability (appreciation) has received consideration and this, possibly, is a minor aspect. And secondly, the unknown reliability of the data in the first research and the mutually contradictory results in the second, make it impossible to draw a definite conclusion. If the results are admitted to have suggestive force, they indicate a low correlation between artistic appreciation and intelligence.

Researches concerning the intercorrelation of Scholastic abilities (including artistic ability).

B.D.Wood¹ reports that "the correlation ordinarily obtained between 'intelligence' tests and school examinations of the academic type has been found, at Columbia College, where the question has been thoroughly studied, to be about .672". The correlation of art with certain subjects of the school curriculum should therefore prove to be of interest in relation to our present purpose. On this topic there is a considerable amount of information. Many of the investigations about to be reviewed are based upon teacher-awarded school marks. It is considered advisable therefore, to discuss first the degree of confidence which may be placed in such marks.

In attempting to evaluate an individual's ability by examining his performance in a particular test, there are two main sources of error which normally vitiate the result. When the mark awarded involves a personal judgement on the part of the marker the result must be coloured by the marker's own views. Such a test when assessed by different markers will yield different results. The test is said to be subjectively marked.

Subjectivity in the marking of a test may be avoided, and the "personal equation" of the marker thus eliminated, by framing the test in the manner adopted in mental testing. Where the testees responses are restricted to the underlining of a particular word, complete agreement is reached by different markers in assessing the result. Complete objectivity in the marking is then said to have been attained.

It is necessary to realise that there are drawbacks attendant upon the attainment of objectivity in marking. Whereas certain simple

1. B.D.Wood. Measurement in Higher Education.

abilities readily lend themselves to assessment in this manner, there are others, particularly those of a creative nature, which are too complex to be analysed into a number of simple responses. It may be that increased knowledge of such abilities will result in making the analysis possible but at present we are very far from reaching this position in many cases. Such lack of knowledge concerning any particular ability must affect subjective as well as objective methods of marking. It still remains an advantage therefore, to adopt objective methods of marking rather than subjective methods, where knowledge of the ability to be measured permits this and where care is exercised not to interpret too widely the results of the objectively marked tests.

Without eliminating subjectivity from marking it is possible to estimate its influence, and possibly, in some cases to discover that its effect is slight. When this occurs and the ability in question is complex in nature, the subjective method of testing may be judged to be superior to an objective method of measuring the same ability. The influence of subjectivity may be estimated by a comparison of the assessments of the same test-performances, arrived at independently by a number of markers. Where the assessments show close agreement, the personal factor is unimportant. Where the assessments show marked differences, however, the ability in question cannot be considered to be measured by any one of them.

When the effect of subjectivity in marking on a test result has been either eliminated or estimated, the value of the result may still be affected by the second source of error to which reference has already been made. This concerns the suitability of the material used in the test. For the test to have diagnostic value the ability

needed for its correct performance must clearly be precisely the ability which it is desired to measure. Where it is difficult to frame tests conforming exactly to this requirement, a battery of tests each of which involves in a large degree the ability to be measured will yield a result more reliable than that afforded by a single test.

That a particular form of test has successfully measured some definite ability may be verified by calculating the coefficient of correlation between two successive applications of the same (or a closely similar) test, to the same set of testees. Such coefficients of correlation are regarded as measures of the "reliability" of the test in this special sense. A high reliability affords no guarantee that a test is measuring what it is desired to measure, but merely that it is measuring something.

The tests employed in mental testing are highly objective, are designed to measure a certain form of ability and have high "reliabilities".

The tests employed in school examinations generally stand at the other extreme, being subjectively marked, measuring in all cases a very wide range of abilities, and having no known "reliability".

McCall, in "How to measure in Education"¹ gives the range of reliability for typical teacher tests as "much lower than .5".

John W.Cox in his book "Mechanical Aptitude"² reports the intercorrelation of school marks awarded in two successive years in three elementary schools as .40, .60, and .42, average $.47 \pm .06$.

1. How to measure in Education. W.A.McCall. (p. 396).
2. Mechanical Aptitude. John W.Cox. Methuen. 1928.

Information concerning the wide range of marks awarded by different markers for the same test-performance (in this case an essay) is given by G.H.Thomson and S. Bailes in "The Forum of Education"¹ 1926.

Recent experiments, again concerning the marking of essays and English literature papers, have revealed the amazing extent to which subjectively awarded marks may vary with different markers. An experiment² which aroused considerable discussion in educational circles (and which is now generally referred to as the "Durham Experiment") was carried out with 48 scripts (Essays and English Literature) that had been written by boys (of Rutherford College Boys School) in the Durham School Leaving Certificate Examination. These scripts were independently submitted to seven markers who were in complete ignorance of each other's estimates but were fully aware of the nature of the test in which they were taking part. The markers were specially selected for their lengthy and wide experience in such marking and it may be confidently accepted that the estimates submitted by each marker were in all cases the result of highly conscientious and fully experienced work. In the report, the following comment appears on the nature of the results:-

"The Board had expected to find some divergences of opinion as to the relative merits of individual essays or précis, but the extent of these variations proved to be astounding. Here for example, were the actual percentages awarded

1. "The Reliability of Essay Marks" by G.H.Thomson and S.M.Bailes. Forum of Education 1926. Vol.4.p.85.
2. Full particulars are given in the Journal of the Assistant Masters' Association Dec. 1931 and Feb.1932 by C.Roberts and H.V.A.Briscoe, and some (erroneous) details are given by C.W.Valentine in the "Reliability of Examinations" page 30.

for paper 1. (Essay and Précis) by the seven examiners to the candidate regarding whose merits they differed most widely".

Examiner.	1	2	3	4	5	6	7
Candidate X.	28	32	46	56	56	58	80 %

↓
definite
failure

↓
distinction.

In the case of one boy only out of 48 were the seven examiners agreed as to the class (pass, credit etc.,) of the candidate.

Dr. Williams reports ¹a further experiment in which 50 compositions were marked, on a previously carefully standardised scale of marking, and the results "were even more bewildering than the Durham Experiment". One of the compositions occupied nearly every position in the list from 1st to 46th. Marks ranging from 16% to 96% were awarded to it.

Such then is the extent to which an order of merit list may depend upon the personal views of the marker. The results quoted here are for the marking of essays and English literature papers and it may be contended that such wide discrepancies as are revealed here would not be found in the marking of other school subjects such as mathematics. It is true that subjectivity in marking will not affect all school subjects equally but, what is seldom realised, and what we have attempted to demonstrate here, is that the unknown factor introduced by subjectivity in marking may be so powerful in its effects as to render such marks almost useless for measuring purposes. And this applies even when the marking has

1. The Northamptonshire Composition Scale
by G. Perrie Williams. 1933.

been carried out with the greatest care and skill of which the marker is capable.

In the researches now to be discussed, artistic ability (or drawing ability as we must here be content to consider it) has usually constituted a minor part of the investigation and has received in consequence, a relatively small amount of attention.

One of the tests used by William Brown in his investigation¹ concerning the abilities of 40 boys of a London Higher Grade school (ages 11-12) and 39 girls of an elementary school, is stated to be a test of drawing (No. 11). No information is given concerning the value of the test nor was the reliability of measurement estimated, although this was done for other tests. The correlations given by him for drawing and school marks (.51 for the boys and .00 for the girls) can hardly be considered to be of importance.

In Dr. Carey's investigation concerning the "Factors in the Mental Processes of School Children"² school marks awarded for "painting" to children in four L.C.C. elementary schools are used to obtain the correlations of this subject with other subjects of the curriculum. Low correlations (.17 — .44) except with needlework (.52) were obtained, but here again the remarks already made concerning the validity of school marks for this purpose, apply.

The work done by Burt³ on the relation of educational abilities is well known. Experimenting with 120 children (ages 10-12)

1. "Some Experimental Results in the Correlation of Mental Abilities" by Wm. Brown. Brit. Journ. of Psychology. Vol.III. 1909. p.206.
2. "Factors in the Mental Processes of School Children" by N. Carey. Ibid. Vols. 7 & 8. 1914-17.
3. "The Distribution and Relation of Educational Abilities" by C.Burt. L.C.C. Memorandum. 1917.

from two schools he applied educational tests to measure ability in the subjects of the elementary school curriculum, including drawing. Discarding school marks as being insufficiently reliable he arranged that subjects like drawing and composition should be marked by mutual comparison of the performances to be marked and in such a manner that the marks awarded should be distributed normally over a pre-arranged scale. Further "all the children were tested at least twice in each subject on different days. The tests were applied personally and the papers marked (with one or two small exceptions) by the same individual throughout". It is clear that the subjective influence of this marker on the results has not thereby been eliminated. Burt obtained low correlations between drawing and other subjects, ranging from .12 with dictation to .38 for composition. Higher correlation was shown with handwork (.50) and writing (quality) (.57). He deduced further that drawing correlated with "general educational ability" to the extent of $.24 \pm .06$. He finds evidence in his results for the existence of a special ability functioning in connection with drawing, handwork and writing(quality). He considers Carey's results (in which, as we have seen, drawing ability figures as school marks awarded for 'painting') and concludes that they are in agreement with his own. This may be true as far as the general nature of the results is concerned but it can hardly be contended that what Burt measured as 'drawing ability' was necessarily the same as Carey estimated by school marks in 'painting'. The nature of the test applied for drawing ability is revealed in his later publication in 1921.¹ The pupils were asked to "draw a man". Discussing here the nature of his results he says (p.317) "Tests of drawing do not, in my experiments, show high correlations with

1. Mental and Scholastic Tests. C. Burt. L.C.C. 1921.

intelligence or educational ability". And again (p.325) "of all special scholastic abilities, that which underlies drawing is the most easily verified".

An investigation in which the general conclusions reached by Burt were considered to be confirmed, was carried out by H.G.Stead in 1923.¹ Here the conclusions were based upon the marks awarded in the terminal examinations at two schools. The investigator makes a special point of the care which was exercised in awarding the marks at one of the schools and implies that we may therefore place considerable faith in the validity of the results. We recall that the marking of papers in the Durham Experiment was carried out with exemplary care, and that this did not render the combined result of the marking any more reliable. A more serious criticism may be made against the paper we are discussing. The results which were obtained from the marks of the Second School were considered to confirm the conclusions reached in the first part of the investigation from the marks of the first school. In particular drawing is found, in both cases, to show low correlations with other subjects. He says "there is little doubt that these subjects (drawing, woodwork) involve abilities which are, in the main, of a different nature from those involved in the successful performance of the other Subjects" (English, Maths. etc.,) But the drawing marks given for the second school appear under the heading of 'geometrical drawing'. While it is permissible to associate these marks with those for drawing from the first school, it would be a difficult matter to say what ability was thereby measured, and it is definitely misleading to infer that the same ability is measured in both cases. What is clearly needed here is some

1. "Correlation of School Subjects" by H.G.Stead.
Forum of Education. Vol.1. 1923.(p.27).

information concerning the nature of the tests on which the marks were awarded. Until this information is given full consideration, any conclusions drawn concerning the existence of special abilities must rest on entirely inadequate evidence.

Stead summarises (p.29) previous information on the intercorrelation of scholastic abilities. For drawing the following correlations are given:-

	Geog.	Alg.	Geom.	Latin.	Maths.	Hist.	Science	Eng.	French
			.06(B)	.40(A)	.02(A)	.10(A)	.30(A)	.20(A)	.30(B)
Drawing.	.12(c)	.20(B)		.10(B)	.14(C)	.10(B)	.33(B)	.15(B)	
								.15(C)	

References A, B, and C are given at the bottom of the page.

The correlations here given are all low but we are still left in doubt concerning what exactly was measured and the degree of reliability in the measurement.

- (A). Brinkerhoff, Morris, and Thorndike.
"Columbia contributions to Education". Vol.XI.No.2
- (B). S.C.Parker using marks of 245 first year high school pupils quoted by Thorndike in "Educational Psychology" (p.36) 1903 edition.
- (C). Smith "using teacher's marks for 1525 grammar school subjects as taught in New York City schools.

Stead quotes a statement from a paper by E. Elderton¹ to the effect that correlations of drawing with other school subjects are "extraordinarily low". Miss Elderton does not base this statement on any experimental evidence of her own but merely on the results that she has deduced from a statistical treatment of the material given by M. Ivanoff² in "Archives de Psychologie" VIII 1908, concerning 1405 boys. Her conclusion is conditioned by the statement (p.222) "If we can trust the data".

A further investigation by Stead,³ in 1925, although concerned mainly with the inter-correlations of (1) Scholastic ability, (2) Mental ability, and (3) Character, does contain some intercorrelations between school subjects, including drawing. The correlations coefficients for drawing with other subjects range from .04 with Essay to .22 with Arithmetic (Rules). The exact nature of the drawing test was as follows:- "All the subjects were instructed to draw a man, woman, boy or girl doing anything they liked". (p.202). Marking was carried out by first placing the drawings in groups of approximately equal value and then transferring drawings from group to group where considered necessary. And, at last, we meet a statement concerning the evaluation of the drawings. He says "(the drawings) were all marked by the writer, in order to secure uniformity in marking, as far as possible". (p.202). To assess the relative values of drawings of the nature described must have been a difficult task, but

1. Biometrika Vol. VII 1909. (p.222)
"On the Association of Drawing with other capacities in School Children" by Ethel M. Elderton. Galton Eugenics Library.
2. "Recherches experimentales sur le dessin des Ecoliers de la Suisse Romande". M. Ivanoff. Archives de Psychologie III. VIII. 1908.
3. "Factors in Mental and Scholastic Ability"
H.G. Stead. Brit. Journal of Psychology. Vol. XVI. 1925-6. (p.199)

no matter how carefully or with what skill this was done the final result would still be affected - to an unknown degree - by the subjective nature of the marking.

F.Sandon¹ in "a Statistical study of some school marks" gives the correlation between drawing and general school ability as "up to .5". He admits the results to be very crude, estimates being based on small numbers.

The final research to which reference is to be made is a recently published investigation by J.H.Wilson,² the object of which was to discover what group factors were revealed in the abilities involved in a School Certificate Examination. Using results for 110 pupils (in his second experiment) and for 77 pupils (in his third experiment) he obtained evidence in both cases that art (in common with handwork and needlework) involves an ability of a special nature. The correlation between ability in art and the general ability which was found to function in the performance of all subjects was relatively low, $.372 \pm .055$ (N= 110) and $.186 \pm .075$ (N= 77). Correlations of art with its 'specific factor' are given as .928 and .982 for the same two experiments. These specific correlations were so high as to suggest "that, for satisfactory tests of the special ability here involved, there may not be long to wait" (p.106). The experimental data used in this investigation was obtained from the results of the School Certificate Examination conducted by the Northern Universities Joint Board in 1929. While it is well known that under this particular examining Board great care and attention is given to the problem of standardising the marking, (the large number of candidates must, of course, make this standardisation essential), and while it is

1. "A Statistical Study of Some School Marks" by F. Sandon. Forum of Education. Vol.4. 1926. (p.223).
2. "Group Factors among Abilities involved in a School Certificate Examination". JH.Wilson. Brit. Journal of Educational Psychology. Vol.III. parts 1 & 2. Feb. and June. 1933.

often assumed that School Certificate marking may be accepted with perfect confidence, those associated with these examinations are quite aware that such confidence is by no means universal.

