CHAPTER I

INTRODUCTION

HISTORICAL BACKGROUND

1. Title and Meaning of the Terms:

The title of the thesis is suggestive of the scope of enquiry in the present investigation. The terms embodied in the title are organised in a simplified manner. Here we are concerned with the influence of the variables like age, sex, locality and occupational training courses on the individual's test performances.

In fact, nearly two decades ago Vernon (1947) reported fascinating results in his article on variations of intelligence with occupational groups, Age and Locality. Also, Vernon and Parry (1949) reported more detailed results on the topic. The present writer, therefore, had a mind to plan an investigation to study the variations of intelligence with reference to the variables mentioned by Vernon (1947) with an addition of sex as a variable because the present conditions of Indian homes have given an almost equal occupational opportunity for both the sexes.
Ray-Chowdhury (1960 b) observed that Indian students seemed to possess different abilities from those of British boys. This caused Ray-Chowdhury (1960 b) to suggest that the observations made by Vernon (1947) and again by him and Parry in (1949) might be justifiably verified in Indian conditions.

At the advanced adolescent level many psychologists like Vernon (1960) find it difficult to distinguish between intelligence and attainment, though Thomson (1924) used the two terms almost synonymously at the animal level. Kemp (1955) observed significant results establishing the relationship of various characteristics of junior schools and their environments to one another and to the average level of attainment in the final junior year. In 1957 Kemp observed variability in attainment within schools in comprehension factor consisting of school subjects like Arithmetic problems, reading comprehension and general knowledge. In the same context the author found significant results of variability in attainment under rote factor consisting of school subjects like mechanical arithmetic, spelling, writing and comprehension.
Again, Anastasi (1958) has summarised various research evidences and commented that the 19th century 'Intelligence' has lost its title to 'abilities' and attainments from the angle of factorial studies. Vernon (1955) completely broke away with those who tried to retain the title 'intelligence' by placing in his presidential address to the British Psychological Society—his organised views on intelligence as A (or hereditary), B (acquired) and C (measured by psychological tests).

Obviously, the title of Vernon's (1947) article is retained with slight modification in the present investigation. The writer with a view to attempting to measure both intelligence (or abilities) and attainment factors and to study the variation of intelligence with age, sex, locality, and that of attainment with occupational training courses during adolescence.

For convenience, it is desirable to define and describe (A) Intelligence and attainment, and their development during adolescence. (B) Variation of Intelligence due to heredity and environmental factors.
Intelligence:

Drever (1952) in his dictionary of psychology, has defined the above term. According to him, "Intelligence" is the relating activity of mind; 'insight' as understood by Gestalt Psychologist, in its lowest terms Intelligence is present where the individual, animal, human being, is aware, however dimly, of the relevance of his behaviour to an objective; many definitions of what is really indefinable have been attempted by psychologists, of which the least unsatisfactory are:

(1) the capacity to meet novel situations, and to learn to do so, by new adaptive responses, and (ii) the ability to perform tests or tasks, involving the grasping of relationships, the degree of intelligence being proportional to the complexity, or the abstractness, or both, of the relationships." Then, again, "adolescence" is defined by Drever (1952) as "the period in human development between the beginning of puberty and the attainment of adulthood." Vernon (1950), Burt (1955), Guilford (1951) and many authorities on the subject are trying to explain intelligence and attainment from various angles, particularly factorial approach. We will therefore draw an historical picture of the findings
of the factorial studies on intelligence and attainment later. Here in the following sections, therefore, it is better to have a direct note of definitions of 'intelligence' and attainment under a conventional plan of (i) Bird's-eye view of observational, biological, physiological and individual psychology, (ii) Factorial picture, (iii) Development of Intelligence and attainment during adolescence.

(i) Bird's-eye view of observational, biological, physiological and individual psychology:

Discussing the evidence for the concept of intelligence Burt (1955) records the following four main concepts gathered by recalling the actual statements of leading authorities in each field:

(1) Observational:

"The earlier attempts to analyse and classify the activities of the mind were based partly on the observation of various types of person in everyday life and partly on introspection. Plato, to whom we owe the basic distinctions, draws a clear contrast between 'nature' and 'nurture'; and then distinguishes three parts or aspect of the soul, (Republic 435 A). The modern terms intelligence, emotional, and moral, cognition, affection, and connection - suggest rough but somewhat inexact equivalents for these untranslatable
expressions. In a celebrated passage (Phaedrus, 253 D) he sketches a picturesque analogy which conveys a better notion of the fundamental difference: the first component he compares to a charioteer who holds the reins, and the other two to a pair of horses who draw the vehicle; the former guides, the latter supply the power; the former is the cybernetic element, the latter the dynamic.

Aristotle makes a further contribution of lasting importance. He contrasts the actual or concrete activity with the hypothetical capacity on which it depends and thus introduces the idea of an 'ability'. Plato's threefold classification he reduces to a twofold. For him the main distinction is between what he calls the 'dianoetic' (cognitive or intellectual) capacities of the mind and the 'orectic' (emotional and moral). Finally, Cicero, in an endeavour to supply a Latin terminology for Greek philosophy, translates... by facultas, and... by appetitio or sometimes conatus; while to designate he coins a new word, rendering the Greek term almost literally by the compound 'intelligentia'. Here there we have the origin of both the concept and the term. So far from being a word of popular speech; whose meaning has been restricted and distorted by the modern psychologists, intelligence is a highly technical observation. From Aristotle and Cicero it descended to the medieval schoolman; and the scholastic theories in turn became elaborated into the
cut-and-dried schemes of the faculty psychologists and their phronological followers*. 

(2) Biological: 

"As Guilford has reminded us, the modern notion of "intelligence as a unitary entity" was "a gift to psychology from biology through the instrumentality of Herbert Spencer." Following Aristotle and the later Scottish school, Spencer recognizes two main aspects of mental life - the cognitive and the affective. All cognition, he explains, involves both an analytic or discriminative and a synthetic or integrative process; and its essential function is to enable the organism to adjust itself more effectively to a complex and ever-changing environment. During the evolution of the animal kingdom, and during the growth of the individual child, the fundamental capacity of cognition "progressively differentiates into a hierarchy of more specialized abilities" - sensory, perceptual, associative, and relational, much as the trunk of a tree sprouts into boughs, branches, and twigs. To designate the basic characteristic he revives the term 'intelligence'.

Evidence favouring Spencer's somewhat speculative theories was adduced by Romanes, Lloyd Morgan, and other pioneers of comparative psychology; and his views on intelligence were accepted, not only by British biologists
like Darwin, but also by continental writers, like Binet and Claparède. Certainly, Mendel's earliest disciples maintained that the doctrine of unit-characters was utterly irreconcilable with the inheritability of graded trait, such as intelligence (cf. Carmichael, 1946); but, as we shall see in a moment, the later developments of the Mendelian hypothesis not only permit it, but actually suggest it."

(3) **Physiological:**

"The clinical work of Hughlings Jackson, the experimental investigations of Sherrington, and the microscopical studies of the brain carried out by Campbell, Brodmann, and others, have done much to confirm Spencer's theory of a 'hierarchy of neural functions, with a basic type of activity developing by fairly definite stages into higher and more specialized forms. In particular, the examination of the cortex, both in mental defectives and in normal persons, suggests that the quality of the nervous tissue in any given individual tends to be predominantly the same throughout. Defectives, for example, exhibit a "general cerebral immaturity"; their nerve-cells tend to be 'visibly deficient in number, branching, and regularity of arrangement in every part of the cortex." After all, as Sherrington himself points out,
much the same is true of almost every tissue of which the human frame is composed, of a man’s skin, bones, hair or muscles. Each is of the same general character all over the body, although minor local variations are usually discernible. In the adult human brain marked differences in the architecture of different areas and of different cell-layers are perceptible under the microscope; but these specializations appear and develop progressively during the early months of infant life. And, of course, such differentiation is precisely what the Spencerian theory would entail.

The experimental study of the brain leads to the same conclusion. The intact brain acts always as a whole. No part of the brain functions in total isolation from the rest, as the older champions of cortical localization originally assumed. The activity, in Sherrington’s phrase, is "patterned not indifferently diffuse"; but the patterning itself "involves and implies integration." Lashley’s conclusions about the ‘mass action’ of the brain seems to lend further corroboration to that view; and as several writers have suggested, this ‘mass – action’ might well be identified with g.