The investigations concerning the correlation of scholastic abilities, which have now been reviewed contain, in all cases, some information about drawing ability. The data which has thus been collected is so frequently of minor importance or of so uncertain a nature that there is little encouragement to draw conclusions. We may say the available data appears to indicate a low correlation between drawing ability and other scholastic abilities.

We must proceed now to the presentation of the method adopted in this investigation and the results obtained therefrom.

(22).

A.

Record of the Experimental work
undertaken in this research.

This investigation is most easily considered, and will be described in three parts.

- I. The grading of 128 boys for "intelligence"
- II. The grading of 128 boys for artistic ability.
- III. An examination of the correlation between the orders obtained in parts I and II.

For testing purposes it was necessary to have a group of testees, homogeneous with respect to age, but revealing considerable range both in regard to "intelligence" and artistic ability. Since orders of merit were to be correlated it was further to be desired that the group should be sufficiently large to reduce the probable errors of the correlation coefficients to small values. The testees moreover had to be available for testing purposes over a considerable period of time (some months) since it was not possible, nor was it considered desirable, to have all the tests performed at about the same time. It was found possible to set some of the tests in the normal course of the school time-table, but others, requiring the entire group to be tested at one time, needed special adjustments of the time-table.

All the preliminary requirements concerning the group of testees were fulfilled through the kindness of Mr. W. Maw, the Headmaster of Rutherford College Boys School, who permitted the testing of the entire Fourth Form in that School. Grateful acknowledgement is here made for that privilege.

The test group initially contained 137 boys, but by the time all the tests had been completed, 9 of these boys had missed one or more of the tests and were excluded from the lists. We were left with a group of 128 boys who had completed all the tests. These boys were all in the same school year and constituted a

suitably homogeneous group in respect of age. The average age was 13 years 8 months with a standard deviation of 5.2 months.

In addition to expressing my gratitude for the kindness of Mr. Maw, I must also acknowledge my deep indebtedness to others whose hearty co-operation made this investigation possible. The following art-masters:-

- | | |
|-------------------------|---|
| Mr. H.H.Burns, A.R.C.A. | - Art master at Rutherford College Boys School. |
| Mr. F. Loughton. | - Art master at Heaton Secondary School. |
| Mr. C.W.Fallows. | - Art master at St. Cuthbert's Grammar School. |
| Mr. J.G.Herron | - Art Master at Shiremoor Central School |

readily undertook, and carried out in a thorough and painstaking manner, the large amount of marking which was required in part II of this investigation. In addition to this they were always willing to give their time and professional knowledge for the purpose of critical discussion of the objects of the investigation. I feel I am under special obligation to Mr. H.N.Burns. He is an enthusiast in all matters relating to Art education. The full weight of his enthusiasm was thrown into this enquiry, and he permitted his school periods with the Fourth Form to be used for testing purposes. Professor Mains of Armstrong College has kindly discussed matters relating to this investigation. When eventually, the results of the experiments were all available for listing and recording, I found that the extent of my indebtedness increased enormously. I cannot speak too highly of the careful and readily offered assistance which was given to me at this stage by some of the boys of the Sixth Form of Rutherford College. I had always known them to be willing workers but was rather surprised, as well as delighted, when I discovered that their desire

to be of service was strong enough to bring them back to school on Saturdays and - during the vacation! To Mr. J.R. Balsdon of Rutherford College I am indebted for the excellent photographs of the groups used in the drawing tests. To all of these my thanks are due and to some members of the Staff of Rutherford College for assistance in supervising the Art tests.

P A R T I.

Grading the Testees for "intelligence".

--oOo--

It was decided to use two different sets of group tests for this part of the work. Very high reliability coefficients of the order of .9 are frequently claimed for particular types of group test but, although successive applications of the same (or essentially similar) tests may yield a reliability coefficient of this order, it cannot be maintained that "intelligence" is thereby measured to that degree of reliability. A fairer criterion of reliability will be got by testing the intercorrelation of two different sets of tests (compiled by different investigators) both of which, of course, purport to measure "intelligence".

An intelligence test, when normally employed, serves a double purpose. It arranges the testees in order of "intelligence" and, in addition to this, allows the performance of a particular boy to be compared with that of a normal boy of his own age. This second aspect of intelligence testing was entirely irrelevant to this enquiry. All that was required of the tests employed was that they should rank the boys in correct order of intelligence. It was necessary to realise that the boys being tested did not constitute a group which was representative of the general population of that age. Being Secondary School boys they had already been selected for intelligence. The effect of this was to make the range of intelligence in the group less than it would be for a completely representative group of boys. The intelligence tests selected had therefore to possess

sufficient discriminating power to cause a suitable degree of separation (or 'spread') amongst the testees. The tests used were "A Measure of Intelligence" for use in Schools" by C.Spearman and the "Otis Group Intelligence Scale - Advanced Examination: Form A." by A.S.Otis. Copies of these tests have been included in the Test Material folio (pages 1 and 2).

The 'Spearman' Test is designed for all normal children from 10 to 14 years. The maximum score obtainable is 163. The average age of the testees has already been stated as 13 years 8 months (standard deviation of 5 months). On account of the mild selection for intelligence mentioned above it was feared that the test would not yield a sufficient spread of marks and therefore lack 'discriminating power'. It was therefore decided to reduce the scores made, by penalising errors more heavily than in the usual system of marking which is one point for every correct response. The device was adopted of subtracting the number of wrong responses from the number right to get the score in each subtest. Owing to the easy nature of the tests there were very few instances, perhaps three in all, in which the number wrong exceeded the number right. In these cases the sub-test score was taken as 0. The scores obtained on the test, with this system of marking, ranged from 72 to 155. These marks were quite out of keeping with the norms published for the test but, as was previously pointed out, information as to the absolute standard of a boy's score was not required but simply his score relative to the others taking the test.

The Spearman Group test contains seven sub-tests. They are:- (1) same or opposite, (2) Synonyms, (3) Classification, (4) Questions

(5) Completion, (6) Analogies, (7) Inferences.

The test is administered orally. If the test is employed for its usual purpose of comparing performances with the stated norms it would seem that this oral feature of the test must introduce a variable and uncontrollable factor. It is certain that different investigators will not speak with equal clarity and that the testees will not be equally well placed for hearing. There are some instances in which a spoken word may be interpreted in two ways as with "wait and "weight". This difficulty is removed when the tester is aware of these particular words and writes them on his board. In this enquiry, I gave all the tests to the whole of the fourth form. The clarity of speech factor was, under these circumstances, constant. The testing, moreover was carried out with each of the five classes (4A.B.C.D.E.) separately and the number of boys tested on any occasion was never more than 30.

An investigation to establish norms for the Spearman Test was published in 1929 in "The Forum of Education". The writers¹ there state that the time occupied in giving the complete test is about 1 hour and 20 minutes. It was found in our case that to carry out the complete Spearman Test, including the preparation of the answer paper, the marking and checking of the results (all done by the boys) occupied three complete school periods each of 45 minutes duration. The total time thus needed (2½ hrs.) is far in excess of that stated in the above mentioned paper. And, in my opinion, is a feature which will affect the popularity of this test scale. The large amount of time needed is

1. Some notes of the standardisation of Professor Spearman's "Measure of "Intelligence" for use in Schools".
by E.H.Walters and F.C.Thomas. (loc.cit).

due to the fact that every test (163 in number) must be spoken clearly, twice. The instructions allow an eight second interval for each question to be answered. The average time necessary to state each question and repeat it with what was considered suitable clarity was carefully estimated as 18 seconds. These figures give a total of 1 hr. 10 mins. for the time needed to state the questions and have them answered. To this one must add the time taken to explain the sample exercises, the time taken by boys to number their answer papers, the time spent in supplying the answers and having the whole test marked, and finally the time spent in having the addition of the marks checked. These extras easily account for the total of 2½ hrs. In fact, it was found that many of the questions were so very easy that the eight second interval allowed was unnecessarily long and when it was observed that everyone was finished in perhaps, four seconds - the next question was given immediately. In very few cases was the full eight seconds interval used. It is very difficult to see therefore how the complete test may be administered in 1 hour 20 minutes. This question of time has been elaborated because it was felt, while the tests were being carried out, that most of the time was taken up in exercising the voice of the tester while only a small proportion of the time was occupied in exercising the minds of the boys. Three complete 45 minute periods of speaking, repeated five times! - make this test laborious for the tester, but it cannot be described as laborious for the testee. Surely this is a misuse of the testing time. An oral test may save the expense of purchasing printed forms but its drawbacks are many.

The Otis Group Intelligence Scale has been standardised for an age range from eight

years upwards. No upper limit is stated and it is found that the maximum score of 230 is never attained. It was thus anticipated that the tests would be of sufficient difficulty to cause a considerable spread among the testees. The tests were carried out strictly in the manner described in the manual of directions, and no attempt was made, as in the Spearman Test, to increase the range of scores by excessively penalising mistakes.

The Otis Group Intelligence Scale comprises 10 sub-tests which are called:-

1. Following directions.
2. Opposites.
3. Disarranged sentences.
4. Proverbs.
5. Arithmetic.
6. Geometric figures.
7. Analogies.
8. Similarities test.
9. Narrative completion.
10. Memory.

The test material is in the form of a printed booklet and, although certain instructions and explanations have to be given, these occupy comparatively little time. The testee spends a large proportion of the test time actually working the problems on the booklet. Responses are reduced to the underscoring of a word and in this way the total number of test items is made very large.

The testees were examined in two separate groups (of about 60 and 70). It was found possible, keeping strictly to the time intervals stated in the directions for each sub-test to complete the testing of each group in 75 mins. The whole of the testing was thus completed in one afternoon school

session. In these tests it was necessary that the time allowance for each sub-test should be strictly the same for each boy. All must start a sub-test together and finish together. With a group of 60 or 70 it was possible to see that this was done. The same strict supervision would not have been possible with the entire group of 128 testees.

The marking of the Otis Intelligence Tests is almost perfectly objective and extremely simple. The process, although mechanical is quite laborious if one marker deals with a large number of booklets. The objective nature of the marking makes it possible to employ a number of different markers and so distribute the labour involved. These booklets were marked by a team of 10 sixth-form boys working carefully under my instructions. A very few instances did arise in which judgement had to be exercised by the marker. These were all referred to me. All totals were carefully checked. These 10 enthusiastic and highly interested markers were able to complete the marking and checking of 128 booklets in 2½ hours.

In carrying out these two intelligence tests some conclusions were drawn with regard to their relative merit, from the point of view of administration.

The main point of difference between the tests was that the first was given orally while the second was in printed booklet form. Reasons have already been put forward why the oral method was considered less suitable and much more laborious than the booklet method.

It is this main point of difference between the tests which causes the time spent on each to differ so considerably. Treating the testees in groups, as already described, the total

time spent on testing with the Spearman test was $11\frac{1}{2}$ hours. The total time spent on the Otis Test was $5\frac{1}{2}$ hours. Finally, it became clear that if a test, for school boys, is to extend over a period of about one hour it must contain material which is inherently attractive and holds the attention. It was particularly noticed that the Otis Tests were enjoyed and that the keenness with which the first sub-test was tackled was maintained until the end of the last subtest. Anyone familiar with the problem of keeping a schoolboy working hard and interestedly at one kind of task for $1\frac{1}{2}$ hours must appreciate the excellence of this testimonial. On the other hand the keenness and interest with which the Spearman tests were commenced was not so much in evidence at the end of the third testing period.

For our particular purpose, the Otis tests were of a more suitable range of difficulty than were the Spearman tests. This is shown by the fact that the scores range from 96 to 202 (107 points) in the case of the Otis tests and only from 76 to 140 (65 points) in the results of the Spearman Tests.

From the score obtained by each boy in the Spearman Tests, his position in an order of merit list was deduced. All the lists used in this investigation and the calculations based thereon are contained in a 'Data' folio appended to this thesis. The results of the Spearman tests (both mark and order) are shown on pages I and II of this folio. The Otis test scores were similarly used to determine a boy's position in an order of merit list. (pages I and II of the data folio). Where several testees attained the same score they were all given the same position, namely, the average position of the group. For example, if a score of 174 marks gave a position of 15th and three testees each had a score of 173, these three testees were each given the position 17th. This method sometimes gives rise to "fractional positions" such as 17.5, as would have happened in the illustration just given if there had been four testees scoring 173 instead of three.

The coefficient of correlation between the results of the two intelligence tests was calculated. Prof. Spearman's rank method was used for this purpose, the formula employed being
$$\rho = 1 - \frac{6\sum d^2}{N(N^2-1)}$$

where 'd' represents the difference in position in the two ranks of a testee and 'N' had the value 128. The 'P' value was converted into the equivalent r value by means of the relationship $r = 2\sin(\frac{1}{2}P)$ the table of corresponding values given by Pearson in Drapers' Company Research Memoirs, Biometric series IV, 1907, being used for the purpose. The probable error of the correlation coefficient was determined from the formula:-

$$\text{Prob. Error} = .67449 \frac{1-r^2}{\sqrt{N}}$$

It may be as well to state here that, in the course of this investigation 37 correlation coefficients were calculated. In all cases the rank method (employing the formula quoted above) was used and the 'P' values were converted to the corresponding r values and their probable errors calculated as just stated (page XXIX data folio). The rank method of correlation was adopted because it was felt, particularly with regard to the drawing tests described in the first section of Part II of this report, that the most we could expect from the markers was that they would place the testees in correct order of merit. The rank method of correlation is based upon the position of a testee in a list and not upon his marks. The value 'P' thereby obtained may then be adjusted, on the assumption of normal distribution of the testees, to give the value of the coefficient r. With this method of calculation all that was expected of the markers was that they would arrive at (or closely approximate to) the correct order of merit without any reference to the form of distribution - a task which is easier than the correct awarding of marks which would result in fixing the distribution of merit among the testees and which, through bad marking or other causes, might not be a normal distribution. Since the rank method was so clearly

indicated for use with the drawing tests, no useful purpose would be served in availing ourselves of the marks rather than the positions in the intelligence tests, even though these marks do approximate to a normal distribution. It was decided therefore, not to use the product moment formula here, but to employ the rank method for all the coefficients.