The evidence of neurology, therefore, itself suggests something very like a theory of general ability, which gradually differentiates into more specific functions, though we must beware of picturing such functions as
separate 'faculties' located in certain centres or compartments of the brain, after the fashion of the older phrenologists and of several recent writers on so-called 'physiological' or 'medical' psychology."

(4) Individual Psychology:

"All these earlier writers were interested primarily in the workings of the mind as such, that is to say, in problems of general psychology. The first to apply scientific methods to the problems of general psychology was Galton. Darwin and Spencer had maintained that the basic capacities of the human mind were hereditary, transmitted as part of our common racial endowment. Galton went further and maintained that individual differences in these capacities were also innate. As a result of his investigations into 'hereditary genius' he was led to discard the traditional explanation in terms of faculties and types, and to substitute a classification in terms of 'general ability' and 'special aptitudes.' Of the two he considered that general ability was "by far the most powerful." The differences between individuals formed, so he believed, not a set of distinct and discontinuous classes, as the type theory assumed, but a series of continuously varying gradations, distributed more or less in accordance with the normal curve, i.e., much like differences in head-length, or stature (cf. Galton, 1889)."
Further, Drever's definition is broad enough to cover the definitions given by psychologists holding different views. Psychologists have been testing intelligence with some success for over forty years but have failed to reach any definition agreed upon by all. Binet (Cf. Vernon, 1950 pp. 3) regarded intelligence as a collection of faculties: "Judgement practical sense, initiative. --------- adapting oneself to circumstances." Several psychologists have considered intelligence as the ability to profit from experience. In a famous symposium published in 1921, thirteen psychologists gave thirteen different definitions of intelligence. Terman defined intelligence as the capacity for abstract thinking, Dearborn as the capacity to learn and Calvin as adjustment to environment.

"Stem defined intelligence as the ability to adjust oneself to new situations. Thorndike took more account of the quantity of bonds or connexions "the intelligence capable of the highest reasoning and adaptibility differs from the intelligence of an imbecile only in the capacity for having more connexions." Spearman suggested the significance of the ability to observe one's own mental processes, to discover essential relations, and to make further inferences therefrom. In addition, in view of the tendency to positive correlations between success in different types of intellectual activity, he postulated a hypothetical general factor underlying all cognitive performances.
of any kind. Knight added that 'the man of high intelligence is one who, faced with a problem, can seize upon the significant aspects of the objects or ideas before him, and can bring to mind other ideas that are relevant'. In Piaget's view, intelligence is the most highly developed from of mental adaptation the word intelligence being a genetic term to indicate the superior forms of organization of equilibrium of cognitive structurings to which all others tend. To Heim it is important to note that intelligent behaviour may admit of differences in kind as well as in degree - intelligent activity consisting in grasping the essentials in a given situation and responding appropriately to them; while Vernon (1955) would agree that intelligence is a very fluid collection of overlapping abilities comprising the whole of mental life."

Some of these definitions referred to by Fleming (1958) lay emphasis on biological aspects of mental functioning, others on competence in a variety of fields and still others on the influence of environment and on adaptation to cultural or social and emotional pressures. It is, therefore, desirable that we should elaborate here-in the views which are relevant in this investigation. Of these views, Piaget's and Vernon's appear most important to us.

Piaget's work on the development of intelligence in children is based on experimental findings. He formulated
a theory of intelligence consisting of two aspects. Braine (1959, pp. 1) summarizes Piaget's theory of intelligence as follows:

Piaget's theory has two aspects. First, it is a theory of intelligence: Piaget believes that the development of intelligence consists in the development of an ability to perform logical operations. Second, Piaget makes specific statements about the ages at which certain type of reasoning develop. He claims that as children grow older certain specified groups of logical operations develop in the average child at given ages. In his studies the principal ages of transition are reported to be at 7 and 11 year, approximately. At around age 7, the operations of the spatial and class interpretations of Boolean calculus make their appearance in children's thinking; at around age 11, the operations of the propositional interpretation appear. (The appearances of the spatial interpretation are revealed in Piaget's studies by changes at around age 7 in the child's manner of using measuring instruments and in his performance on a number of tasks supposedly demanding conception of, or reasoning about, spatial relations (Piaget and Inhelder, 1956; Piaget, Inhelder, and Szeminska, 1948). The operations of the
class interpretation are revealed by the development of number concepts and by the disappearance of certain anomalies in the child's class concepts (Piaget and Szeminska, 1952). The appearance of propositional operations at age 11 is attested, according to Piaget, by the child's performance on a variety of reasoning tasks (Piaget, 1955; Piaget and Inhelder, 1953).

Piaget's theory affirms that in the course of development there are ages of transition during which intelligence changes from relatively 'primitive' to more 'mature' forms. Such important changes in the nature of intellect should be manifested in longitudinal studies of the development of intelligence as measured by intelligence tests. In the past twenty years there have been several studies of this kind, of which probably the best known is the Berkeley Growth Study (Jones & Bayley, 1941).

In the past there have been two principal viewpoints about the development of intelligence. The classical view is that there is no change in the nature of intelligence during development, that there are no qualitative differences in thought and reasoning between early childhood and later years, and that intellect develops through steady and continuous quantitative increments from birth to, at least, adolescence. The viewpoint found its clearest expression in the doctrine of the consistency of I.Q.
At the time of the heyday of the classical view about 25-50 years ago, the exponents of the opposition viewpoint were largely limited to Piaget's group at Geneva, although the psychoanalytic view has this in common with Piaget's. The theoretical dichotomy between the 'primary processes' characteristic of infancy and the secondary processes which are thought to develop approximately at the time of resolution of the Oedipus complex necessarily implies a transition in the development of intelligence.

Many of the early criticisms of Piaget's work were advanced before the classical viewpoint had been generally discredited. These criticisms, therefore, tended to assume that there were no changes in the nature of intelligence during development and consequently where Piaget saw a research problem, his critics saw either no problem or pseudo-problem. Thus, not only were Piaget's early theories (Piaget, 1926, 1928, 1930a, 1930b) severely criticised, but also, unfortunately, the problems on which he was working were largely disregarded. Consequently, most of these critical studies (Bruce, 1941; Dentche, 1937; Huang, 1943; Huang & Lee, 1945; Issacs, 1930; Mead, 1932; Oakes, 1946) have tended to be unfruitful; they have led neither to alternative solutions nor to reformulations of Piaget's research questions. They have largely confined themselves
to demonstrating, often convincingly, that Piaget's theories, as he stated them, had serious flaws and that the evidence adduced by him was often a good deal less than cogent. Piaget has himself admitted the validity of some of the criticisms of his early work (cf. Piaget, 1953b, pp. 12)."

The most revolutionary and widely accepted view today is that of Professor P.E. Vernon (1955 b), who in his presidential address on "The Psychology of Intelligence and G" classifies into three main groups the thinkers who have offered the definitions of intelligence. He designates them as (1) the operational, (2) the biological and (3) the psychological. "Operational writers consider that theorizing about the nature of intelligence has proved fruitless; it is best regarded as "what the tests measure", and should be investigated by factor analysis of the relations between different tests, and through empirical research into what tests enable us to predict about people. The biological approach contrasts the relatively mechanical responses of lower animals, based on fixed tropisms, reflexes, or instincts, with the more versatile and adaptable behaviour of higher species, including man. Thus many definitions stress capacity for profiting by experience, adaptation to environment, plasticity or ability to learn by trial and error, or, still more, by insight. The third
category of psychological definitions include various faculties, such as grasping relations, abstract thinking, reasoning, problem solving, originality, foresight, judgement, all round mental efficiency, etc.

Summarising his viewpoints Vernon (1955 a, pp. 194) suggests three types of intelligence. According to him the term intelligence can be, and often is, used in the very different senses which he calls A, B, and C. He says "Intelligence 'B' is the all-round ability or mental efficiency that children or adults actually display in everyday life, at school or at work. Intelligence 'B' is very largely acquired. Intelligence 'A' connotes the underlying, inborn potentiality, that is some quality of the central nervous system determined ultimately by the genes. But this quality is purely hypothetical. It is a legitimate hypothesis, but we have not, at present any means of observing or measuring it, and have little prospect of ever being able to do so. Intelligence 'A', then, is the innate capacity to acquire intelligence 'B'. Intelligence 'C' is the I.Q. or Mental Age or other score obtained from a standard test, which may or may not correspond very closely with intelligence 'B'. It too is largely a product of environment; and though it is ultimately limited by innate potentiality 'A', it clearly does not measure pure inborn ability." Again he
sorts out the definition of intelligence in this way: "Intelligence 'B' is not any one thing; it is a loose mixture of all sorts of overlapping abilities, which can fairly readily be broken down or classified under a number of relatively distinct headings by factor-analytic investigation. Moreover, the mixture is very different at different age levels." In this connection Vernon (1955a) quotes Hebb (1949) who defines Intelligence 'B' as the intelligence which is recognized in daily life. This type covers the intelligent thinking capacities which are acquired during adolescence. These various intelligent thinking capacities do not develop fully without the aid of intellectual stimulation. Again he quotes Piaget (1950) who emphasizes in his recent book 'The Psychology of Intelligence' that intelligence is no one distinctive faculty, and can not be reduced to grasping relations or abstract thinking, but is present in all adaptations of the organism.