The value obtained for the coefficient of correlation between the two intelligence tests was $.74 \pm .03$. This figure may be regarded as representing a highly satisfactory coefficient of reliability in our measurement of intelligence, particularly in view of the differences in the administration of the two tests which were pointed out earlier in this account.

Scores on the Otis Group Intelligence Scale have been correlated with scores on the "National Intelligence Tests" and on the "Illinois General Intelligence Scale" and have yielded a coefficient of approximately $.8$.¹ The coefficient of reliability of the Otis Scale is claimed as $.967$ ² but S.S. Colvin gives the figure as $.84$ as a result of his investigation.³ An enquiry by Stenquist⁴ gave a correlation of the Otis Scale with a composite score obtained from six well known mental tests as $.680$.

1. University of Illinois Bulletin Vol. 19. No.9
Bureau of Educational Research Bulletin No. 6. p.58.
2. As reported in "Educational Tests and Measurements"
W.S.Monroe, J.C.Devoss, and F.J.Kelly.
3. Journal of Educational Research. Vol.3. (pp.1-12)
1921. S.S.Colvin.
4. Journal of Educational Research. Vol.4. (pp. 241-54)
1921. Stenquist. J.W.

Franzen,¹ in a similar investigation obtained a correlation coefficient of .92 for the Otis Scale with a composite scale formed from 13 separate test scales. Finally, we quote McCall² who gives the "reliabilities of five standard educational tests as .55, .7, .75, .8, .9". We may thus regard the result obtained in this part of the investigation, serving as it does^{as} a criterion of reliability for the measurement of "intelligence", to be quite satisfactory.

From the two lists for intelligence it was decided to make a composite list which, since it embodied the information from two sources correlating substantially, would be expected to give a more truthful representation of the order of intelligence than would either of the lists separately.

Now these two lists may be combined in a number of different ways. The maximum mark obtainable is not the same in each list, nor is the distribution of marks. We must therefore come to some conclusion as to what "weight" each list should have in forming the composite list. Three possibilities presented themselves.

(1) Should the tests bear equal weights in the final list? (This would necessitate making the range of marks the same in each list before adding the marks.) Whether this plan is adopted depends on the relative efficiencies of the two tests in doing what they purport to do. We have no means of knowing their relative merit in this respect.

1. Journal of Educational Psychology Vol.14. (p.273. 1923.)
2. "How to Measure in Education". W.A.McCall. (p.310.)

(2). Should they be weighted in proportion to the time spent on each test? This question was answered definitely in the negative because the large time difference was caused by the Oral nature of the Spearman Test which was not considered to be rendered thereby more effective. The extra time was taken up by the statement and repetition (necessary) of the questions and not in an increased number of test items.

(3). Should the lists be weighted according to the maximum mark obtainable, that is, in proportion to the total number of responses possible in each test? In the absence of any knowledge as to the relative accuracies of the tests, this seemed the most reasonable method of combining the lists. This enquiry raises a most interesting point. We decided finally, simply to add the marks obtained in each test and so obtain the mark for the composite list. This device, as pointed out above, allows the test with the larger number of possible responses to weight the total more heavily than the other test does. This was accepted as a reasonable method and depends for its validity on the equality (assumed) of the test items used in the two tests.

Now all group tests contain a number of sub-tests (e.g. 10 in the Otis tests). The possible totals in these sub-tests are usually not equal and hence the sub-tests do not have equal weight in the final score. What weight each sub-test should have in the total there appears to be no means of finding out because it depends upon whether an item in one sub-test is strictly equivalent as a unit of measurement to any other item in any other sub-test. The weighting of the final result by the performances of a testee in the various sub-tests thus appears to be settled in a purely arbitrary manner.

The composite list for intelligence was obtained, then, simply by adding the marks in each test. From this mark list an order of merit was

constructed.

The results shown in this final grading for "intelligence" are based on information from two sources which correlate to the extent of $.74 \pm .03$. The range of marks in the final list is from 187 to 347, that is, 161 points. (128 testees). The distribution of these marks (although ranks and not marks were used in subsequent correlations) is ~~is~~ shown in a histogram on page XXX in the data folio, and approximates to a normal distribution. These considerations enable us to regard this final grading for "intelligence" with confidence.

P A R T II

Grading the Testees for Artistic Ability.

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To achieve the object of this part of the investigation two methods were adopted. These methods were quite different and will be described in separate sections (A and B) of this part of the account.

Section A.

The method which most readily suggests itself for our purpose is to arrange in order of merit a number of drawings done by the testees. This method at once meets with criticism. It may reasonably be doubted whether, assuming that this method can be carried out with sufficient reliability, it will then grade truly for artistic ability. It is proposed to delay the discussion of this question until the exact method adopted and the results accruing therefrom have been described. Firstly because these results give definite evidence concerning the possibility of measuring drawing ability in a reliable manner. And secondly because it is clear that drawing ability is at least an aspect of artistic ability and if it can be measured the information gained in doing so must be valuable for our purpose.

Having decided to investigate the possibilities of this method of testing, a preliminary consideration yielded the following conclusions:-

- (1). The subjective nature of the marking would lead us to anticipate that different markers, assessing the same drawings independently of one another would differ considerably, and so invalidate each other's estimates.

- (2). It cannot be assumed that a boy's drawing ability is the same in pencil drawing as in (say) colour drawing and, in fact, drawing ability may (or may not) depend considerably upon the medium used

In view of these conclusions it became necessary to arrange tests so that,

- (1). The extent of the variation in estimate between different markers working independently could be measured.
- (2). More than one drawing test was used in order to investigate the variation in ability with the nature of the test.

These two conditions were fulfilled in the following manner:-

- (1). The drawings done by the boys were assessed by four Art masters. Each marker worked quite independently and had no knowledge of the estimates made by the other markers. The intercorrelation of the orders presented by the four markers were calculated and are given later.
- (2). The question of the nature and number of the tests to be employed was discussed fully with Mr. Burns. The ultimate conclusions were that the tests used should be:-
 - (1). A pencil study of a simple group of objects (T.1)
 - (2). A colour study(water colour) of a simply shaped object (T.2)
 - (3). A memory drawing of a simple object (in pencil).(T.3)

It is to be observed that these tests cover only two drawing media, pencil and water colour and that therefore no claim is made that they are

exhaustive in that respect. All that we can do, obviously is to test boys as to the ability in media with which they are familiar, and in which they have all had about the same amount of practice - that is in pencil drawing and water colour drawing. Some evidence as to whether ability in these two media is linked can be gathered from the results of this experiment. But whether ability in these media links with ability in other media such as oil colour, pen and ink, and so on has not been tested. It seems quite likely that those of outstanding ability in one drawing method would prove to be also of marked ability in different media. This would be a difficult matter to test satisfactorily since, as a general rule, only those of marked ability in pencil drawing and water colour pass on to the use of other media of expression.

It was considered that T.1 would give evidence of a boy's ability to represent correctly the shape of the objects in front of him, to illustrate the forms by the arrangement of the lights and shadows, to make some attempt to interpret the texture of the surfaces and, in general, his power to represent faithfully and artistically the objects before him.

Test 2 was given in order to gain evidence as to his ability in representational drawing when the additional factor of the colour of the objects is introduced as well as their form.

Test 3 was included to test a boy's ability to represent correctly an object which he had been shown but which was not before him as he drew.

A boy who observes closely and completely when an object is put before him must, of course, do well on a test of this description, where his work is judged solely from the representational aspect. But whether care in observation goes with artistic ability, is open to enquiry. It may further be doubted whether the ability to retain a clear mental image of an object is an essential constituent of drawing ability. The drawing tests used in the School Leaving Certificate of the University of Durham include a memory test of the kind used here. Without enquiring further into precisely what was measured by T.3 it was considered advisable to include this test and form an opinion when the correlations of its findings with those of the other tests were known. (The matter is discussed further on page 55.).

These three tests having been decided in consultation with Mr. Burns, the other Art masters were asked whether they considered the tests sufficiently extensive for the purpose of measuring drawing ability. They were invited to suggest any other arrangement of tests that they considered to be more suitable. Consulted separately, each master stated that he was satisfied that the results of these tests ought to be sufficiently exhaustive to list the boys in order of drawing ability. (that is, in pencil and water colour drawing).

We were able then to proceed with the testing in the following manner:-

The group arranged for test 1. was a small parcel placed beside a cylindrical ink bottle. The constitution of the group was decided by Mr. Burns and was considered by him to be of a suitable degree of difficulty for the boys to be tested. One class of boys only was tested at one time. This meant that the number of testees was about 30. By setting up three similar groups of objects in

the Art Room it was arranged that no boy was very far away from the group he was drawing. Photographs, showing several views of the groups used, are given in the test material folio appended to this thesis.

The boys were told that their work was to be used for a special purpose and were urged to do their very best work. The time allowed for the drawing was $1\frac{1}{2}$ hours. Throughout this test, and the other two drawing tests also, the boys were under the constant supervision of the Art Master. Careful observation showed that the boys worked most industriously. No 'slackness' was shown towards the end of the time period and it may be confidently assumed that the work they handed in was quite the best of which they were capable. There were only a few isolated cases in which a boy would have liked an extension of the time allowance, and the time was thus judged to be adequate

The completed drawings were then given to one of the markers, along with a complete set of photographs as shown in the test folio. The grading of the drawings was carried out as follows. It has already been pointed out that all that was expected of the markers was that they should arrange the drawings, by mutual comparisons, in order of merit. The method adopted in all cases was to spread out the drawings on a long bench, or on the floor, roughly in order of merit. The drawings were then inspected again and, by more careful comparisons, the order was made more definite. This process was repeated several times until the marker was satisfied with his order of merit. The names of the boys were on the backs of the drawings so that in the case of Mr. Burns to whom the boys were known by name, his judgement could not be affected by his knowledge of the boys usual performance. In a discussion with the markers it had been agreed that since we had 128

drawings to grade the distribution of merit ought to approximate to the normal curve of probability. At the ends of the set of drawings ranged on the bench therefore, the drawings were individually separated while towards the centre there were increasingly large groups of drawings which were considered to be of equal merit. It was decided to ask the masters to put a definite numerical mark on each drawing after this grading by mutual comparison had been effected. This mark served simply as a convenient method of fixing the order of merit which had been assigned to the drawings. It must be made quite clear that actual marks were not used in the calculations of correlation coefficients which followed. This numerical marking was only introduced, as just stated, as a convenient method of obtaining the order of merit and further as a check on the markers to see whether the marks awarded did follow a normal curve of probability.

Each marker was asked separately what he considered to be a suitable maximum mark to award for the drawings. Two markers said "30" while the other two said that "anything from 10 to 100" would be suitable. Now the maximum mark used in any scheme of marking should be decided by the discriminating power exercised in the marking. It is clear that a maximum of 100 presupposes the ability to judge a drawing as worth 56 marks (say) and not 55 or 57. I am inclined to think that this aspect of the marking was not realised by two of the markers. After discussing the matter they considered that a maximum of 30 would be a fair indication of the discrimination that could be exercised in marking the test. It was agreed then, that the whole marks range from 0 to 30 should be utilised in assessing marks. That is, the best drawing had to receive 30, in all cases, the worst drawing had to receive 0 and all the other marks awarded had to

be distributed with approximate normality between these extremes.

The marks awarded by a marker were written lightly in pencil on the drawings. When he returned the marked drawings, the marks were entered on a list, his marks were carefully erased, the order in which the drawings were arranged was destroyed by shuffling them, and they were then passed on to the second marker who was thus in complete ignorance of the marks awarded by his predecessor. This procedure was adopted in the marking of all the tests. In nearly all cases the drawings were marked at the home of the marker, and the independence of the marking can be accepted with perfect confidence. It is necessary to emphasise this in view of the nature of the results which were obtained.

One more point in connection with the marking must be made clear. It has been stated that the marks were not used in themselves but merely served to fix the rank of a testee in the order of merit list. Correlation coefficients were then calculated by the 'rank method' and corrected to normal distribution by converting ρ into r . Now the rankings cannot be entirely independent of the nature of the distribution of the marks. I mean that, if the marks show a pronounced deviation from normal distribution by having say a large group of boys all with 28 marks out of 30 when this group obviously ought to be small, then the question arises, how will this affect the ranking of the boys and hence the final coefficient? It was decided that a large group out of place, as instanced above, would simply reveal lack of discrimination in the award of marks and the effect of this would be to bring the correlation coefficient more nearly to what it would be between two chance series, that

is, the effect would be to tend to lower the correlation to zero.

The second drawing test was a water colour painting of a green glazed bowl placed against a background formed by a sheet of yellow paper. This subject was selected as being of suitable difficulty. The form was simple and the colours few. As before, the approximate number of pupils tested at one time was 30, and three object groups were set up in the art room so that every boy could be sufficiently close to a group. A photograph of this group is included in the Test folio. The time allowed was $1\frac{1}{2}$ hours and was fully utilised. Grading was carried out by the same four markers as before, using the same method of mutual comparison

The object used in the memory test was a bucket of the shape shown in the photograph in the Test folio. This bucket was placed in front of the class for two minutes. It was then concealed and it had to be drawn as it had been seen. After 15 mins. the bucket was again displayed (in the same position) for two minutes, during which time drawing was prohibited. When the bucket was again removed faults could be corrected and drawing continued for a further 45 minutes. In addition to drawing the bucket it had to be shown as if it were standing in front of two steps, outside of a door. The steps had to be drawn in and the lower part of the door and doorposts indicated. The marker was supplied with photographs of the bucket and a detailed statement of the exact nature of the test.

Results of the three drawing tests.

The marks awarded by each marker are shown:-

For the pencil drawings.....on pages III and IV in the Data folio
 For the colour drawings..... " " VII " VIII " " "
 For the Memory drawings..... " " XI " XII " " "

The position of each boy in the order of merit list, obtained from his mark, is also shown on these pages.

Consider first the results obtained in marking the pencil drawings. There were four separate gradings, one due to each marker. These four gradings could be paired in six ways, giving rise to six correlation coefficients. These coefficients were calculated by the rank method as used previously in the case of the intelligence tests, the rank differences, squares, and calculated values of ρ being shown on pages III, IV, V, and VI of the data folio.

For convenience, the results (giving r value and probable errors) are tabulated here. (Table 1).

PENCIL DRAWING.

	Burns.	Loughton.	Fallows.	Herron.
Burns.	-	.81±.02	.81±.02	.79±.02
Loughton.		-	.79±.02	.78±.02
Fallows.			-	.76±.03
Herron.				-

Average.... .79 ± .02

Table 1.