(ii) Factorial picture:

(a) Intelligence:

Actually there is much overlapping between Psychologists giving different views on definition and concepts of intelligence. But it is very difficult to prove the truth of the statement unless we have a scienti-
fic approach to the definition of intelligence, better known as abilities, which can be given in terms of factors, Vernon (1950) says, "the real need for factors arises as soon as we begin to discuss and name abilities or traits, and to compare the relative standing of different people on such faculties." He defines factor as a construct which accounts for the objectively determined correlations between tests in contrast to a faculty which is a hypothetical mental power - - - - - - - - - - - - factor should be regarded primarily as categories for classifying mental or behavioural performances, rather than as entities in the mind of nervous system.

But until the advent of factorial approach to intelligence, workers were busy with correlational techniques to study the problems of intelligence. Galton and Pearson devised the method of correlation to measure the agreement between two sets of scores. First, this method was applied by Wissler (1901) to measure mental functions. His results obtained from the analyses of tests of reaction time and sensory acuity showed scarcely any correlation with the grades of college students. Thorndike and others, while working on transfer of training reinforced the view that abilities are highly specific. Muscio (1922) and Perrin (1921) obtained extremely small correlations between different tests of manual skills.
Thomson has shown that the statistical fact that test inter-correlations can be largely accounted for by a single factor does not prove that such a factor represents any unitary power, or organ of the mind. It might also arise if the mind is thought to consist of an immense number of 'bonds' including inherited reflexes, acquired habits and association, etc. Accordingly, Thomson's (1939, pp. 31) view is that factors over and above 'g' arise, partly perhaps from hereditary influences, but mainly because an individual's upbringing and education imposes a certain grouping on his bonds. Illustrating the view of Thomson, Vernon (1950, pp. 32) writes "The vsed factor is a rather strongly unified group because our society gives a fairly uniform education to all its members. It does not readily breakdown into separate verbal, number, speed, reasoning, attention, memory or other factors because the abilities covered by these names tend to be developed differently in different schools and homes, though partially distinct minor group factors can often be established, especially in fairly homogeneous groups such as university arts students. On the practical or k:m side there is, as Anastasi points out, less cultural standardization, hence the k:m pole is more heterogeneous and amorphous than vsed. It would appear to be not so much a positive practical ability as an aggregate of all non-symbolic capacities, or of bonds
that are not usually affected by primary schooling.
Nevertheless, evidence is available to the extent that
not only mechanical and spatial, but physical and manual,
and some non-verbal 'g', perceptual and performance tests
all have something in common over and above 'g'. The
kind of test which is most strongly saturated with this
factor is the mechanical assembly test, presumably because
this epitomizes, as it were, non-scholastic activities."

Spearman's Two Factor Theory: However, there are
number of such evidences relating to the works with
correlational techniques. But, in the fall of the present
century, it was Spearman who in 1904 published his results
obtained from correlations between sensory tests and
estimates of intelligence which showed that, "all branches
of intellectual activity have in common one fundamental
function (or group of functions), whereas the remaining
specific elements of the activity seem in every case to
be wholly different from that in all others". He devised
a technique, known as tetrad differences, to prove that no
significant factors other than 'g' and specifics are present.

Spearman's book on 'The Abilities of Man' was
published in 1927. In this book he has presented his
theories along with numerous experimental findings obtained
by himself and his students supporting the view. Vernon
(1951, pp. 13) summarizes Spearman's theories which show that "neither the anarchic, nor the monarchic or oligarchic theories of the mind accord with the facts. The monarchic view reduces all abilities to a single capacity of general intelligence or 'common sense'. This would imply that they are all perfectly correlated, and would make no allowance for the unevenness of people's abilities along different lines. The oligarchic theory is the view that the mind is ruled by a number of separate powers of faculties."

Although Spearman wisely refused to identify 'g' with intelligence or any other quality whose definition was controversial, he suggested that it depends on the general mental energy with which each individual is endowed. He compared s-factors to a large number of mechanisms or engines, which could be stimulated by general mental energy or 'g'.

Although Spearman, in Britain, established for the first time the truth of the general factor 'g', actually the importance of additional sub-types of ability or group factors came into existence from the works of Kelley (1928), Stephenson (1931), El Koussy (1935), Alexander (1935), Burt (1940), and others.

Burts' concept of Group-factors: Burt (1909) suggested a sensory discrimination group factor beyond
'g'. He noticed verbal, numerical and practical group factors in school subjects, in addition to a general factor. He used a fundamental formula for the Simple Summation technique of analysis, later rediscovered by Thurstone and named Centroid method, and developed techniques of assessing group factors. The verbal factor appeared to be two-fold, one part included the literary subjects, namely Composition, History, Geography and Sciences the other included the simpler wordreading and spelling attainments. The practical group included Handwork, Drawing, Writing Quality and Speed. Similar results were obtained with 613 ten-year old children in 1939, except that the two types of verbal ability appeared to have amalgamated. For the average school subject the variance attributable to the general factor was 27.9 per cent., and to group factors 20.7 per cent. Another interesting point was that the general factor correlated highly, but not perfectly, with an intelligence test. This suggested that general scholastic ability is largely made up of 'g', but it also involves other qualities as interest.

Kelley's work: In 1928, Kelley studied the intercorrelations of batteries of tests given to three groups of over a hundred pupils, aged around 13, 9 and 3½ to 6 years. He established verbal, number, rote memory, spatial
and speed factors. The general factor was prominently found in all groups. He explained this general factor in the light of heterogeneity due to differences in age or maturity, race, nurture, sex, etc.

**Stephenson and El-Koussy:** Stephenson and El-Koussy established group factors. In 1931 Stephenson tested a large group consisting of 1037 girls, aged around ten to twelve. He gave seven verbal and eight non-verbal intelligence tests. The correlation between the non-verbal tests could be accounted for by a single factor, which he identified with 'g'. The verbal tests were more complex, but their correlations with one another and with the non-verbal tests could be accounted for by 'g' and a verbal group factor.

Illustrating, Stephenson’s findings, Vernon (1950) writes: "Stephenson’s results do not disprove the alternative of another group factor of a spatial - perceptual nature in the non-verbal tests - that is the structure similar to that of Table I. In terms of variances, (roughly calculated by Vernon, 1950) Stephenson's solution was:

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<td>Showing Vernon's Factor Solution of Stephenson's Results.</td>
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<td>Average non-verbal test</td>
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<td>Average verbal test</td>
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A solution which would be more favoured now-a-days, and which maintains the same communalities, would be:

Average non-verbal test  \[ \frac{g}{31\%} \quad \frac{k}{7\%} \quad \frac{v}{0\%} \]

Average verbal test  \[ 44\% \quad 0\% \quad 5\% \]

El-Koussy (1935), was the first man who applied the symbol \(k\) for the spatial factor."

**Aleksanders' work:** In 1935, Alexander applied Thurstone's centroid method in his investigation for measuring abilities. He tested one hundred Scottish primary school boys and girls, aged around 11 to 12 years, American Secondary and Technical school pupils (16-17) years, and adult women in a delinquent institution. He gave large batteries of verbal and non-verbal intelligence tests. He obtained multiple factors which were closely related to a group factor pattern. In addition to \(g\) he obtained \(v\) factor in the verbal tests, and a practical group factor, which he called \(F\) in constructive performance tests. On the basis of these results obtained from the investigation, he developed his performance test scale, consisting of cube-construction, Kohs Blocks and Passalong, for measuring 'concrete' or practical ability. In the third group he found out another factor, which he called \(X\), and identified it with the influence of personality and interests.
Multiple Factor Analysis established by Thurstone:

Burt's Simple summation technique of analysis was rediscovered by Thurstone (1931) and named as Centroid Method. He applied this technique in measuring attitudes and rating of personality traits.

Thurstone (1938) obtained eight main or primary factors on the basis of a long series of investigations of human abilities. He could not notice 'g' at all. The eight factors are as follows:

V  Verbal
P  Perceptual Speed
I  Inductive Reasoning
N  Number
M  Rote Memory
D  Deductive Reasoning
W  Word Fluency
S  Space or Visualization

Vernon's Concept of Group Factors and Hierarchical Theory: Vernon (1950, pp. 14) strongly criticizes Spearman's theory in the following manner: "The chief criticism that would be raised now-a-days against Spearman's view is that he failed to allow sufficiently for types of ability which, while less general than 'g', are certainly not specific. He admitted indeed that different number of tests, also different mechanical, and certain other types of tests show residual correlations over and above
'g'. But he ascribed this to the presence of common specific factors and insisted that such 'specific overlap' is very rare. Actually the notion of specific overlap is a contradiction in terms, and towards the end of his life Spearman did begin to recognize the existence of broad group factors such as the verbal and spatial, which arise from the overlapping of quite diverse-factors. One reason why his own work, up to 1927, failed to yield evidence of group factors was that he and his followers were seldom able to test large populations. Hence any residual overlap that did appear was usually not statistically significant; it might have arisen from chance errors in the correlations. But Spearman was unduly cautious and did not admit that lack of statistical significance does not disprove the existence of additional factors; it only fails to prove it. A large scale experiment was carried out by Brown and Stephenson (1933) with the avowed object to demonstrating the truth of falsity of two-factor theory. Three hundred 10 year boys were given twenty varied tests. Some of the pairs of the tests did in fact show correlation beyond that accounted for by 'g'. Some years later Blakey (1940), reanalysed the correlations by Thurstone's method, without omitting any of the awkward overlap, and concluded that verbal, perceptual and spatial group factors were present, though their variances amounted only to 12.9 percent, as compared with 41.2 per cent, attributable to 'g'.
It is noteworthy that if Spearman's strict view was correct, educational and vocational guidance with the aid of tests would be impossible. We could not measure aptitude for linguistic or mechanical works by linguistic or mechanical tests, since both types of tests would predict nothing but 'g'. In fact the only tests worth using would be the purest 'g' ones. By means of these we could determine the general level of occupation or education for which an individual was suited, but could not differentiate between different types of ability at this level. The only possibility would be to apply tests covering the specific factors in each prospective job. Thus an assembly test might measure the S-component of mechanical assembly work; but would throw no light on aptitude for lathe operating or other mechanical jobs.

In point of fact Spearman has proved much more nearly right than vocational or educational psychologists would wish him to be. We shall see later that group factors are generally more limited in scope than general, and highly specific, ones, so that it is indeed very difficult to differentiate types of aptitude."

The hierarchical theory was first put forward by Burt, under the influence of McDougall. Burt (1949 a) describes its origin and application to abilities. Vernon
(1950) says, "It is certainly an improvement both on the original two-factor theory and on the 'neo-faculty' limitations and implications."

Vernon (1947 a), however, from the tests of recruits entering Navy and Army confirmed the importance of 'g'. In his eight analyses, 'g' was found to cover more than twice as much variance as all group factors combined (cf. Fig. 1). After the removal of 'g', tests tend to fall into two main groups: The verbal-numerical-educational on one hand (referred to as vised factor), and the practical-mechanical-spatial-physical on the other (referred to as kim factor). If the analysis is sufficiently detailed, i.e., if sufficient tests are included, these types themselves sub-divide. The vised factor gives minor v and n (number) group factors. In further analyses (cf. Vernon, 1950, pp. 23) kim splits similarly into mechanical information, spatial, and manual sub-factors.
(b) **Educational Attainment:**

Vernon's (1950) final views are as follows:

"School marks yield a different structure from objective psychological tests because of the X-factor—a complex of personality traits, interests and background. This, together with 'g' and varied from the major influence in all educational attainments in unselected groups of children and adults, though differentiation according to subject matter can readily be established in selected secondary school pupils or university students. The more drilled and mechanical aspects of v (verbal) and n (number) abilities differentiate most clearly but there is insufficient evidence to justify 'rote' with 'reasoning' attainments. Many a priori classifications of types of reading and number ability lack empirical substantiation. For example word-knowledge (vocabulary) and comprehension in reading come to much the same thing. However, mechanical, rote, vocabulary and comprehension aspects are partially distinguishable at advanced levels."

Vernon (1950) has cited the works of Holzinger and Swineford (1939) Sisk (1940) Carroll (1943) and Comary (1949) in connection with the industriousness factor in school marks, Bredford (1946) Blackwell (1940) Kerr (1942) Comery (1949) in connection with overlap of school

Further concluding educational attainment factors Vernon (1950) says "No further factorial evidence seems to be available regarding the practical subjects that Burt distinguished, though we shall see that the kin factor probably links up with scientific ability, and that this may be an aesthetic discrimination factor relevant to certain subjects (cf. figure 3 pp. 47 Vernon 1950).

Note that 'g', 'X' and other relevant personality, interest, and physical factors, together with vied are
placed in a central complex which constitutes general-educational ability. This effects all branches of all subjects. the influence of particular interests traits or physical conditions on particular subjects, could not be shown. Vare subdivides into v and n, which branch into the various linguistic and mathematical-scientific subjects. Each such subject, it may be assumed, would yield its own small group factor if appropriately investigated. An attempt has been made to place the more specific attainment, those which are usually least dependent on general educational ability, furthest from the centre; also to place furthest apart those attainments which tend to show the lowest correlations."

(c) Development of Intelligence and Attainment during Adolescence:

Intelligence will not be complete without a brief mention of the development of intelligence and attainment during adolescence. During adolescence the normal young person advances on many intellectual fronts. He continues during the teens to gain in intellectual capacity. He increases his ability to learn. He becomes better able to deal with abstract ideas. While growing in the ability commonly measured by intelligence tests, the adolescent also continues, if all goes well, to gain in breadth of
knowledge, in depth of understanding, in practical
wisdom, in judgement, and in common sense.

Staines (1958, 1961) while discussing the differen-
tiation of self in the social groups has regarded intelli-
gence as an important factor. He finds that
the bright children were generally more differentiated
than the dull children. Jersild (1957, pp. 2) explains
the importance of adolescence period in this way "Ado-
lescence is a time of great promise but much of the pro-
mised land is a wilderness that is untried, uncharted,
and unknown. It is necessary for the young person to
find a path, to build a road, to establish, as it were, a
settlement of his own, before he can be at home in the
promised land. No matter how much help his elders may
try to give him they cannot fully open the way or prepare
a place for him. The adolescent's task is not simply one
of dealing with the external environment and other in-
dividuals but one of seeking to discover himself, his
reaches and his limits, and his role in the world in which
he lives."

Again regarding the importance of relationship
between abilities and adolescence Jersild (1957, pp. 74)
continues, "there are many young people, who, during
adolescent years, attach increasing importance to their
intellectual abilities when they directly appraise themselves. Moreover, as we have implied, the young person's intellectual abilities have an important indirect bearing on his appraisal of himself. From an early age his experience of success and failure has been influenced to a prominent degree at school and also at home and in the community, by his ability to acquire the many intellectual skills children in our culture taught. His ability to learn things calling for mental ability influences the way others regard him and this, in turn, influences his regard for his own worth. Sometimes even the young person's conception of his "goodness" or "badness" influenced by the fact that he has high or low intelligence. Often the youngster who is regarded as "good" is one whose intelligence enables him to learn quickly the lessons parents and teachers want him to learn. Failure to learn or slowness in learning is often treated with impatience by adults, as something that should be punished as a sign of disobedience or lack of moral character.

In the subtle ways the growing persons ideas concerning his intellectual ability will influence not only his conception of who and what he is but also his anticipations and hopes concerning what he may become. If an adolescent is convinced, rightly or wrongly, that he is rather stupid,
this conviction may close many avenues of life to him that might otherwise be open. Even in the late elementary grades he may look upon himself as one who probably cannot take a full academic programme in high school and should not even think about going to college. The more his thinking is dominated by this idea, the more he will tend to shut off lines of vocational choice about which he might otherwise speculate and daydream.

This has been recognised that some of the changes in thinking and concept formation take place when a young person matures in intelligence and acquires certain abilities, such as (i) ability to deal with the generalizations, (ii) ability to deal with the abstractions, (iii) ability to deal with the concept of time, (iv) ability to deal with the ideas without immediate personal involvement and (v) ability to make decision, etc.