Similarly the four gradings for colour drawing gave rise to six correlation coefficients. The calculations are shown on pages VII, VIII, IX, X, and the final results are tabulated below. (Table 2)

COLOUR DRAWING.

	Burns.	Loughton.	Fallows.	Herron.
Burns.	-	.65±.03	.83±.02	.79±.02
Loughton		-	.77±.02	.67±.03
Fallows.			-	.83±.02
Herron				-

Table II.

Average..... .76 ± .02.

Finally the four gradings for memory drawing taken in pairs, yielded six correlation coefficients. These are calculated on pages XI, XII, XIII, XIV and are here tabulated for convenience (Table III).

MEMORY DRAWING.

	Burns.	Loughton.	Fallows.	Herron
Burns.	-	.64±.04	.81±.02	.57±.04
Loughton		-	.71±.03	.48±.05
Fallows			-	.59±.04
Herron.				-

Table III.

Average..... .63 ± .04

Average of 18 Correlation
Coefficients... .73 ± .03

It will be recalled that the object of obtaining these intercorrelations was to investigate the degree to which the subjectivity of the marking of the drawings would affect the reliability of an estimate of drawing ability. It must be confessed that it was anticipated that all these coefficients would be found to be low. This opinion was based upon the results of similar investigations that have been carried out in other subjects of the school curriculum. The coefficients obtained here caused great surprise and indicate a remarkably close agreement between the markers in all three tests.

The coefficients obtained with the pencil drawings range from .76 to .81 having an average value of $.79 \pm .02$, showing that the four markers agree very closely in their estimates.

The coefficients yielded by the colour drawings range from .65 to .83 and have an average value of $.76 \pm .02$ again showing remarkable agreement.

The coefficients obtained from the marking of the memory drawings range from .48 to .81 and have a mean value of $.63 \pm .04$. Here the range is larger but substantial agreement is clearly shown.

These 18 correlation coefficients range from .48 to .83 and have an average value of $.73 \pm .03$.

It was noticed that the three lowest coefficients .48, .57 and .59 all appeared in the group of three correlations containing Mr. Herron's Memory drawing list as a common factor. This was significant and indicated

that this particular list was least in agreement with the others. (It still correlates with them, of course, to a substantial degree). If these three lowest coefficients are omitted from the list of 18 coefficients that we are now discussing, the range of variation shown by the coefficients reduces considerably to .64-.83, and the average value is increased to $.75 \pm .03$. Attention has been drawn to this slight variation in the agreement and the matter will be discussed further on page 55 where some light is thrown on the cause of this variation, but in forming the final list for drawing ability (page 52) the 12 drawing lists were all given equal weight in the total.

There are useful conclusions to be drawn from the high values of these 18 correlation coefficients. They are:-

- (1). In spite of the subjectivity of the marking of the pencil drawings, an order of merit list for ability in pencil drawing having a very high degree of reliability, can be compiled. That is to say an order of merit list for ability in pencil drawing formed by adding the four marks awarded in this test by the markers, may be regarded, with confidence, to be a close approximation to a true order of merit.
- (2). Similarly a composite order of merit list formed by adding the 4 marks awarded in water colour drawing can be taken to represent closely a true order of merit in that ability.
- (3). Finally, the order of merit formed when the marks awarded in memory drawing are added must be a close approximation to the true order of merit in that ability.

FURTHER RESULTS.

Three new lists were therefore compiled. The first, to measure ability in pencil drawing as estimated by four markers (whose independent

estimates moreover closely agreed) was got by the addition, for each boy, of the four marks awarded to him in pencil drawing. Test 1. The second, to grade for ability in water colour drawing was obtained in a similar way from the marks awarded in Test 2. The third, grading for ability in memory drawing, was formed in a similar manner. These three lists appear on pages XV and XVI of the data folio, where also marks are changed into positions.

From these three lists, three correlation coefficients formed by taking the three lists in pairs, were calculated. The three coefficients are tabulated here for convenience. (Table IV).

	PENCIL.	COLOUR.	MEMORY.
PENCIL.	-	.55 ± .04	.61 ± .04
COLOUR		-	.52 ± .04
MEMORY			-

Average..... .56 ± .04

Table showing the correlation coefficients between gradings in Pencil, Colour and Memory drawing.

These three coefficients all reveal a substantial degree of correlation. It is to be noted further that the coefficients are closely similar, their range having the insignificant value of .09. Their mean value is .56 ± .04.

The first conclusion to be drawn from these results is that there must be a close kinship between the three abilities measured by the tests 1, 2 and 3. When we consider the reliability with which these lists are considered to be determined, the conclusion just drawn becomes highly significant.

It is to be noted further that the average coefficient indicating the degree of similarity between the three abilities measured by Tests 1, 2 and 3 ($.56 \pm .04$) is markedly lower than the average coefficient obtained in the marking of any one ability by four different markers. ($.73 \pm .03$). If the three abilities were identical we would expect the former average coefficient to be closer in value to the latter. It is tempting to deduce from this that there are small but significant differences between a boy's performances in pencil drawing, water colour drawing and memory drawing. This deduction cannot fairly be made from the facts. The difference between these coefficients $.73 - .56 = .17$ is just less than $3\frac{1}{2}$ times the probable error of the difference which is given by $\sqrt{.03^2 + .04^2} = .051$. Hence this difference can hardly be regarded as significant, although it remains suggestive. The experimental data, therefore, reveals no significant differences in the abilities measured by the three drawing tests. The experimental evidence on this point is not sufficient to preclude the possibility of the existence of such differences. In the performances of pencil drawing, colour drawing and memory drawing there are clearly certain common factors, particularly between the first and the third. These factors would tend to make the gradings on the three tests similar. If, further, the criteria adopted by the four markers were in all cases such as to give special emphasis to these common factors of performance then, the marking itself would tend to eliminate differences in performance on the three tests.

Differences in performance between the tests 1, 2 and 3 might reasonably have been expected. Amongst artists distinction is frequently

1. The Essentials of Mental Measurement. W. Brown and G.H. Thomson. (p.105). C.U.P. 1921.

drawn between a good 'colour man' and a good 'black and white man'. The former appears to be more sensitive to, and is a more successful worker with colours, while the latter reveals his greatest skill in relation to forms.

We must take into consideration that our tests were given to schoolboys and that differences in an individual that may become significant in the work of an artist do not necessarily reveal themselves in tests requiring such an elementary standard of technique. Throughout this enquiry indeed, we must be on our guard against assuming that effects observable amongst those of marked artistic ability should necessarily be reproduced even in a minor degree, amongst the rank and file of humanity.

We repeat in conclusion, then,

- (1). that the tests show substantial correlation between the abilities measured by tests 1,2 and 3.
- (2). That they do not reveal minor significant differences in the performances of tests 1,2 and 3.
- (3). That the evidence is insufficient to preclude the possibility of these differences owing to (a). the elementary nature of the ability demanded in the tests or (b). the possible adoption by the four markers of criteria which tend to emphasise factors common to the successful performances of 1,2 and 3.

(Information concerning the criteria used in marking is given later (page 53)).

Twenty one correlation coefficients have now been reviewed in connection with this part of our investigation. The high values shown by all of these coefficients reveal, firstly, a remarkably close agreement between four separate gradings of the same drawings, and secondly, a substantial similarity between the three abilities measured (reliably) by the tests, 1, 2 and 3. The conclusion can hardly be avoided, that by means of these tests some definite ability has been measured. This conclusion is warranted by the experimental facts and may be accepted without the need of forming any opinion whatsoever concerning the nature of the ability thus measured. The ability measured by these tests we refer to as 'drawing ability'.

To obtain an order of merit list of the boys for this ability, the total mark awarded to each boy for all three tests was found. This supplied a mark for each boy out of a possible maximum of 360. The list obtained from these marks is shown on page XV data folio, and will be referred to as D_s , signifying drawing ability subjectively measured. Some estimate of the range of drawing ability represented by the list can be formed by considering the selected drawings shown in the data folio, pages XXXI, XXXII, XXXIII. The distribution of ~~of~~ the marks is shown graphically on page XXX and approximates to a normal distribution.

The list is considered to grade the boys in order of 'drawing ability' to a high degree of reliability and considerable confidence is placed in its ratings. Each boy's final mark has been formed by pooling 12 estimates based upon the results of 4 hours hard work by the boy. It is not claimed that a test necessarily grades truly in proportion to the amount of time spent in its performance, but a lengthy testing period at least avoids inadequacy of data for grading purposes.

Having decided that the drawing tests had revealed the existence of 'drawing ability' and having obtained an order of merit in this ability for the testees, it became necessary to investigate the nature of the ability that we had named and measured. This was done by asking each marker to state the precise criteria he adopted in marking. The replies were as follows:-

Mr. Burns. 1 and 3. Object drawing and memory drawing.

- (a) Sense of direction.
- (b) Sense of proportion
- (c) Observation of details.)
- (d) Representation of light and shade
- (e) " " nature of surfaces.

2. Colour.

- (a) Colour sense.
- (b) Observation of natural colour.)
- (c) Appreciation of colour

) Expressing tones
) and blending of
) colour.

Mr. Loughton. 1. Pencil Drawing.

- (a) Correct proportions.
- (b) Correct shape
- (c) Quality of line (delicacy, evenness, variety)
- (d) Lighting (giving rise to impression of solidity)
- (e) Textures.
- (f) Arrangements of drawing on the paper.

2. Colour.

As for 1. (a), (b), (d), (e), (f),.
(c) becomes brushwork and handling of medium.
Accuracy of colour.
Power of discrimination of colours.

3. Memory.

Same criteria as in 1. but a changed emphasis.
Greater emphasis on (b), and (f).

Mr. Fallows. 1 Pencil Drawing.

- (a). Shape or good construction.
- (b). Form, solidity (by shading)
- (c). Texture and 'colour' (by shading)
- (d). Placing of drawing on paper.
- (e). General appearance (cleanness of line, absence of smudging).

2. Colour.

All the points mentioned in 1. with, in addition:-

- (a). technique in handling different medium.
- (b). matching colour.

3. Memory.

All the points mentioned in 1. with outstanding emphasis on accuracy of representation.

Mr. Herron. 1. Pencil Drawing.

- (a) Technique as applied to execution in pencil drawing.
- (b). Shape (to include proportion and perspective).
- (c). Arrangement of drawing on paper.
- (d). Tone - light and shade to be correct.
- (e). Interpretation of Textures of surfaces.

2. Colour.

All the above points except (a) with the following added.

- (a). Technique in water colour.
- (b). True colour.

3. Memory.

- (a). Intelligence with regard to placing of scuttle..... 5 marks
- (b). Drawing of scuttle..... 5 marks
- (c). Correct perspective..... 5 marks
- (d). Proportion..... 5 marks
- (e). Technique.....10 marks.

A consideration of these statements yields some important information.

In the first place it is clear that the three tests possess much in common and cannot be regarded as tests of different abilities. Test 2, though a test in water colour drawing, yet involves many elements in its performance which are to be found also in 1 and 3. In the same way the memory test appears (from the system of evaluation) to be little different from 1. The high correlations between the three gradings for pencil, colour and memory, then, are understandable on these grounds. It is of particular interest to notice that Mr. Herron was the only marker who considered it necessary to draw up a detailed marking scheme for the memory drawing test. It will be recalled that it was this particular grading (memory by Mr. Herron) which gave rise to the three lowest correlations amongst the gradings. This would appear to show that agreement in the marking of the Memory drawings disappears in proportion to the extent to which it is regarded as a test of a separate ability. It is difficult to see what useful purpose is served by the inclusion of a 'memory drawing' test in an examination for drawing ability. It would appear that a grading obtained from a pencil drawing test would be little modified by the information gained from an extra 'memory' test. I have been unable to obtain a convincing explanation of the inclusion of such a test in the School Leaving Certificate Examination.

The second point that arises from the statements of the markers is that they were all, in the main, concerned with the purely representational aspect of the drawings. The elements insisted upon are, with the exception of the arrangement of the drawing on the paper, those which would give rise to an accurate representation of the objects. This, then, is the ability to which we have given the name "Drawing Ability."

It may be contended that the ability to represent objects with accuracy is not the highest form of artistic ability. In the first place it is difficult, and in fact impossible to decide what is a correct representation of any object. The experiments of Dr. Thouless¹ have shown that no one, viewing a horizontal circle would represent it on paper by the actual ellipse which is the stimulus effect on the eye and which can be deduced from the known diameter of the circle and its known position relative to the eye. The drawn ellipse is always closer to the circular form than it ought to be. This he calls 'phenomenal regression'. Since different people exhibit this to different degrees it is clear that we cannot decide exactly what is a correct representation of the circle.

Secondly, it may be argued that the artist is not concerned with accurate representation, a task which is disdainfully relegated to the less romantic photographic camera in apparent ignorance of the fact that the camera lens is often guilty of great distortion. T. Elder Dickson,² in a rather iconoclastic mood, scorns the element of accuracy in an artistic performance. He says "The criterion of accuracy used to estimate Artistic Ability and as an aim in teaching representational drawing is psychologically unsound and detrimental to the development of artistic ability". It will be generally agreed that this is an over-statement. We may regard the matter in the following way. No two people when representing the same object, even if they were striving for 'photographic' accuracy, could arrive at the same representation. The factors which would prevent this are many and some are closely linked with the personalities of the

1. "Individual differences in Phenomenal Regression"
Dr. Thouless. Brit. Journal of Psychology.
Vol. XXII. Part 3. Jan. 1932.
2. "The Criterion of Accuracy in Representational Art".
T. Elder Dickson. Brit. Journal of Educational
Psychology. Vol. III. Part II. June 1933.

performers. Just as we bring to the observation of any object a background of experience and feeling which is peculiarly our own. So we reveal those personality traits in attempting a representation of the object. The attempt at representation we can regard as the vehicle which makes possible the expression of the artists personality, which is the all-important matter. Although the stated criteria of the markers appear to be cold accuracy they would undoubtedly be swayed in their judgements by subtle personal qualities revealed by the boys in their treatment of the objects. It is in this way that it is considered possible to reveal the existence of true artistic ability by asking boys to make a representational drawing.

It is in keeping with what has just been said to consider that there are elements of artistic ability other than those revealed in drawing. A sense of design and colour may be shown in the power to arrange objects in the most effective and pleasing manner.

PART II. SECTION B.

Two methods were adopted in the attempt to measure artistic ability. The method involving subjective marking has been described in Section A. of part II. of this account. In the second method, to be described here, an attempt was made to introduce objective methods of marking.