We will now consider the development of intelligence and attainment during early and later adolescence. Jersild (1957, pp. 76) Summarizes several characteristics of the adolescents mental operations,‘generalization,' 'abstraction', 'concept formation', etc.

Regarding the increased ability to generalize, one very noticeable characteristic of the mental operations
of an older person, compared with a younger child, is the ability to deal with the generalizations and more inclusive classes or categories of thought. This is shown, for example, when children express their wishes. The younger the child, the more he tends to think in terms of the concrete things, such as bicycle or a base ball glove. As he grows older he tends to think in more inclusive terms (cf. Jersild and Tash, 1949).

A corresponding trend towards a more generalized type of thinking appears in the fact that the younger child tends to see things on perceptual level, while the older child sees more on a conceptual level. In studies of children's reactions to a war situation (cf. Bender et al., 1942; Preston, 1942; Jersild and Meigs, 1943) it was observed, for example, that younger children tended to describe war in terms of concrete happenings, such as the damage that has been done by bombing or the fact that butter was rationed. A large portion of children of about teen age, on the other hand, saw the war in terms of larger concepts; the damage from a particular bombing represented not an episode but an example of a larger wartime policy. The scarcity and the lack of butter was incorporated into a more inclusive idea concerning
scarcity of material or destruction of material in wartime.

However, before closing this discussion it would be wise on our part to take into consideration Vernon’s (1950, 1955) picture of adolescent abilities in terms of factorial concepts, as depicted by Lovell (1958), in the following manner:

Verbal educational abilities (the v:ed group), and spatial mechanical abilities (the km group), increase during adolescence, provided the individual is receiving adequate stimulation in these fields. As for later adolescence, the v:ed abilities (other than reading abilities) remain stationary or decline somewhat, in the years immediately following school-leaving, unless there is further training or relevant experience; while it is possible that the km abilities increase until the late teens with or without much training or experience. Teachers, Lovell advises, should note that the more homogeneous the children in a secondary-school class are in respect of general intelligence, the more important special abilities become in determining the relative progress that pupils can make in a school subject.
(B) Variations of intelligence and attainments due to environmental and hereditary factors

Observing the effect of hereditary and environment on the variation of intelligence Vernon (1960) writes: "A direct indication of the effects of advanced education is provided by Lorge's (1945) and Husen's (1951) investigations, where the same individuals were tested as children and as adults. Lorge reckoned that, at 34, adults who had received University education were 2. M.A. years superior to others who possessed the same intelligence at 14 but had had no further schooling. Husen tested 722 men entering the Army at 20 whose I.Q.s at 10 years were known, and found that those who had matriculated had gained 12 I.Q. points relative to those who had had no secondary education.

That the quality rather than the length of schooling makes a difference is indicated by a research (Vernon, 1957 a) in which almost all the boys in the 14 secondary schools of an English city were tested at 14 years, and their results compared with their I.Q.s at the time of secondary school selection 3 to 4 years earlier. Allowing for initial differences between boys entering different schools, and for regression effects, there were now differences of up to 12 points between boys in the 'best' and
'worst' schools. The combined grammar and technical school boys had apparently gained 7 points over the combined modern schools. Much of this difference might well be due to the grammar school boys coming from better homes, with more favourable attitudes to education; but this would nonetheless be an environmental effect. The results supply strong grounds for suspecting that some secondary modern and all-age schools, actually inhibit the full growth of intelligence over the 11 to 15 years period; if the pupils and staff are bored or resentful and the teaching mechanical; whereas other modern schools, together with most technical and grammar schools, are relatively successful in stimulating the mind and bringing out potentialities more fully. According to a further research by Lovell

1. "This finding is disputed by Pidgeon and Yates (1957); however, if their figures are adjusted for expected regression effects they accord closely with Vernon's. It is interesting to speculate whether the strong positive skew in Terman-Merrill I.Q.s at 11 years may not be due to the success of junior schools in stimulating the intelligence of above average pupils who have a chance of success in the selection (or Scottish qualifying) examinations. It appears to be considerably more marked than in America."
(1955), it is mental flexibility in particular, and the capacity for forming new concepts, which are affected by the adolescent's intelligence and emotional circumstances, that is those very capacities which are most subject to deterioration in adulthood."

The present investigation is concerned with the influence of some external factors, namely age, sex, locality, and training courses. But various workers have in the past included some or all of these variables with a view to studying the influence of 'practice', meaning an aspect of education of schooling. It would be coherent if we quote some of these relevant works in the following lines: Vernon (1957) reported three investigations and while discussing 'intellectual stimulation' he meant by the term "not quantity but quality of schooling during adolescence". Lorge in America and Husén in Sweden showed that length of schooling in adolescence and early adulthood has an important influence on intelligence. Lovell (1955) studied the intellectual deterioration, etc. By intellectual deterioration he meant lack or forgetting of schooling a education either in one particular intellectual aspect or in several such aspects. After Lovell if anybody is to be referred to here, it seems that Norris (1940), merits a place in this context. His
study suggested that educational attainments tend to lapse rapidly after leaving the school except in so far as they are used in daily life. There are still number of workers who may be referred to in this context. However, as the purpose of the present section is to survey as far as possible, within the limitations of space and time, the variations of intelligence and attainment as aroused by environmental factors or stimulus, such as sex, age and other socio-economic conditions, let us discuss them one by one to have a clear idea about the tremendous influences which these factors or the conditions exert in connection with intelligence and attainment. It seems quite sufficient to quote mainly Vernon (1949) who has wonderfully summarized with his masterly comments on various studies of variations of intelligence with age, sex, and other socio-economic factors which are briefly discussed below:

(1) **Age**:

(1) 'g' factor increases on the average at a steady rate upto about 12 years and the rate of decline is observed after the age of 15 when a maximum is reached, though on some tests there is little if any increase after 13 and on others rises have been reported even beyond 18 - 20 (cf. Dearborn and Rothney, 1941).
Between twenties and sixties there is a progressive decline on tests of 'g' involving abstract reasoning and speed of mental manipulation, though on other tests of what has been called 'crystallised' intelligence, such as vocabulary and information, the level is better maintained (cf. Cattell, 1943, Brody, 1944).

Vernon et al. (1949 a) have discussed (cf. Fleming, 1948) that 'longitudinal' studies of particular children often show great irregularities of mental growth, with spurts and plateaux attributable partly to emotional adjustment or maladjustment, partly to the stimulating or inhibiting effects of the child's home and school environment. The same may be true of adults, but longitudinal studies are much more difficult since an adult cannot be re-tested many times without his scores being affected test 'sophistication', and by his attitudes towards the investigator e.g. growing hostility.

Educational attainments tend to be forgotten rapidly after leaving school, except in so far as they are used in daily life. Thus, Norris (1940) finds that scores on linguistic tests may rise till about 40 years, but arithmetic achievement declines in most persons other than clerks who practice arithmetic in their job. The perfor-
mance of adults on intelligence tests, according to Lorge (1945), is also affected by education beyond 14 years, though, as Garrett (1946), points out, results on a verbal test do not necessarily mean that intelligence itself alters. Adults with a university education, tested at 34 years, were about two years superior in mental age to others of the same intelligence level when aged 14 years who had received no secondary or university schooling. An investigation by Miles (1932) also appeared to show an earlier decline in intelligence among adults who had only elementary schooling, and Cattell (1943) claims that superior occupational groups retain their intelligence better than lower ones.

(5) While discussing changes with age from 14 to 18 Vernon et al (1949) writes that he, during 1946-47, administered several S.P. tests on a sample of 1200 14-year olds leaving school at Glasgow. He observed that percentage increases or decreases in this group were very different from those found among boys of superior intelligence whose education was continued. There is only a negligible increase in the all-round ability measured by Binnett Mechanical test or in the 'g' measured by Abstraction test. On educational test there is a serious loss.
Further summarizing the facts, Vernon et al. (1949) write that average performance of a group of adolescents or adults on psychological tests varied greatly with the type of ability tested, with age and training the group has received, or forgotten.

(11) Sex:

Anastasi (1958, pp. 460) has clearly discussed the influence of sex on the global scores on intelligence tests (cf. Rigg, 1940). In her opinion, "whether boys or girls obtain higher I.Q.s depends upon the items included in the test. When no deliberate effort has been made to exclude sex differences from the test, there has generally been a tendency to favour girls. This follows from the fact that intelligence tests consist so largely of verbal items (cf. McCarthy, 1930, 1953, 1954), on which girls are superior. In so far as the tests depend upon memory, girls have an additional advantage. Moreover, many intelligence tests are validated against school achievement (cf. Traüler, 1954), in which girls also excel, especially at the elementary school level. It is apparent from the above discussion that the question of which is the more "intelligent" sex is somewhat ambiguous." Anastasi's comment is well illustrated by the 1937 Stanford-Binet which is the revision in
current use (cf. McNemar, 1942). Items that showed a large sex difference in percentage passing were excluded entirely, on the assumption that sex differences on such items may be specific to the task in question and many simple reflect differences in experience and training. Among the remaining items, those slightly favouring girls were balanced against others which favoured boys to an equal degree. The fact that no significant sex difference in I.Q. was found in the standardization sample of the 1937 Stanford-Binet is therefore an index of the care with which this procedure was followed, and has little or no bearing upon sex differences in intelligence.

(iii) Occupational and geographical differences:

Few large-scale studies of civilian occupational differences were carried out (cf. Vernon, 1949, pp. 195). In this study the age distribution was held constant in all groups.

Vernon (1949, pp. 195) observed that the range of scores from clerks at the top to labourers at the bottom is rather small, corresponding in terms of I.Q. to a range of about 110 to 90. Verbal Tests, such as Army Alpha and Cattell's scale III give a much wider range than does Matrices. This bears out the contention that occupational
suitability and, therefore, occupational level, depends upon sex factor and as well as on 'g'.

Regarding the geographical distribution of intelligence, Vernon et al (1949) observed the findings of the studies conducted over nine very heterogeneous areas into which Naval recruiting centres were grouped. They observed small yet significant differences indicated by the mean scores. Also, they observed differences between Glasgow containing the longest population of labourers and Manchester, containing an excess of clerks and electricians, between Scottish Highlanders and Glasgow Irish. Also, they observed differences between boys of Roman Catholic schools at Glasgow. The reasons for these differences Vernon (1949) presume to be due to making no separation of boys between predominantly urban and rural regions.

Samp's (1954) work: Quite relevant to this are the findings of inquiries into the differences between children in larger and smaller schools in urban and rural districts. Socio-economic levels are in general paralleled by differences in average performance in tests of intelligence and attainments; but there is wide overlapping on the part of individual schools and individual pupils; and relatively high scores are obtained in the smallest rural schools where teaching skill is high and parental cooperation is effective.
Regarding socio-economic status and intelligence, studies of Neff (1938), Jordan (1933), Loevenger (1940), Preda (1939), Dockrell (1959) and many other investigators have indicated interesting results which may be valuable references to our present study. Regarding locality, community or race discrimination, the works of Leahy (1936), Zimmerman (1927), Thorndike et al (1942) and Thorndike (1951) would be of great interest to the present study but due to various limitations these works could not be discussed here in details.

II. Previous Researches; Methods and Tests used:

(a) Methods:

The fact that changes in environment can bring about changes in capacity to do intelligence test has, as far as possible within the limitations of space and time, been clearly discussed in the previous section of this chapter. But as previously we made no mention about the designs of experiment or investigation used by former workers, the present section deals with the same. Before starting with the present investigation it is desirable that we should make few points clear at this stage.

We have, as pointed out in the previous section, discussed that now-a-days intelligence does not mean a
single faculty or power and instead of using the word 'intelligence' we may conveniently use 'abilities' as classified under several factors. Later in this section we will notice that while measuring intelligence, the workers have expressed their estimates either in terms of global scores on tests (i.e. I.Q.) or in terms of ability factors present in the tests. This remark was thought desirable at this stage so that no reader might lose his sense of continuity in the discussion. From the survey of the researches we may broadly classify the methods of the previous workers under the following heads (i) Longitudinal method (i.e. by testing-retesting technique); and (ii) Cross-sectional method (i.e. cross-cultural, cross-institutional etc. technique). Although the statistical technique of agreement (i.e. by correlational methods) and of the difference (i.e. by differential method of variance etc.) have been frequently referred to by the workers, it seems necessary not to regard this statistical approach as a separate technique as it is liberally used by the followers of both the techniques.

Hence, let us survey in brief the relevant researches classified under the above two main headings so that from the discussion of the techniques we will find their defects
or merits and can design our own investigation that will benefit from the mistakes, if any, of the previous researches.

(1) **Longitudinal Studies (i.e. testing-re-testing techniques):**

Dearborn and Rothney's (1941) work: They summarize most of the American work, and show from their Harvard Growth study that practice effects are generally not very large, but that they do occur with some-not all group tests. They do not seem to be confined to any particular type of test material. With repeated testing the effects tend to diminish, i.e. the greatest increase is from the first to the second test. These authors also claim that practice on one test affects that test only and does not extend to other slightly different tests.

Commenting on this Vernon (1949) says, "Some, but not all of these results are confirmed by British investigations, and we would suggest that the difference lies in the greater degree of 'test-sophistication' among American children and adults. Not only do they habitually take more intelligence tests, but also most of their examinations are new-type ones, which are made up of questions similar to those in intelligence test. We would therefore
expect rises to be larger in this country, and spreading to occur from any one test to other dissimilar ones."

Rodger's (1936) work: He applied six parallel tests at fortnightly intervals to 95 British 11 - 12 year old pupils and claims that the average increase was about 1 percent., or I.Q. point per test. His figures suggest, however, a rise of 3.8 percent between the first and the third tests and therefore no further change. The Moray House tests which he used have a fore-exercise or practice sheet, which probably minimizes the susceptibility of the tests themselves to practice. Rodger also states that the rise was greatest (1½ points) in brighter children of I.Q. about 120, and lower (½ point) in dull children of I.Q. about 80. Dearborn and Rothney make a similar claim. It is a nice theory that the most intelligent, because of their intelligence, improve most. But all our evidence, cited below, shows the greatest rises among those scoring least.

McRae's (1942) work: He likewise gave sets of six tests to small groups at weekly intervals and confirms the diminishing effects of repeated practice. He concluded that when testees vary initially in their previous familiarity with tests, a single test will act as a sufficient 'shock-absorber' to bring them all on a par. He also
noted, when giving parallel versions of a test, that the
effects on Form of actual coaching on Form A were no
greater than the effects of merely doing Form A in the
ordinary way.

Dave's (1938) work: He found that some types of
test are much more affected by practice than others, non-
verbal and spatial items apparently being more susceptible
than most verbal items (cf. Recent researches by Heim, Wall-
ace and Carpenter reported by Vernon, 1949).

Vernon's report: Vernon et al (1949), referring
to work in the Forces, reported that "the Matrices test
was re-taken by 537 seamen in an entry establishment
one to six months after it had been done at recruiting
centres. The average rise was 4.7 points or 8.6 percent.
But as the reliability of this test is rather low, the
correlation between the two sets of scores being only .79,
the alterations were irregular. Some men actually declined
on the second occasion, and the total range of changes was
from 25 points increase to 13 points decrease. A natural
consequence of what is called the regression effect is that
very high scorers showed least improvement, very low scorers
most.
An experiment in the Army where the same test was re-taken by 277 men after only one day yielded almost the same rise, and other later work suggested that practice effects are much the same after several months as they are immediately after. But a possible alternative explanation is that military or Naval training, including the taking of proficiency examinations, also helps performance at tests, hence a rise after six months may be partly due to this and only partly to recollections of the previous testing. Sometimes, of course, the training received is directly relevant to the abilities tested, e.g. mathematical or mechanical. This would account for the different findings in the major Naval and Army experiments on test reliabilities and re-test rises."

Another experiment reported by Vernon et al. (1949) was "based on re-testing 500 men, representative of the total intake, after eight weeks of primary training (which involved little or no book work). In Navy, however, 500 air mechanics were re-tested after six to eight months of mechanical training. The percentage rises along with the tests used are as follows: (1) Abstraction (Army-, Navy 3.2); (2) Bennett Mechanical (Army 4.6, Navy, 10.4); (3) Arithmetic-Mathematics (Army 2.1, Navy 8.6); (4)
Squares (Army 8.0, Navy 10.6); (5) Verbal (Army 3.3, Navy -); (6) Clerical (Army 6.6, Navy -); (7) Assembly (Army 6.0, Navy-); (8) Morse Aptitude (Army 3.9, Navy-); (9) Agility (Army 7.2, Navy-). Inspection of the longer interval their increase on Tests 2 and 3 are far larger.