Attempts to arrive at some fixed objective standards of marking children's drawings have been made by the construction of 'drawing scales' on the same lines as 'handwriting scales' for the judgement of quality of writing. Such scales have been constructed by Thorndike¹ and Burt.² H.G.Childs³ considers that "repeated trials have demonstrated that such scales limit the subjective factor in judgement and narrow greatly the range of variability in rating achievement". Their further consideration need not delay us here since their main purpose is to institute standards applicable to large numbers of testees. They illustrate one approach to more objective marking. A.S. Lewerenz⁴ has attempted to use objective methods in measuring artistic ability and reference has already been made to the art appreciation tests of Seashore and McAdory which showed so little correlation. In this country, tests

1. The Measurement of Achievement in Drawing. E.L.Thorndike. Teachers College Record. Nov. 1913.
2. Mental and Scholastic Tests. C.Burt. L.C.C. Dec.1921.
3. Journal of Educational Psychology. Vol.VI. 1915.(p.403).
4. Journal of Educational Psychology. Vol. XIX. 1928.(p.629).

of art appreciation have been used by Margaret Bulley¹ and quite recently a large scale investigation of this nature was carried out by Burt² in co-operation with the British Broadcasting Company. These cases are cited to illustrate that objective methods of measurement are being used to some extent in relation to art but it cannot be claimed that their value is established.

The second method of investigating artistic ability was introduced into this research for two reasons. It was anticipated that the results of a subjective method of marking would prove unreliable and that, therefore, the possibility of assessing artistic ability by objective methods of marking ought to be investigated. The second reason concerned the scope rather than the reliability of method 1. It was believed that certain aspects of artistic ability would remain unmeasured by the drawing tests. It was desired to attempt to measure these additional aspects by special tests.

With these objects in mind a booklet of tests was compiled. The tests in the booklet were arranged so that the marking was objective. Four different kinds of tests were introduced to measure four aspects of artistic ability. Since the form of the tests depended on certain views concerning the nature of artistic ability, these views are discussed before the test booklet is described in detail.

1. "Children and Art. An Experiment" by M.N. Bulley.
The Burlington Magazine. Oct. 1923.
2. Described in an appendix to "Have you good taste?"
by Margaret N. Bulley. 1933.

Certain 'elements' of artistic ability were arrived at by considering the characteristics of a person who would be judged to have marked artistic ability. Whether this analysis is accepted depends to a considerable extent on the meaning attached to the word artistic. The meaning used here is very wide. It was considered that the possession of one of these 'elements' would entitle a person to be considered of artistic ability to that extent. Marked artistic ability however, would only be shown by the possession of all or most of them. It was further considered that the possession of some of these characteristics would not necessarily imply possession of the others. These conclusions were reached in the absence of any experimental data to contradict them. It is considered that a reliable analysis of artistic ability, if this is ever achieved, must be based upon a large amount of experimental data. It was realised that this was a task which would far exceed the limits of a single investigation. Under these circumstances it was considered justifiable to make a tentative analysis which would at least serve as a basis for some experimental data. The following 'elements' of artistic ability were decided upon:-

- (1). Knowledge of correct methods of draughtsmanship to be used in representational drawing.
- (2). Judgement by eye of (a) relative sizes of lengths in different orientations.
(b) relative sizes of angles.
- (3). Good hand and eye co-ordination.
- (4). Sense of design. (a). appreciation of appropriateness of design.
(b). sense of proportion.
- (5). Colour sensitiveness. (a). accuracy in matching.
(b). choice of colour combination.
(c). choice of colour proportions.

6. Creative power and Originality.

The grounds for this analysis were as follows. To be a good drawer is one of the most readily accepted characteristics of the possession of artistic ability. The relationship between these two things has already been discussed (page 56.). This ability implies certain other qualities. Certainly a knowledge of what constitutes 'correct' drawing from the representational point of view is implied in this. A good drawer for instance, would not be guilty of drawing parallel lines as diverging as they receded from the eye. I am aware that certain artists such as Van Gogh and Paul Nash have in some of their work done precisely what I have just described as incorrect. Such distortion is always intentional, however, and an artist, though he may indulge in distortion for special purposes is fully aware of the device he is using. It may fairly be claimed that a knowledge of 'correctness' in drawing will be possessed by those of artistic ability. Good draughtsmanship implies further the ability to judge by eye the relative sizes of lines (or lengths) in a group of objects. This ability must extend to the judgement of relative directions or angles. The possession of these abilities is clearly necessary before correct representation of a group of objects can be made on paper. To be able to judge sizes and directions in objects would not lead to accurate representational drawing unless the drawer also possessed good hand and eye co-ordination. This would result in precisely those marks being made on the paper which the eye judged to be correct. These characteristics of a good drawer appear as elements of artistic ability under numbers 1, 2 and 3 in the previously given list.

There are other elements of artistic ability which may well be quite independent of ability in representational drawing.

One of these we have called a sense of design - or the ability which will enable a person to say which of two designs is the better. The person who can do this correctly (assuming the two designs are such that we could easily get an agreed opinion amongst acknowledged artists concerning which was the better) must be more artistic than the person who cannot. To be able to discriminate between two designs implies the power to gauge their relative suitability or appropriateness to their purpose, and also a good sense of relative sizes or proportion since design employs the device of dividing lines and spaces into simply related parts. These elements appear under number 4 in the above list.

Sensitiveness to colour is shown as a 5th element of artistic ability. Individual reactions to various colours are by no means easily understood. Strange prejudices against particular colours, to be explained possibly on psychological grounds, are frequently met. Overlooking these special cases of colour reaction we may make the general observation that people differ largely in their sensitiveness to colour, and particularly to combinations of colour. At one extreme we have those who are peculiarly sensitive to colour variations and who are affected violently by certain colour combinations and at the other we have those who never react violently to any colour combination but regard them all with unmoved calm. Similar individual differences are to be found in connection with the effects of combinations of musical notes and the terms harmonious and discordant are frequently transferred to the realm of artistic appreciation. Colour sensitiveness in an individual will reveal itself in, accuracy of matching (which will make for ability in representational drawing where colour is a factor), a correct

choice of the more pleasing of two colour combinations (where an agreed opinion concerning the better is easily obtained from those of accepted artistic ability) and a good arrangement of the relative proportions of two colours. Colour sensitiveness, and its accompanying qualities therefore appear in the list of elements of artistic ability.

The remaining element of artistic ability which is included in the analysis, we have called creative power and originality. It is conceivable that two artists may be of equal merit in the qualities already discussed, yet, one of them may show a marked superiority in the ability to create new designs - to evolve new and effective arrangements of form and colour. This particular ability would reveal itself most markedly in imaginative and decorative work. It may well be, however, that this quality is of much more general importance. Its greatest purpose may be to give life and activity to the other elements of artistic ability and to charge the artistic effort with force and meaning. An urge to create is frequently recognised as the mainspring of a man's artistic activities. This creative urge may assert itself with insistent and overpowering force, successfully overcoming adverse external factors. It then becomes the quality of supreme importance. The dependence of executive skill upon ^{some} such powerful factor as just described is remarkably illustrated by an instance related by Ballard.¹ A young artist of marked ability was disabled in the Great War. The highly developed technical skill which he had previously possessed in his hands was destroyed. The movements which he was able to make with his hands were greatly restricted. This artist

1. Mental Tests. P.B. Ballard. 1926.

commenced to draw again using his less crippled hand (his left) and eking out his movements with his right. Soon, the work which he did revealed the same outstanding merit which it had previously possessed. It received great praise from critics who knew nothing of his infirmity. Commenting on this instance Ballard says:-
"To thwart the creative impulse in such a man is impossible - unless you kill him. If his hands are gone, he will draw with his feet; if his feet too are gone he will draw with his elbow, his chin, his teeth - with any part of his person to which he can attach a pencil or brush. If the essential spirit is within him it seems to create the machinery with which it works..... It is in the mind of man that artistry and craftsmanship reside".

The analysis of artistic ability which has just been stated was arrived at as a result of lengthy discussion and careful thought. It was made as exhaustive and as rigorous as was found possible. For the views here expressed, however, no finality is claimed. In the writer's opinion any analysis of artistic ability which is achieved by discussion and argument and lacks a basis of objectively determined data, must be accepted with great reserve. This evaluation of the analysis having been agreed upon, it may yet be claimed that it forms a useful starting point for experiment. It was with this justification in mind that this piece of work was undertaken.

The booklet of art tests (shown in the test material folio). to which reference has already been made, was compiled with the stated aims of investigating the possibility of marking artistic ability objectively and of examining those aspects of artistic ability which were not likely to reveal themselves in the drawing tests. The tests used in this booklet were based on the results of the analysis just outlined.

All the tests were framed in such a manner that objective marking was possible. The first test was designed to measure knowledge of correct representational drawing. Accuracy of eye judgement of lengths and angles and also of stated fractions of lines and angles was also tested. Further tests were designed to measure sense of design and sensitivity of reaction to colour combinations. No tests were included for the purpose of measuring hand and eye co-ordination. Although tests are available for this stated purpose, the activities they involve are different from those of artistic representation and it must not be assumed that ability in any form of hand and eye co-ordination such as in "ball and slot" tests necessarily implies equal ability in the form of eye-guided hand movement used in drawing.¹ It is possible to design tests in which those of superior ability in this kind of activity may reveal their superiority. The difficulty of marking their performances in an objective manner remains. The possibilities of measuring hand and eye co-ordination of the type used in drawing were explored no further than to reveal these preliminary difficulties.

No attempt was made in these tests to measure creative power and originality. Here again it is simple to set tests in which those of outstanding merit in this ability will show their superiority. It would be a bold, and possibly a foolish experimenter however, who would undertake to assess the results of creative activity.

1. The work of Akroyd on this point is of particular interest. Using four tests for hand-eye co-ordination he obtained low correlations with drawing - .35, .125, .106, .02. The inter-correlations of the four tests were also low. He concluded "there is not one motor ability, but several."

"Some tests and correlations of Hand-Eye Co-ordination".
F.Akroyd. Forum of Education. Vol.6.(p.127) 1928.

These omissions would be a serious reflection on the value of the tests if they were intended to be used for the purpose of measuring artistic ability. It has already been made clear that the aim in using these tests was the much less ambitious and more easily attainable one of supplementing the information that had already been gained about the artistic ability of the boys in using the drawing tests.

The test applied for knowledge of correctness in representational drawing is to be found on the first three pages of the booklet. The next three pages contain a duplicate test, closely similar in form, which was designed to estimate the reliability of the results got from this type of test. Each complete test (three pages) comprises 24 drawings (8 per page) some of which contain drawing errors (of the type known to be commonly committed by boys of this age) while the others are correct. The correct drawings were introduced to minimise the effect of guessing. In 24 drawings there are 9 correct and 15 incorrect. Preliminary trials with these tests showed that great care must be exercised in making the drawings. The type of error that has to be looked for must be clearly explained. The correct drawings must be free from the slightest error in the matter of draughtsmanship. The incorrect drawings must be made undeniably incorrect in one particular only. These conditions are not easily satisfied and it was only after a great deal of trial and error that the final test was compiled. When the tests were applied, it was made clear to the boys, in a preliminary statement that they were to look for drawing errors; that the tests were not necessarily meant to be tests of intelligence, and that they were not a form of 'catch'. An error when detected would prove to be, a line drawn in the wrong direction or too long or too short, a shape impossibly represented, an object or part of an object in a wrong position and other errors of the same nature. We then worked through the drawings together one by one. In the case of every drawing they were told what the drawing was to represent.

The indistinctness of some of the duplicating made this necessary in one or two cases but the main purpose was to make quite certain that every boy knew what the drawing in front of him was intended to represent. The test booklet shows that the response was to cross out one word and leave the word "correct" or "incorrect" standing, whichever applied to the drawing in question. It was considered that a boy who was able to see that a drawing was wrong and, in addition to this, was able to put into words what was wrong with the drawing, possessed the ability we were attempting to measure, in a higher degree than the boy who could see that the drawing was wrong and yet could not say precisely what the error was. In each case then, the boys were asked to write in a few words beside the drawing they had indicated as incorrect, what they considered the error to be. One mark was awarded for a correct response to "correct or incorrect" and an extra mark was awarded when the correct reason was given. This made the maximum mark possible of attainment on the 15 incorrect drawings 30, while the correct drawings supplied a possible mark of 9. The total mark possible for the test was thus 39. It may be remarked that in allowing the interpretation of a written statement to enter into the marking the objectivity, which was to be a feature of these tests, would be reduced. This is true, but in the marking it was found that very few cases occurred in which judgement was necessary on the part of the marker. If the boy's statement indicated that he knew the error that was present in the drawing, he got the extra mark, and it was usually the case that if he had judged the drawing as incorrect he had detected the precise error in addition. In the few cases where a drawing was judged incorrect and an entirely wrong reason given, no mark was awarded. The objective nature of the marking made it possible to have this done by a team of markers working together under my instruction. The test now being described was the only one

where any doubt as to the correctness of the response might occur. All cases where any doubts entered into the marking were referred to me.

In stating that these tests were worked together page by page it is not intended to convey the impression that a time limit was imposed on a boy's work as is done in the case of the Otis Tests. This procedure was adopted in order that the ~~the~~ meaning of each drawing could be made perfectly clear. And in the case of the subsequent tests this procedure ensured that each boy knew exactly what he had to do. The work was not hurried and, when the complete booklet of tests had been explained and worked, any required amount of extra time was allowed to any boy who desired it. There were four boys who availed themselves of the extra time permitted.

The errors which were involved in a complete set of 24 drawings were:-

1. Incorrect representation of parallel lines.

This error occurs in drawings.....

TEST 1. (pages 1-3 inclusive.)

No. 3. The top line of the door is wrong.

No. 5. The edges of the box should not diverge.

No.10. The tops and bottoms of the windows are wrongly shown.

No.14. The bottom line at the side of the steps causes the steps to look as if they were not horizontal.

TEST 2. (pages 4-6 inclusive.)

No. 27. The top edge of the lid as shown would not rest on the table.

No. 32. The bottom edge of the plank is in the wrong direction.

No. 34. Same error as in No.3. Test 1.

No. 39. Right hand side of blind wrong.

2. Incorrect representation of an ellipse.

TEST 1. (pages 1-3 inclusive).

- No. 1. The bottom edge of cylinder should not be straight.
- No. 8. Both ends of the cylinder should not be shown.
- No. 9. Base wrongly represented.
- No. 19. The broken curve showing the far end of the arch is wrongly drawn.

TEST 2. (pages 4-6 inclusive).

- No. 26. Upper and lower edges of label wrongly drawn.
- No. 36. The middle ellipse should be wider.
- No. 44. The O's in OXO are too circular.
- No. 46. The top of the thinner ellipse is too wide.

3. Objects represented in unbalanced positions.

- TEST 1. No. 4. The lengths of the two portions of the supporting cord are shown unequal and this should cause the picture to sway slightly to the side.

- No. 12. The level of the liquid should be shown horizontal.