Vernon (1957) reported three studies out of which one was that of Lovell (1955) who carried out the work under the former's supervision. Hence, the first two of these studies are being reported below to show the method and the tests used along with the conclusions reached by him. These two studies are extremely important in this investigation as the present study follows closely the instructions given by Vernon (1957) in these two studies.

Ist Study: In 1955 he re-tested almost all the boys in a large English city at the age of 14 with the Moray House Adult Intelligence test, who had been tested at the time of allocation to secondary schools 3 to 4 years earlier with a standard Moray House Test. Thus two I.Q.s were known for 865 boys who had attended one or other of three grammar, one technical, and ten modern schools.
The resulting gains or losses clearly suggest that the grammar and technical school do more to stimulate the intellectual development of their pupils than do the modern schools, and that some of the modern schools are more successful at this than others. The former schools show relative rises equivalent to between 6.9 and 3.0 points (average 4.9), and the modern schools show changes ranging from 0.4 to -5.5 I.Q. points (average -1.9 points). Among the ten modern schools also, an F-ratio of 4.78 was obtained where a figure of 3.1 would be significant at the .01 level.

From the results obtained, Vernon (1957) concluded: "There is no justification for supposing that, in some modern schools, boys have actually declined in intelligence. They have all developed intellectually from 11 to 14; but it is true that those in some schools have developed faster than others. Secondly, it would be false to attribute the changes wholly or even mainly, to the schools as such. Boys in grammar schools tend to come from better homes, where they have facilities for home work, and are encouraged in many ways. Those in modern schools more often come from poorer homes where the parents may be uninterested in, or even opposed to education. Thus the attitudes to study among pupils in different schools will depend largely on
Environmental factors outside the school. Nevertheless, it is extremely probable that differences do exist in the traditions and morale of the schools, in their staff-pupil ratios, in the provision of building and equipment, and in the degree to which the staff either stimulate the pupils or allow them to become apathetic or resentful. The Education Officers of the city, before they saw the above results, were asked to rank the 14 schools in order of 'stimulatingness'; and their judgements correlated as high as 0.787 with the actual order of relative gains or losses."

2nd Study: In this study the scores on intelligence and several attainment tests, namely (1) Arithmetic and Mathematics problems and knowledge of operations, (2) English Composition, (3) Abstraction test of intelligence, (4) General Knowledge of current affairs, Science, art, etc., (5) Reading Comprehension, and (6) Spelling, of 167 14 year-old pupils were analysed. Of these 43 attended the grammar schools and 124 the modern schools of a small English country town. No scores obtained at 11 years, on allocation to one or other of these types of schools, were known. However, the differences between the means of the schools at 14, if expressed in terms of
sigma scores, will tell us on which tests there has been relatively greatest or least divergence; in other words, which tests tend to show greater or lesser effects of the differing stimulation provided by the two types of school (plus the accompanying out of school environment).

As might be expected, the grammar schools forge ahead of the modern schools to the greatest extent in mathematics. There is least superiority of improvement in reading comprehension and spelling, presumably because the modern pupils also received a good deal of practice in these skills. Indeed differences approximating 1.2 sigma would be anticipated purely on the basis of the selection which occurred 3 to 4 years previously. However, grammar school education would seem to have brought about small, though appreciable, superiority in English composition writing, General Knowledge, and in the reasoning capacity measured by the Abstraction test. Thus the findings of our first investigation cannot be explained simply by gains in mathematical and English attainment; abilities that would normally be classified under intelligence and attainment are also affected.

(ii) Cross-Sectional Studies:

As our purpose here is to note down the methods and results, it is not binding on our part to begin with the
first work reported in the history. Hence, from our point of selective display, let us discuss the researches relevant to the present investigation:

**Newman et al's (1937) work:** Newman, Freeman and Holzinger found the correlation between the I.Q.s of identical twins to be as high as .90 or .86. The average difference between I.Q.s has been found to be 5 points in the case of identical twins reared together, but the range of the difference may be from 0 to 20 points.

**Robert's (1940) study:** Out of 3,400 children of school age, he investigated the siblings of the brightest 4 percent and the dullest 4 percent. He found that 62.3 percent were dull, whereas the dullest 3.7 percent of their siblings were bright and 56.3 percent were dull.

**Wellman's (1934) study:** She compared the performance of children who had had nursery school training with that of children who had not such training. She declares that, 'A permanent change in intellectual standing can be effected in one to one-and one-half years that will last four to eight years.'

**Lewis's (cf. Royal Commission on population Vol. V pp. 48) Study:** He found that the level of intelligence in some villages, judged by the results obtained with group
tests given to the school children, compared very favourably with that of urban population. The disposes off the hypothesis that all migrants are more intelligent than the stay-at-homes, and that therefore the superiority of urban scores is due to selection. Clearly, sometimes it is the go-ahead who migrate, sometimes those who are unsuccessful, and sometimes migration is due to factors which affect bright and dull alike, such as a famine or the arrival of the boll weevil.

Freeman, Holzinger and Mitchell's (1928) Study:
They investigated some 401 foster children in and about Chicago. They found that there was a difference between I.Q.s of the ones brought up in poorer homes and those brought up in better ones. When 74 of them were re-tested after they had been four years in their foster homes the ones who went to the 'better' homes and gained 5.3 points while those in the 'poorer' ones had gained 0.1. The effect of the environment is greater the younger they were adopted, and when they were adopted into different kinds of homes the correlation between their I.Q.s was reduced to .19, which contrast with the average correlation of siblings brought up together, which is about .50. They go as far as to say that the "maximal effect of the
best environment raises the I.Q. 20 points." Indeed, it was found that when the average I.Q.s were classified in accordance with the occupation of the foster father, the order in which they were lined up from highest to lowest corresponded to the order found in all the studies relating the intelligence of children to the economic status of their parents. This piece of evidence is slightly weakened by the possibility that the foster parents of the professional class may have chosen the brightest children for adoption, but there is no evidence that they made any determined effort to do so.

Burk's (1928) Study: She compared 214 foster children with 105 children living with their parents. She found in the first place, that the correlations of test scores between foster child and foster father was .07, between foster child and foster mother .19, which are lower than those found by Freeman and his colleagues (.37 with foster father and .28 with foster mother), and that the correlation between children and their parents in the control group was .45 for child-father, and .46 for child-mother. This might be taken to indicate the operation of inheritance. The correlation between the I.Q. of the foster children and the quality of the home was .42, which is like Freeman's estimate of .48. The correlation of I.Q. and measurable home environment was subjected to further analysis and, as a result, Burks arrived
at the estimate of the relative weights of home and innate factors at about 17 percent. for the home, about 33 percent for parent’s intelligence, while the total contribution of innate and heritable factor is probably not far from 75 to 80 percent.”

Commenting on the results obtained by Burks, Spritt (1952) says “that this celebrated estimate is quoted with approval by Sir Cyril Burt (1946), but it is not universally accepted. One of the difficulties is that Burks had to calculate her correlations on ‘measurable’ features of home environment, and that does not provide an entirely satisfactory basis for so definite an estimate; in any case, what about school, friends, neighbours and so on? Burt himself, in the same paper gives a rather more restrained estimate of ‘one-half’ as the very least attributable to ‘nature’ as distinct from ‘nurture’.

Burt’s (1921) Study: Expressing complete dissatisfaction with the conventional methods of experimentation in connection with the influence of educational attainment upon tests of intelligence, Burt (1921) suggests a statistical technique of ‘partial correlation’ to eliminate the influence of one factor on another, keeping a third factor constant. For example, age factor can be eliminated to show the influence of educational attainment on intelligence. While elaborating the factors influencing the individuals’ scores on Binet-Simon scale, obtained with
this technique, he records the following observations:
"For every child in an entire school, comprising just over three hundred pupils aged between seven and fourteen, I have secured the following measurements: first, the child's age; next his school attainments, measured by an educational examination, the results being revised by the teachers; thirdly, his intelligence measured by special tests of reasoning, the results, again being checked by the teachers; and, lastly, his mental age, given directly by the present version of the Binet-Simon scale, unchecked and unrevised."

Lovell's (1955) study: He applied a large and varied battery of tests to four groups of about 50 persons each, two aged 14 and two aged 17-20. One was being educated in a good and stimulating modern school, another in a Further Education Centre. By contrast, the third was attending a depressing and unenterprising modern school, and the fourth consisted of young criminals who had likewise received little intellectual stimulation from their schools on jobs. The tests used by Lovell were as follows (cf. Lovell, 1955):

Test 1. N.I.I.P. Group Tests 70/2 and 70/3
Test 2. Watts - Vernon Reading Test.
Test 3. Arithmetic Test. This consisted of fifty
problems similar to the problem section of the Moray House type of Arithmetic Test and thus similar to the Wechsler–Bellevue Arithmetic Test, but much longer.

Test 4. A shortened version of Wechsler vocabulary Test.

Test 5. A group version devised by the writer of the Wisconsin Sorting test. This test was scored in two ways— for the principle of classification ("labels"), and for sorting the pieces correctly ("pieces").

Test 6. A group version devised by the writer of a sorting test suggested by Vinacke (1951). This test was scored in two ways as in the case of Test No. 5.

Test 7. A group test prepared by the writer based on the Trist-Hargreaves Test (Somnoff, 1955). This also was scored on the principle of classification as stated, and for the pieces correctly classified.


Test 9. A non-verbal classification test. The test was scored for the underlining of the correct figures and for stating the principle of classification.
Test 10. Proverbs
Test 11. Test of Memory for stories
Test 12. Babcock Test of Memory for sentences.
Test 13. Test of Memory for Designs including fourteen of the designs used in the Bender Visual Gestalt and Ellis Tests.
Test 14. Creative Effort Test. The writing of ZEKE forward, and then in reverse as KEZ.
Test 15. Creative Effort Test. The writing of 239 forward and then in reverse.
Test 16. Creative Effort Test VAT. The letters were written first in the normal way and then upside down.
Test 17. A creative Effort Test in which there were 46 very simple addition and subtraction exercises but whenever there was a plus sign the testee had to subtract and Vice versa.
Test 18. Similar to test 17 but consisting of interchanged multiplication and division exercises.
Test 19. Creative Effort Test - Seasons. Here the subject had to associate a month of the year with a season, e.g. August with summer. But sometimes the process had to be reversed, e.g. April had to be associated with autumn.
Test 20. This was the first of three tests which in themselves are entirely original although of the type used by Luchins. It involved the simplification of very easy fractions and was in two parts the first of which measured basic speed of working.

Test 21. Hidden words. The test was in two parts, the first of which measured the basic speed of working.

Test 22. Beginnings and Endings of words. Again, the test was in two parts, the first measuring the basic speed of working. In each tests 20, 21 and 22 there was an attempt to develop a mental set in Part I of the test and to measure the extent to which this set interfered with the working of Part 2.

Test 23. Three different operations were first performed separately and afterwards similar operations had to be performed in quick rotation. It was suggested by the Army Clerical Test, (Vernon and Parry, 1949).

Test 24. Gottschaldt Figures: 42 items from Thrustone’s revision.

Test 26. A group version of the Kohs Blocks Test devised by Hay (1951).

Commenting on the results obtained by Lovell, Vernon (1957) writes, "Here also we can not be certain how far the two pairs of groups differed in their initial intelligence level; actually the third and fourth were probably slightly superior. But the differences in mean sigma scores for different tests will indicate which psychological functions are most, and least, affected by environmental stimulation during adolescence.

Here again, reading comprehension shows the lowest difference. A sigma score difference of -1.0 may be taken as a kind of base line, and any score above that probably represents some effect of stimulating adolescent environment. Vocabulary, Abstraction and Non-Verbal intelligence are least affected. But clearly the functions most affected are those involving flexibility and originality of thinking, capacity to form new concepts as contrasted with rigidity or mechanization of thought and perseveration - that is very much the same functions as are found, in clinical practice, to deteriorate with advanced age, with brain injury, and in such psychopathological states as Schizophrenia. Naturally there are many other differences between our two pairs of groups, besides. schooling, which may have played
a part in the development (or the inhibition) of thinking capacity; for example the home, job and leisure environments, or the social and emotional adjustment of youths' personalities, may be more important."

The general implications of these three studies are that we should cease to classify the abilities of adolescents and young adults under the simple heading of attainments (affected by schooling) and 'g' or intelligence (dependent purely on maturation or innate factors). Certain aspects of intelligence, in particular flexibility of thinking, are as much, or more, affected by the stimulation that different environments and different types of training provide as are the conventional attainments. Clearly, far more research is needed into the nature of these abilities, and into the type of education that best helps to develop them.

(B) Tests Used:

While discussing intelligence and attainments methods used in its study, we saw that many tests, with comments made by various workers in the past, were also furnished with. Still, for clarity and pointed emphasis on the nature of tests, it is desirable that we make out a separate sub-heading of tests used by previous workers, so that either at the time of selecting the tests in the
Present investigation or at the time of concluding the results to be obtained from the present investigation, we do not find any difficulty to show that from our survey over the mistakes of the past workers lot of precautions were taken in the present investigation.

Goldstein and Scheerer (1945), Hanfmann and Kasarin (1937), Berg (1948), and others, have devised a number of concept formation or sorting tests. In a typical test the subject is presented with a series of objects which can be classified in various ways and he is told to sort them according to a given principle or pick out others similar to a given object. When the subject has mastered one principle of classification he is given a new and more complex problem. It is claimed that brain-injured patients and some schizophrenics can cope with these at the concrete level, but cannot realize and formulate abstract principles of classification, nor can they switch from one principle of classification to another.

Walker, Staines & Kenna (1943), and Cattell (1946) now state that the earlier tests so often used to measure perseveration (e.g. the alternation type of test and miscellaneous sensory tests) are useless; but that 'creative effort' tests, where the subject has to break down some well-established habit, are more consistent and
measure a quality which has been termed 'disposition rigidity'. Cattell claims that a person with low disposition rigidity is a person of strong ego-development and capable of modifying his habits. Little, however, seems to be known of the validity of tests of disposition rigidity.

Luchins (1942, 1947) maintains that inefficient methods of education may produce rigid rather than flexible minds and has devised a number of paper-and-pencil tests. Subjects are given a series of problems which can be solved by the application of one principle. Half way through the principle alters, but the original 'set' may delay or prevent them entirely from realizing this. The interference in such tests is established temporarily during the course of the test, whereas in disposition rigidity tests the interference is with a fully automated habit. Yet another concept of rigidity has been put forward by Lewin (1935) and Kounin (1941). These and other Gestalt-minded psychologists regard rigidity as one of the main characteristics differentiating the personalities of the feeble-minded from those of normal children. When given a choice of drawing tasks, feeble-minded children tend to persist longer at a single task, whereas normal children prefer a change.

Again, there is a mass of literature dealing with
tests of the type included in the Wechsler-Bellevue Battery (1944), the Babcock-Levy Battery (1940) and the Shipley-Hartford test (1940). The performance of psychotics, especially those of the organic type, is poorer than expected on some of the tests; performance also declines in aphasic conditions, in cases of brain lesion and to some extent with age. The decline is least marked in tests of what Gattell calls 'crystallized' intelligence, such as vocabulary. Tests of 'fluid' intelligence, which are most affected, include speed tests and tests of abstraction or conceptualization.

Halstead (1947) applied nineteen tests to fifty patients. Neglecting the analysis which led to an oblique factor structure and concentrating on the analysis performed by Holzinger which gave a general and orthogonal group factor solution, it seems clear that the general factor is general intelligence or 'g', while Halstead's 'A' factor is possibly the ability to group to a criterion, for it has its highest loading of 0.6 on a category test. This work has been criticised by Vernon (1950).

Crown (1951), in a review of the literature dealing with psychological changes following prefrontal leucotomy, comments on the lack of consistency between investigations on the issue of whether or not abstraction is affected
following the operation. This lack of agreement is not surprising, he maintains, considering the variety of tests which have been used to measure abstraction. He divides these tests into two main types:

(1) Those which are primarily intelligence tests—Kohs Blocks, Vocabulary tests, Shipley, proverbs, fables and abstract words.

(2) Tests which appear to confirm to Halsteal's definition of abstraction as the basic capacity to group to a criterion. Tests of the latter type involve the comprehension of essential similarities and differences—as in, say, the Goldstein - Scheerer Colour Form Sorting Test. 'It is suggested', writes Crown, 'that, in factorial terms, sorting tests, if included in a test battery with our cognitive tests would cluster together, these tests having, in addition, moderately high correlations with intelligence. Whether the abstraction group factor would be different from group factors already widely recognized remains a problem for further research'. In the opinion of the writer Crown's suggestion comes remarkably near the truth. But, as the commonly known factors of intelligence are also dependent on intellectual development; probably Crown's suggestion may be regarded as extra-precautionary measures for studying the development in the cognitive aspect.

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