TEST 2.

- No. 35. The lengths of the rod is such that the centre of gravity of the rod is outside of the bowl. The rod therefore would fall out of the bowl.
- No. 45. The spoon could not remain in the position shown but would fall down.

4. Two objects shown with their relative size wrong.

TEST 1.

- No. 17. The match is much too large for the box.

TEST 2.

- No. 48. The sailing ship shown on the horizon is much too large compared with the lighthouse.

5. The shape of an object wrongly represented.

TEST 1.

No. 13. The points of attachment of the handle of the pail should be at opposite ends of a diameter.

TEST 2.

No. 38. The upper place of attachment of the handle is not shown vertically above the lower place of attachment.

6. Shadows wrongly shown.

TEST 1.

No. 23. The shadow inside the vessel should be on the other side.

TEST 2.

No. 30. The shadow should be on the dark side of the cube.

7. The image. (often called 'reflection'). of an object in
water wrongly shown.

TEST 1.

No. 15. The image of the stake sloped in the wrong direction.

TEST 2.

No. 29. The image of the bridge is of the wrong shape.

8. A representation of an impossibility or an absurdity.

TEST 1.

No. 22. The two flags should be flying in the same direction.

TEST 2.

No. 41. The dial of the clock is wrongly divided.

Note. This last test approaches in type the kind of drawing that has been used for intelligence testing.

The correct drawings are:-

TEST 1.

- No. 1. Simply a possible shape.
- No. 7. A flask with its shadow shown.
- No. 5. A cylindrical jar. (Note. Unfortunately the drawing of this was not sufficiently beyond reproach. The right hand side of the bottom ellipse is rather high. Where this was pointed out as an error, one mark was given. The error which was involuntarily introduced is not of the gross type shown in the other drawings.)
- No.11. A cylinder.
- No.16. A shelf. The observer is looking up at the underneath side of the shelf.
- No.18. A cone.
- No.20. Showing a correctly drawn reflection.
- No.21. A cylinder with a portion removed.
- No.24. A rectangular prism.

TEST 2.

- No.25. A pyramid.
- No.28. A hollow cylinder.
- No.31. A possible shape (a trough).
- No.33. A sink in the gutter.
- No.37. The top portion of a hexagonal pillar.
- No.40. A trapdoor, opened and leaning against a vertical wall.
- No.42. A table.
- No.43. A hatchet.
- No.47. A flagstaff. Four supporting stays and a plot of grass at the base are also shown.

To take this test booklet, with the sole information that some drawings are correct and some incorrect and proceed to work through the drawings, would be a sure way to form the impression that the tests were of little value. It must be borne in

mind that verbal information was given with each test. For example, consider No.9. The boys were told this was to represent the shape of a bell tent. "Look for a drawing error. Do not say there are no guy ropes shown. The guys have been omitted to simplify the drawing and the drawing error which you have to look for is an error of a gross kind which there would be ready agreement about if it were pointed out." It was necessary to adopt similar safeguards with other tests to avoid the possibility of useless answers and the failure of the particular test item.

Actually, high hopes were entertained that these tests would measure something correlating closely with drawing ability in spite of the fact that there was no drawing at all done in the performance of the tests. It seems reasonable to argue that the reaction which is produced in us when we view a drawn representation of an object is more intense the more we are capable of producing a correct representation ourselves. This becomes clearer when we consider that in drawing we proceed by trial and error methods. We place a line in a certain position, compare the effect on our minds with that produced by the object itself, approve or disapprove as the case may be and proceed in this way through a series of incorrect drawings until we achieve what we consider to be a correct representation. A person who cannot see where a drawing is wrong is obviously incapable of making the drawing correct, and we are entitled to conclude that anyone who considered all the incorrect drawings to be correct would himself make all the drawing errors which are included in our tests.

To illustrate this meaning further consider drawing No. 35. The rod here is represented by a pair of lines. To realise that the drawing is incorrect these two lines must produce a deep impression on us. We must see a

rod, we must feel a rod, we must experience its weight, we must almost feel ourselves placing the rod in the position shown. At the same time the representation of the bowl must be fully interpreted as a bowl. We must realise its size, the relative proportion of its parts, its shallowness, its size relative to the rod and so on. When these impressions are intense, viewing the representation approaches most closely to the experience of placing the rod in the position shown. This same intensity of impression is what is needed to enable us to work through a series of approximately correct drawings to the best interpretation of which we are capable. It was on this line of argument that our high hopes were based.

The experiments of Dr. Thouless on perspective vision, which show that two people viewing the same horizontal circle from the same position would not interpret it by the same ellipse, may be thought to invalidate those tests which involve faulty representation of ellipses. A consideration of these drawings will show that no such view can be held. Where an ellipse is represented as too narrow as in drawing 36, its position relative to the other drawn ellipses makes the error undeniable, whatever view may be held with reference to the actual (and not the relative) sizes of the ellipses.

Tests 1 and 2 have been described in great detail. They represent a studied attempt to measure drawing ability (admittedly in a restricted sense) objectively. The duplicate test (test 2) was available for estimating the reliability of the measurement.

Having obtained a ranking for drawing ability from the drawing tests, the intercorrelation

of the two gradings (assuming that the 'spread' produced by the 'objective' tests was suitable for this purpose) was awaited with interest.

The remaining tests in the booklet are much shorter. There is insufficient test material in them to estimate reliability. The information supplied by them was pooled and was regarded simply as information likely to be supplementary to that obtained in other ways about the artistic ability of the boys. Since the correct performance of the tests undeniably required the possession of artistic ability it was justifiable to add the information they afforded to that obtained by the other tests. What remains unknown is the relative importance of different aspects of artistic ability and the lack of evidence in this connection has already been commented upon.

Test No.3 required the selection of one line from four given lines (in various orientations) which was most nearly equal to a shown line. (page 7 in the booklet) This was repeated for angles. (page 8) Similar tests in which stated fractions of a line (and angles) had to be selected were also given (page 9). The selection had to be made by eye estimation alone. The use of a ruler (or any other measuring device) was strictly forbidden, and this restriction was rigidly enforced.

One mark given for each correct response in this test gave a possible maximum of 14 marks.

It has been stated previously that a sense of design includes an appreciation of the appropriateness of the design and also of the suitable proportioning of the parts. Pages 10 and 11 of the booklet contain 8 pairs of drawings designed to test this sense. The device here

adopted is to present two designs to the testee, one good and one bad, and to ask him to indicate which he considers the better. To minimise the effects of guessing here the boys were told that they could put a cross on both designs if they thought they were of equal merit. This method of testing allows objective marking. It may be thought that a more reasonable test of what we are measuring would be to ask the testees to produce a design, possibly from given elements. The marking of such a test would be difficult and certainly not objective. The question then arises - do we sacrifice anything in adopting the objective form of this test rather than the one just suggested?. It is probable - though not proved - that we sacrifice very little. The power to produce a good design must imply the power to recognise which of two designs is the better, because it is probable that the process of producing the good design consists in the rejection of inferior ones which suggest themselves to the mind. This will be recognised as a line of argument similar to that adopted when attempting to justify the objective marking of drawing ability.

The first pair of drawings (1 and 2, page 11) show alternative arrangements of three photographs, in a frame. No.2 is considered superior on the grounds that the pattern formed is more varied and shows a more useful employment of the space available.

Drawings 3 and 4 show alternative designs for a book cover. No.3 is the better design. What few lines there are in 3 serve the useful purpose of leading the eye easily from Title to Author or whatever the two statements on the cover are. At the same time they divide the shape of the book into simply related parts. The lines in No.4 act merely as a distraction leading the eye on entirely fruitless quests. Other differences could be urged, but sufficient has

been said to show that No.4 merely illustrates absence of design. It is strange that a number of boys showed a preference for No.4. Others who have also shown this preference have claimed that No.4 shows a very 'modern' form of design!

Alternative designs for a loudspeaker grille are shown in 5 and 6. No.5 has the merits of simplicity and balance while it also suggests radiation. No.6 relies upon the observer's association of beauty with flowers to curry favour with him.

Drawings 7 and 8 show two groupings of the elements of a picture. In 7 there are two foci at the thirds and the pattern formed by the masses provides an acceptable rhythm. In 8 there is crowding of everything to the centre, and a resulting struggle for notice amongst the things thus crowded.

The two arrangements of door panels shown in 9 and 10 gave rise to some discussion and considerable difference of opinion during the preliminary trials to which these tests were subjected. There appeared to be a concensus of opinion in favour of 10 which, it was claimed produced a feeling of stability. There were notable exceptions to this agreement. Since we appeared to be dealing here with a doubtful case it was considered advisable to omit this pair and give the mark whatever the opinion expressed.

Of the alternative bowl decorations shown in the next pair (11 and 12), the former was considered the better. Its form contributed something to the shape of the bowl, whereas the landscape decoration was a pointless superimposition.

The arrangement of the masses in drawing 13 is superior to the arrangement in 14 where there is crowding to the right. The

incomplete bowl, moreover gives one a feeling of being 'left in the air', similar to what would be experienced when listening to a sentence which was abruptly stopped and left incomplete.

The arrangement of printing on a page as in drawing 15 introduces a pleasing variety which is not to be found in 16.

The judgements used in marking this test which we have just stated above, were readily agreed to (with the exception already noted) by a number of people. When Prof. Mains was asked if he would give his opinion on each of the alternatives, the design chosen was, in all cases, the same as stated above.

To each of the eight correct responses possible in Test 4, 2 marks were awarded, making a total of 16 marks possible.

The final test (No.5) is a colour test. Three tests appear on page 12. In these the testee had to select which one of the two side colours he thought would make a more suitable border round the centre colour (as for example, in a carpet). In these tests, again, the boys were told to indicate (by crosses) both side colours if they thought they were equally suitable. This was to minimise the effect of guessing. The responses marked as correct were in all three cases, the colour at the left hand side.

The tests on page 13 were slightly different. In all cases the central of the three colours shown was to be considered as given. The testee had then to indicate which of the two side colours he would use to complete a two colour scheme in which the colours were to appear in about equal proportions (as for example in colouring a wall of a room or passage). Both colours could again be indicated if they were thought to be equally suitable. The boys were advised to cover up one of the side colours while they judged the suitability of the other one with the central colour. The correct responses are here again (by coincidence) all on the left hand side.

The last two tests are self explanatory, words being used instead of colours. It was considered that grey with a black border was better than brown with a black border. A brown centre to a gold border was considered better than a pink centre.

The construction of these tests and the preliminary trials to which they were subjected, were most interesting and often highly amusing. People were frequently found to express the most intense dislike of particular colours, and to be quite unable to justify their attitude. It seems quite possible that associations formed between unpleasant experiences and particular colours, possibly in childhood days, would explain many of these attitudes. It was found that a common device adopted to avoid the necessity of forming a self-revealing choice was to object strongly to both colours. I have grave suspicions that this device is a round-about way of preserving one's 'amour propre' when it is desired to avoid the test. Doubts were entertained, at one time, of ever succeeding in getting some colour tests together. It was found however, that there were some people who showed very little reaction to colours and were quite unable to come to a decision whilst others, with the same colours to choose from, were most definite and decided in their choice. Those of this latter type appeared to have a greater sensitivity to colours. The colours shown in the test represent those about which such colour sensitive people agreed.

It is frankly admitted that this aspect of the Testing has not been fully explored. Our present purpose was considered served when the few tests shown were compiled. Ten colour tests in all were arranged. Prof. Mains was asked to give his judgement of these alternative colours. His decisions coincided with those stated above except in two cases, where he maintained the choice

offered gave rise to indecision. These were in the first test and in the ninth test. In the other cases he agreed that the choice was clear between pleasantness and suitability on one hand and a violent clashing of colours on the other. The 7th test illustrates this well, I think, where the two purples could be used together in great harmony whereas the light purple with the pink would be a most violent partnership. It was decided to give these tests little weight in the pooling of the results owing to the doubt which had been expressed about some of them. A total mark of only 10 was therefore used, one mark being given for each correct response.

The five Art Tests contained in the booklet just described were worked by the entire group of 128 boys at the same time. Working without haste and with adequate explanation of each test the examination occupied about 1 hour 20 minutes. The tests were observed to be of sufficient interest (or perhaps novelty) to make a strong claim upon the attention of the boys throughout the entire testing period. The marks obtained for these tests are shown on page XVII of the data folio. It is as well to state here that it is proposed to refer to these tests always as the 'Art tests' while the tests described in Section A. part II will always be called "Drawing tests".

The marks were treated in the following way. Marks gained in tests 1 and 2 were used to give two orders of merit. That the test items used extended over a suitable and sufficient range of difficulty was shown by the facts that the marks awarded ranged from 14-38 inclusive (25 points) in test 1. and 8-30 inclusive (23 points) in test 2.

The correlation of these two orders was calculated to estimate the reliability of this type of test. The coefficient thus obtained was $.56 \pm .04$, which revealed a substantial degree of agreement.

Many applications of tests would be necessary before a firm conviction as to the extent of the reliability could be reached but our result shows that a sufficient degree of reliability is likely to be attainable if this method of testing is investigated further.

The information obtained from tests 1 and 2 was then pooled by awarding to each boy the average of the marks he gained in these two tests. An order of merit was obtained from these average marks. Call this list $A_{1,2}$. Its range covered 20 points. The marks awarded in tests 3, 4 and 5 were all added together. This yielded a possible maximum of 40 marks. In this total, tests 3, 4 and 5 had unequal weights owing to the different range of marks shown in each.

The Range of marks awarded in test 3 was 6-14 incl. (9)pts.
" " " " " " " 4 " 4-16 incl. (13 pts)
" " " " " " " 5 " 0-9 incl. (10 pts).

This unequal loading was fully realised. A similar, though not so marked unequal weighting of a complete test result by unequal maxima in the sub-tests was pointed out previously in connection with Mental Testing. In the case of Artistic Ability testing we have no criteria which will tell us the correct emphasis to be placed on each sub-test. We do not even know whether we have included sufficient kinds of sub-test (nor do we believe that we have) and we have not examined the reliabilities of the sub-tests 3, 4 and 5. To object to the unequal weight which these tests bear in the total mark would indeed be to "strain at the gnat and swallow the camel". Let us refer to the resulting list of marks and deduced order of merit as $A_{3,4,5}$.

The range of marks shown in $A_{3,4,5}$ being 16-35 (20 pts). it was considered that this joint list might have sufficient discriminating power to justify the calculation of a correlation coefficient between it and $A_{1,2}$. The resulting coefficient was $.33 \pm .05$. This result suggests that the tests 3, 4, and 5 do measure something which is additional to the ability measured by Tests 1 and 2 and indicates the desirability of further investigation in this direction.

A final grading in performance of the complete booklet of tests was got by adding the marks awarded in lists $A_{1,2}$ and $A_{3,4,5}$. It can be seen that this gives $A_{1,2}$ about as much weight in the total as that possessed by 3, 4, and 5 together and this biases the final result towards the ability shown in $A_{1,2}$. The arbitrary weighting which is thus introduced into the final list and the unknown reliability of some of the sub-tests renders the list of no scientific importance. It is submitted that at this early stage of the investigation into artistic ability, suggestion leading to further investigation is the most that can be hoped for. The range of marks shown in the final list was from 31 - 63 (33 pts). This list we refer to as A_0 (signifying artistic ability, objectively marked). The mark distribution in this list was approximately normal (graph page XXX data folio).

The intercorrelation of the results of the "Drawing Tests" with the results of the "Art Tests".

Having now obtained information about the artistic ability of the testees by two different methods (drawing tests, subjectively marked - art tests objectively marked), it became a matter of great interest to compare the results of these two methods. In estimating the importance of the results we must bear in mind that whereas we have some knowledge of the reliability of measurement in the drawing tests and also in $A_{1,2}$, we have no such knowledge with regard to $A_{3,4,5}$.

The degree of correlation shown between the drawing list (D_3) and $A_{1,2}$, was first calculated. The coefficient of correlation was $.53 \pm .04$. This shows substantial agreement between these two gradings and bears out, to a considerable extent, the hopes expressed on page 72. The degree of correlation here shown is of the same order as that found between drawing tests 1, 2 and 3.

The coefficient of correlation between D_s and $A_{3.4.5}$ was next calculated and was found to be $.29 \pm .05$. This lower correlation was to be anticipated on the view already expressed that $A_{3.4.5}$ measured factors of artistic ability not revealed in representational drawing, that is by $A_{1.2}$.

Finally the list A_0 was correlated with D_s . The former of these contained the entire results of objective testing, while the latter contained the entire information got by subjective testing. Their degree of correlation was found to be $.54 \pm .04$. The uncertainty which entered into the list A_0 must affect the importance which the result is regarded as possessing, but the degree of correlation here shown may be taken as an indication that we have succeeded in measuring with the "Art Tests" an ability akin to that shown in the drawing tests. The values of these three coefficients further indicate that the ability which links performances in D_s and A_0 is of the kind measured by $A_{1.2}$ rather than that revealed in $A_{3.4.5}$. This is not regarded as an argument in favour of the rejection of the findings of $A_{3.4.5}$.

The results are summarised in the following table:-

	DRAWING ABILITY D_s .
$A_{1.2}$.	$.53 \pm .04$
$A_{3.4.5}$.	$.29 \pm .05$
A_0 .	$.54 \pm .04$

The substantial correlation here revealed led to the compilation of a list of artistic ability based on the information yielded by both methods of testing. The range

of marks in D_s and A_0 was equalised¹ and the resulting marks added to give the composite list (and its order of merit). We shall refer to this list as $A_{\text{composite}}$ (A_c). It is given on page XXI of the data folio.

1. This was done to give A_0 and D_s approximately equal weights in the total. Marks in D_s ranged from 39 to 327. 39 was taken from each mark and the remainder in each case divided by 9. Marks in A_0 ranged from 31 to 63 and from each of these 31 was subtracted. Final ranges were from 0 to 32. The correlation of A_0 and D_s was also calculated from the known correlations of $A_{1,2}$ and $A_{3,4,5}$ with D_s using Spearman's formula for the correlation of sums. (See page 22 data folio.)

P A R T III.

An Examination of the Intercorrelation
between the orders found for "Intelligence"
and "Artistic Ability".

The experiments performed for the purpose of grading the testees for intelligence have been described in Part I of the investigation. The account of the two methods used to arrive at a grading for artistic ability has just been completed in Part II of the investigation. Part III of this account will be devoted to an enquiry concerning the intercorrelation of the abilities tested in Parts I and II.

It was decided to treat the available data in the following way:-

1. To examine the correlation between intelligence and the results of the "Drawing Tests"
2. To examine the correlation between intelligence and the results of the "Art Tests".
3. To examine the correlation between "intelligence" and the pooled information concerning "Artistic Ability".

1. To Examine the correlation between "intelligence" and the results of the "Drawing Tests".

The coefficient of correlation between the lists D₂ and I. was calculated and was found to be $.15 \pm .06$. It will be observed that the coefficient is less than three times its probable error and may be taken to indicate that there is no significant correlation between the two lists. The degree of reliability with which the abilities in the two lists were considered to be measured has already been emphasised. We must conclude, therefore, that the result definitely shows in this experiment an insignificant degree of correlation between what we have called "drawing ability" and the ability measured by the intelligence tests, which we will now refer to as "g", the general factor in mental ability.

To investigate this matter further the coefficients of correlation between intelligence and each of the three drawing lists, were calculated. The results obtained were:-

	PENCIL.	COLOUR.	MEMORY.
INTELLIGENCE.	.16 ± .06	.07 ± .06	.18 ± .06

Here again every coefficient indicates absence of significant correlation, the coefficients being in all cases less than $3\frac{1}{2}$ times their probable errors. All the gradings have high reliabilities and the absence of correlation is definitely shown.

It is possible, by using the device of partial correlation, to illustrate further that there is common ability linking performances in Pencil, Colour and Memory Drawing, which is independent of "g". Using the coefficients,

$$r_{PC} = .55 \quad r_{Pg} = .16 \quad r_{Cg} = .07$$

we can calculate the value of $r_{PC.g}$ which signifies the coefficient of correlation between P and C where a rigid selection in respect of "g" has been made. If the high value of the coefficient r_{PC} (.55) is due to the fact that performances in P and C both involve the use of "g", then for a set of testees who have been "rigorously selected" so as to have "g" constant, the correlation between their performances in P and C ought to disappear. This correlation coefficient between P and C, with "g" constant, is what is represented above by $r_{PC.g}$.

(Yule's notation)

$r_{PC.g}$ may be calculated from the formula:-

$$\begin{aligned}
 r_{PC.g} &= \frac{r_{pc} - r_{pg} \cdot r_{cg}}{(1 - r_{pg}^2)^{\frac{1}{2}} (1 - r_{cg}^2)^{\frac{1}{2}}} \\
 &= \frac{.55 - .16 \cdot .07}{(1 - .16^2)^{\frac{1}{2}} (1 - .07^2)^{\frac{1}{2}}} \\
 &= \frac{.55 - .0112}{(1 - .0256)^{\frac{1}{2}} (1 - .0049)^{\frac{1}{2}}} \\
 &= \frac{.5388}{.9744^{\frac{1}{2}} \cdot .9951^{\frac{1}{2}}} = .5471 = \underline{.55}
 \end{aligned}$$

This resulting coefficient measures the 'specific correlation' between P and C. Similarly the coefficient of correlation between performances in P and M for a group of testees for whom "g" is constant is given by

$$\begin{aligned}
 r_{PM.g} &= \frac{r_{pm} - r_{pg} \cdot r_{mg}}{(1 - r_{pg}^2)^{\frac{1}{2}} (1 - r_{mg}^2)^{\frac{1}{2}}} \\
 \text{and since } r_{pm} &= .61 \\
 r_{pg} &= .16 \\
 r_{mg} &= .18 \\
 r_{pmg} &= .60 \\
 r_{PM.g} &= \frac{.61 - .16 \cdot .18}{(1 - .16^2)^{\frac{1}{2}} (1 - .18^2)^{\frac{1}{2}}} \\
 &= \frac{.61 - .0288}{(1 - .0256)^{\frac{1}{2}} (1 - .0324)^{\frac{1}{2}}} \\
 &= \frac{.5812}{.9744^{\frac{1}{2}} \cdot .9676^{\frac{1}{2}}} = .5784 = \underline{.60}
 \end{aligned}$$

Finally the coefficient of correlation between C and M, "g" constant is given by the formula

$$\begin{aligned}
 r_{cm.g} &= \frac{.52 - .18 \cdot .07}{(1 - .18^2)^{\frac{1}{2}} (1 - .07^2)^{\frac{1}{2}}} \\
 \text{using } r_{cm} &= .52 \\
 r_{cg} &= .08 \\
 r_{mg} &= .18 \\
 r_{cm.g} &= \frac{.52 - .0126}{(1 - .0324)^{\frac{1}{2}} (1 - .0049)^{\frac{1}{2}}} \\
 &= \frac{.5074}{.9676^{\frac{1}{2}} \cdot .9951^{\frac{1}{2}}} = .5170 \\
 &= \underline{.52} \\
 \text{we have } r_{cmg} &= .52
 \end{aligned}$$

These results are summarised in the following table:-

'Entire' coefficients.		'Partial' Coefficients.	
r_{pc}	.55	$r_{pc.g}$.55
r_{pm}	.61	$r_{pm.g}$.60
r_{cm}	.52	$r_{cm.g}$.52

They show clearly that the ability which causes the high coefficients of correlation between p and c, p and m, and m and c, is not the ability "g", and confirm the conclusion, already expressed, that we have shown "drawing ability" to be independent of "g".

Having shown that the three drawing tests (p.c. and m) show high "specific correlation" it is of interest to obtain the correlation of each of these tests with the common ability that links them. This may be done in the following way. Let r_{pc} , r_{pm} and r_{cm} be the specific intercorrelations between the three drawing tests, that is the correlations which they have with each other because of a common factor "A" (say). Then if "A" is the cause of the correlation between p and c, $r_{pc.A} = 0$.

$$\therefore \frac{r_{pc} - r_{PA} \cdot r_{CA}}{(1 - r_{PA}^2)^{\frac{1}{2}} (1 - r_{CA}^2)^{\frac{1}{2}}} = 0$$

THIS GIVES $r_{PC} = r_{PA} \cdot r_{CA} \dots \dots \dots 1.$

SIMILARLY $r_{PM} = r_{PA} \cdot r_{MA} \dots \dots \dots 2.$

AND $r_{CM} = r_{CA} \cdot r_{MA} \dots \dots \dots 3.$

MULTIPLYING 1. by 2. AND DIVIDING BY 3.

WE OBTAIN $r_{PA}^2 = r_{PC} r_{PM} / r_{CM}$

ALSO $r_{CA}^2 = r_{PC} r_{CM} / r_{PM}$

AND $r_{MA}^2 = r_{PM} \cdot r_{CM} / r_{PC}$

We obtain these formulae.

$$r_{PA} = \left(\frac{.55 \cdot .61}{.52} \right)^{\frac{1}{2}} = \left(\frac{.3355}{.52} \right)^{\frac{1}{2}} = .80$$

$$r_{CA} = \left(\frac{.55 \cdot .52}{.61} \right)^{\frac{1}{2}} = \left(\frac{.2860}{.61} \right)^{\frac{1}{2}} = .68$$

$$r_{MA} = \left(\frac{.61 \cdot .52}{.55} \right)^{\frac{1}{2}} = \left(\frac{.3172}{.55} \right)^{\frac{1}{2}} = .76$$

Coefficients of this nature are frequently referred to as coefficients of "saturation".

These results have been dealt with in detail because the conclusion drawn from them is the most definite and outstanding conclusion reached in the investigation.

It had been the author's view, before attempting this investigation, that the ability to draw well (whether representing the whole or only part of artistic ability) would be found to have a great deal in common with native intelligence. This opinion was also held by several people who, by lengthy experience in the teaching of art might have been reasonably expected to have formed a reliable opinion. It must be admitted that it was an easy matter to find experienced teachers (though not art teachers) who from many years of experience had formed an opinion directly opposite to that just expressed. In fact, the conviction with which views on this matter were always put forward by their expounders would have resulted in the abandonment of the investigation at the outset, had not these views been so frequently contradictory. The result which has emerged from this investigation, surprising as it must appear to some, must nevertheless be regarded as a reliable statement. The grading for intelligence and the grading for Drawing ability were the two most reliable rankings that we were able to obtain. The absence of correlation is thus seen to be definitely demonstrated.

2. To Examine the correlation between intelligence and the results of the Art Tests.

It will be recalled that the measurement resulting from the use of the art tests (denoted by A_0) contained the results of test $A_{1.2}$. (knowledge of correct representation) and $A_{3.4.5}$. (Eye judgement, design and colour sense). The reliability of the former of these had been found to be .56, while the reliability of $A_{3.4.5}$. was unknown. These differences between D_s and A_0 made it important that the correlation of A_0 with "g" should be investigated separately.

The coefficients of correlation between the results of the complete booklet of art tests and intelligence was $.35 \pm .05$. This result shows a small amount of correlation between the two lists.

To examine this result further the coefficient of correlation between $A_{1.2}$ and "g" was calculated. This was found to be $.4 \pm .05$ and was the largest coefficient obtained between an Art Test of any sort and "intelligence". Since we already knew that $A_{1.2}$ correlated with D_s to the extent of .53, these intercorrelations of $A_{1.2}$ were investigated further by the use of partial correlation.

$$\begin{aligned}
 r_{A_{1.2} \cdot D_s} &= .53 \\
 r_{A_{1.2} \cdot g} &= .40 \\
 r_{D_s \cdot g} &= .15
 \end{aligned}
 \quad
 \begin{aligned}
 r_{A_{1.2} \cdot D_s \cdot g} &= \frac{r_{A_{1.2} D_s} - r_{A_{1.2} g} \cdot r_{D_s g}}{(1 - r_{A_{1.2} g}^2)^{\frac{1}{2}} (1 - r_{D_s g}^2)^{\frac{1}{2}}} \\
 &= \frac{.53 - .40 \cdot .15}{(1 - .4^2)^{\frac{1}{2}} (1 - .15^2)^{\frac{1}{2}}} \\
 &= \frac{.53 - .06}{(1 - .16)^{\frac{1}{2}} (1 - .0225)^{\frac{1}{2}}} \\
 &= \frac{.47}{.84^{\frac{1}{2}} \cdot .9775^{\frac{1}{2}}} \\
 &= .5186 = .52.
 \end{aligned}$$

AND SINCE

$$r_{A_{12}g} = .40$$

$$r_{A_{12}D_s} = .53$$

$$r_{D_s g} = .15$$

$$\begin{aligned} r_{A_{12}g \cdot D_s} &= \frac{r_{A_{12}g} - r_{A_{12}D_s} \cdot r_{g \cdot D_s}}{(1 - r_{A_{12}D_s}^2)^{\frac{1}{2}} (1 - r_{g \cdot D_s}^2)^{\frac{1}{2}}} \\ &= \frac{.40 - .53 \cdot .15}{(1 - .53^2)^{\frac{1}{2}} (1 - .15^2)^{\frac{1}{2}}} \\ &= \frac{.40 - .0795}{(1 - .2809)^{\frac{1}{2}} (1 - .0225)^{\frac{1}{2}}} \\ &= \frac{.3205}{.7191^{\frac{1}{2}} \cdot .9775^{\frac{1}{2}}} \\ &= .3822 = \underline{.38} \end{aligned}$$

It was found that:-

"ENTIRE" COEFFICIENT.	"PARTIAL" COEFFICIENT.
$r_{A_{12} D_s} = .53$	$r_{A_{12} D_s} = .52$
$r_{A_{12} g} = .40$	$r_{A_{12} g \cdot D_s} = .38$

These results throw some light on the nature of the ability measured by $A_{1.2}$. It would appear that the correlation of $A_{1.2}$ with D_s was due to a factor not common to "g", while the correlation of $A_{1.2}$ with "g" was due to a factor not common to D_s . Argument on these lines shows that in using the Art tests_{1.2} we have estimated ability in two factors, one substantially correlating with D_s and the other correlated, though to a less extent with "g". The test $A_{1.2}$ therefore, to some extent, measures intelligence in addition to drawing ability. A consideration of the nature of these tests helps to make this conclusion understandable. The tests reveal knowledge of correct representational drawing, or what we might call the intellectual aspect of drawing. Executive ability in drawing cannot show itself in the tests except indirectly through a connection with knowledge of drawing.

That $A_{1,2}$ correlates substantially with tests of executive ability in drawing (D_s) indicates that knowledge and executive ability are usually to be found together. The smaller, but definite correlation between $A_{1,2}$ and "g" indicates, though with no great certainty, the additional measurement by $A_{1,2}$ of a certain knowledge of drawing which can exist independently of executive ability in drawing.

The remaining art tests $A_{3,4,5}$ were correlated with "g", the coefficient being $.19 \pm .06$. This coefficient indicates no significant correlation between the abilities measured by this test and "g". The unknown reliability of $A_{3,4,5}$ makes a definite conclusion impossible. We may claim, however, that the result suggests that certain factors in artistic ability additional to those tested by D_s show no ~~(connection with)~~ closer similarity to "g" than that shown by drawing ability.

Consideration of the intercorrelations of A_0 and "g" has therefore given rise to the following conclusions.

The grading produced by the test booklet shows a + correlation with "g" of very small significance. (coefficient < 7 probable error). This degree of correlation, though of little importance, is higher than that shown between D_s and "g". Further investigation shows this connection between A_0 and "g" to be located in the test $A_{1,2}$. This test measures (1) drawing ability which exists independently of "g" and to a lesser extent, (2). an intellectual aspect of drawing ability. The remaining portion of the test booklet shows no significant correlation with "g" and suggests that lack of correlation with "g" may extend to more elements of artistic ability than are included in D_s . This point is of great interest but our results are no more than suggestive here.

3. To examine the correlation between "intelligence" and the pooled information concerning "artistic ability".

A final grading for artistic ability, got by pooling the information contained in the lists A_o and D_s (with equal weights) was expressed in the list A_o . (Art composite). The coefficient of correlation of this grading with "intelligence" was found to be $.28 \pm .06$.¹ This coefficient is barely significant ($r = 4\frac{1}{2}$ probable error).

The matter was examined in closer detail by employing the device of partial correlation to investigate the relationships between D_s , A_o , and "g". It was found that

$$\begin{aligned} \text{since } r_{A_o D_s} &= .54 & r_{A_o D_s \cdot g} &= \frac{.54 - .35 \cdot .15}{(1 - .35^2)^{\frac{1}{2}} (1 - .15^2)^{\frac{1}{2}}} \\ \text{and } r_{A_o g} &= .35 & &= \frac{.54 - .0525}{(1 - .1225)^{\frac{1}{2}} (1 - .0225)^{\frac{1}{2}}} \\ \text{and } r_{D_s g} &= .15 & &= \frac{.4875}{.8775^{\frac{1}{2}} \cdot .9775^{\frac{1}{2}}} = .5262 \\ & & &= \underline{\underline{.53}} \end{aligned}$$

'Entire' Coefficient.	'Partial' Coefficient.
$r_{A_o D_s} = .54$	$r_{A_o D_s \cdot g} = .53$

This reveals substantial specific correlation between A_o and D_s which is independent of "g". We are able to conclude from this that the abilities needed for the performances measured by A_o and D_s have much in common, and that this common factor has no connection with native intellectual ability.

1. This result was also checked from the known correlations of D_s and A_o with "g", using Spearman's Formula for the Correlation of sums.

The detailed examination of the inter-correlations of the lists obtained in parts I and II of this investigation which we have just completed has thus led to conclusions which are briefly summarised:-

1. The existence of an ability common to the drawing tests used has been shown. It has, further, been demonstrated that this ability shows no significant correlation with that measured by intelligence tests, and generally denoted by "g". This is the most definite and reliable conclusion resulting from the investigation.
2. Such aspects of artistic ability as were measured objectively showed substantial correlation with the drawing ability mentioned above, but little correlation with "g".
3. The artistic ability which we were able to measure by the whole of the testing employed for that purpose did not show a significant degree of correlation with "g".

The first of these conclusions must be carefully interpreted. It certainly does not mean that the boy who is a good draughtsman is necessarily mentally dull and the mentally brilliant boy necessarily of poor ability in drawing. Such a condition would be expressed by negative correlation. We may say that if a boy has marked ability in drawing, he is just as likely to score low in a test for "g" as to score high. The chances are even. His ability in drawing is no criterion of success in an intelligence test. Comment has already been made on the surprise occasioned by this result amongst those who had, from their own experience, concluded that drawing ability and marked intelligence were

generally to be found together. Two observations may serve to make the experimental result less surprising. In the first place, little reliability can be placed on individual judgements with regard to a question of this general nature. Amongst a large number of observed instances, the exceptional cases always stand out and claim the attention. An opinion, based upon these observations, is therefore likely to be considerably biased by the exceptional cases. A few outstanding cases of boys, brilliant at drawing and also brilliant at intellectual studies may cause the observer to generalise on inadequate evidence. Similar remarks apply to the formation of a contrary conclusion. This may explain the extreme divergence of opinion which can easily be found on this matter, when an opinion is sought. It is clear that the more complete and unbiassed evidence of experiment is necessary before a reliable conclusion can be drawn.

The second observation on this experimental result concerns the nature of the ability we have referred to as "g". The symbol "g" is used by psychologists to denote that "general factor" which is common to the performance of all intelligence tests. While it is believed that this general factor measures "native intellectual ability" and must take part in all intellectual activities, there is no intention on the part of psychologists to apply to "g" the much wider and undefinable meanings which are attached to the word "intelligence" in everyday speech. It is this precisely defined "intelligence" which our results have shown to have little connection with "Drawing ability".

In conclusion it is desirable to indicate the precise limits which are now considered to mark the scope of this enquiry. The existence of drawing ability and its independence of "g" are regarded as having been

definitely shown for the 128 boys who were tested.

The reliability of the test employed to measure knowledge of representational drawing (.56) and the substantial correlation shown between this test and drawing ability ($r_{A, D} = .53$) indicates the value of further experiment in this direction.

The attempt made to measure elements of artistic ability additional to drawing ability only touches the fringes of a vast and most interesting aspect of our problem. No serious advance has been made here and the results obtained can only be interpreted as suggesting that such additional elements may show little correlation with "g".

A little has been discovered, something has been suggested and much remains for further investigation. It is in this condition that we must leave our problem.

A P P E N D I X.

Concerning the relation of scholastic ability to (a) "intelligence" and (b) "drawing ability".

Most of the information concerning drawing ability which was quoted earlier in this thesis, from previous researches, dealt with its relationship to general scholastic ability. The results we have obtained cannot be compared with these unless we assume a relationship between scholastic ability and "g". A high correlation coefficient between scholastic ability and "g" could reasonably be expected and has frequently been reported. Cox¹ gives .70, .59 and .77 average .69 as the coefficients obtained between three school examinations (N= 114) and "g". B.D.Wood² reports the correlation of "intelligence" with school rating as .672 and N. Carey³ gives a figure of .59 obtained with four elementary school classes.

On the other hand Oates⁴ reports a coefficient as low as .311 (N= 297) and Skaggs⁵ describes an experiment in which $r = .31 \pm .039$.

These differences are probably attributable to the arbitrary nature of the term "scholastic ability" and to the lack of reliability

1. Mechanical Aptitude. John W.Cox. Methuen. 1928.
2. Measurement in Higher Education. B.D.Wood.
3. "Factors in the Mental Processes of School Children" N.Carey. Brit. Journal of Psychology. Vol.7.
4. The relation of temperament and intelligence to Scholastic Ability. D.W.Oates. Forum of Education. Vol.7.1929.
5. "The correlation of Intelligence tests and School Standing". E.B.Skaggs. Journal of Educational Psychology. 1920.

of some of the marks from which conclusions have been drawn.

While the difficulties associated with the measurement of scholastic ability were fully appreciated it was considered of interest to add to the data previously recorded in this thesis some information concerning the scholastic abilities of the boys. The results here appended are put forward in a tentative manner in view of the undetermined reliability with which scholastic ability is measured.

The group of boys used in this investigation constituted the entire fourth form at Rutherford College. At the end of the previous school session these boys had been subjected to a very careful classification. This classification is based, to a large extent, on the marks gained by the boys in the school examination which they take at the end of one year in the third form. The gradings on the 'marks list' however, are very carefully scrutinised by the masters responsible for the classification of the form. When a boy's position on the list does not fairly represent his ability (as shown to his masters throughout the session) on account of absences or for any other reason, discretion is exercised and the list adjusted until, on the considered judgement of several masters, it represents as closely as they can make it with their experience and the marks list to rely upon, a true list of ability. It is found that the list compiled in this way suffers only slight modifications in subsequent examinations. Three examinations are held in each school session and the boys in question are being graded for the 6th time at the end of the 3rd form year. The order of merit list, arrived at in this way was taken to represent scholastic ability.

This list was correlated with the lists previously obtained for "intelligence" and for "drawing ability". D_s.

The results were:-

Scholastic Ability and "intelligence" $r = .66 \pm .03$

Scholastic Ability and "Drawing Ability" $r = .32 \pm .05$

Here then, we have information of educational importance showing that the possession of drawing ability does not necessarily accompany the possession of general scholastic ability.

OUTLINE STATEMENT OF THE METHOD AND RESULTS OF
THIS INVESTIGATION.

PART I. To grade 128 boys for "intelligence".

Two intelligence tests (Spearman's Measure of "intelligence" and the Otis Group Intelligence Scale) were applied. The correlation of the two gradings was:-

$$r = .74 \pm .03$$

The results were pooled (with equal weight) to give the final grading for "intelligence".

PART II. To grade the testees for "artistic ability".

Section A. using subjectively marked tests. Three drawing tests (Pencil, water colour, memory) were set. The intercorrelations of the gradings given (independently) by four markers were:-

TEST.	MARKER.	Burns.	Loughton.	Fallows.	Heron.	
PENCIL DRAWING.	Burns.....		.81 ± .02	.81 ± .02	.79 ± .02	.79 ± .02
	Loughton.....			.79 ± .02	.78 ± .02	
	Fallows.....				.76 ± .03	
WATER COLOUR DRAWING.	Burns.....		.65 ± .03	.83 ± .02	.79 ± .02	.76 ± .02
	Loughton.....			.77 ± .02	.67 ± .03	
	Fallows.....				.83 ± .02	
MEMORY DRAWING.	Burns.....		.64 ± .04	.81 ± .02	.57 ± .04	.63 ± .04
	Loughton.....			.71 ± .03	.48 ± .05	
	Fallows.....				.59 ± .04	

AVERAGE OF 18 COEFFICIENTS = .73 ± .03

Lists for ability in Pencil Drawing, Colour drawing and Memory Drawing were compiled. Their inter-correlations were:-

PENCIL.	COLOUR.	MEMORY.
Pencil.	.55 ± .04	.61 ± .04
Colour.....		.52 ± .04
		.56 ± .04

A list for "Drawing Ability" was compiled (D_s).

Section B. using objectively marked tests.

A booklet of tests was constructed to measure certain 'elements' of 'artistic ability'. There were five tests, 1 and 2 being duplicate forms of the same test.

The reliability of the first test was .56 ± .04

The pooled result of the 1st and 2nd tests correlated with tests 3, 4, and 5 to the extent of .33 ± .05

The final list obtained from all five tests was called A_0 . The results of the "Art Tests" correlated with the "Drawing Tests" were:-

	DRAWING ABILITY. (D_s)
$A_{1,2}$.53 ± .04
$A_{3,4,5}$.29 ± .05
$A_{1,2,3,4,5}$ = A_0	.54 ± .04

A list (called 'art composite' A_0) was compiled from A_0 and D_s .

PART III. To examine the degree of correlation
between the gradings for "intelligence"
and "Artistic Ability".

- (a). "Intelligence" and "Drawing Ability" were found to correlate:- $r = .15 \pm .06$
 Drawing tests (Pencil, Colour, and Memory) were separately correlated with "intelligence":-

	"Intelligence".
Pencil	.16 \pm .06
Colour	.07 \pm .06
Memory	.18 \pm .06

By 'Partial Correlation' the specific correlations between Pencil, Colour and Memory Tests, "g" eliminated, were found.

"Entire" Coefficient.	"Partial" Coefficient
$r_{pc} = .55$	$r_{pc.g} = .55$
$r_{pm} = .61$	$r_{pm.g} = .60$
$r_{cm} = .52$	$r_{cm.g} = .52$

"Coefficients of Saturation" of ability in Pencil, Colour and Memory drawing with their common factor were obtained:-

$$r_p \text{. Drawing ability} = .80$$

$$r_c \text{. Drawing ability} = .68$$

$$r_m \text{. Drawing ability} = .76$$

- (b) "Intelligence" and the results of the "Art Tests were found to correlate:- $r = .35 \pm .05$
In detail:-

	"Intelligence".
$A_{1,2}$	$.40 \pm .05$
$A_{3,4,5}$	$.19 \pm .05$
A_0	$.35 \pm .05$

The correlation of $A_{1,2}$ with "g" and D_S was examined.

- (c) "Intelligence" and the total art list (A_0) were found to correlate:- $r = .28 \pm .06$
By partial correlation the "specific correlation" between A_0 and D_S , "g" eliminated, was found:-

"Entire" Coefficient.	"Partial" Coefficient.
$r_{A_0 D_S} = .54$	$r_{A_0 D_S; g} = .52$

Appendix. To examine the correlation of "Intelligence" and "Drawing Ability" with Scholastic ability.

"Intelligence" correlated with Scholastic Ability:- $r = .66 \pm .03$
"Drawing Ability" " " Scholastic Ability:- $r = .32 \pm .05$

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