The study is presented in three parts. Part I is concerned with the thoeretical background. The nature of human intelligence is discussed from an historical point of view and current conceptions of intelligence are reviewed. The nature of African intelligence and its assessment is outlined in the light of current investigations. Factors which are known to influence African intelligence are commented on. Two theories on the differentiation of abilities, which differ in terms of methodology, are presented and an assessment of each is made. At the end of the theoretical background three hypotheses are postulated.

As a study of this kind required a battery of diverse tests it was necessary to carry out a number of pilot studies with a view to selecting an appropriate battery. These pilot studies and the study on the construction of a scale with which to measure urbanization, are presented in Part II.

In Part III the final study is presented in detail. It deals with the organization of mental abilities of a Venda group in cultural transition from a rural-illiterate to an urban-literate state. The results are discussed in the light of the two theories on the differentiation of abilities outlined in Part I.

PART I

THEORETICAL BACKGROUND

CHAPTER I

THE NATURE OF HUMAN INTELLIGENCE

In their quest to understand the behaviour of human beings, intelligence has long been of central concern and interest to philosophers, psychologists and educationalists. The definition of the term "intelligence", however, occupies an equivocal status in psychology. An examination of some of the more important definitions will show how susceptible the term is to different interpretations. During this examination an attempt will be made to highlight some of the more enduring trends of thought.

1. Early Conceptions of Intelligence

According to Burt (1955) the term intelligence has its origins in intelligentia, a term introduced by Cicero who endeavoured to supply a Latin terminology for the philosophies of Plato and Aristotle.

Spencer (1895) is generally credited with bringing the term into psychology. Like Aristotle before him, Spencer recognized two main aspects of life; the cognitive and affective. He saw all cognition as involving both analytic or discriminative and synthetic or integrative processes. Defining intelligence simply as the " ..... power of combining many separate impressions" (p. 403) he regarded its function as enabling man to adjust to a

complex and ever-changing environment. Tying his theory to the doctrine of evolution he maintained that during the growth of an individual child, cognition progressively differentiated into a hierarchy of more specialized abilities. He was adamant though, that intelligence had neither distinct grades nor was it constituted of truly independent faculties. We thus see the first explicit proposal that intelligence is a unitary ability or integrative capacity of the whole mind. It will be seen that Spencer's speculative theory made a lasting impression on many of the theories which were to follow his.

The idea of the evolutionary origin of human variation was also attractive to Galton. His attention was caught by the observation that eminent men were likely to have eminent sons (Galton, 1869) and this gave rise to a number of papers on the importance of heredity in intelligence. While Spencer had maintained that the basic capacities of the human mind were hereditary, Galton went a step further and held that individual differences in these capacities were also innate. In order to make comparisons among individuals and to reduce the mass of impressions derived from his observations, it was necessary for him to resort to a quantitative approach. His early work on the measurement of individual differences is famous and needs no elaboration. What is relevant here is his decision to discard the traditional explanation of intelligence in terms of faculties and to substitute a classification in terms of "general ability" and

"special aptitudes" (Galton, 1889). He considered general ability to be by far the more powerful of the two. According to Galton the differences between individuals formed not a set of distinct and discontinuous classes, but a series of continuously varying gradations distributed according to the normal curve.

In approaching the problem of which mental characteristics to measure Galton believed in the principle that all we know comes to us through our senses and therefore if our senses were good it would follow that our intellects would also be good. He therefore devised numerous tests to measure sensory processes. In the course of his work he conceived of the idea of correlation, though the actual product-moment formula was worked out by his close associate Karl Pearson. The concept of correlation was later to lead to the use of factor analytic techniques in the study of the structure of human intellect. As early as 1901 Pearson had already laid down the foundations for modern factor analytic procedures.

Soon afterwards Spearman (1904), who is considered to be the father of factor analysis in psychology, published his "proof" of the existence of general intelligence. At this point his psychological theory will be discussed. At a later stage his factor theory will be examined in relation to other factor theories. On the basis of his analysis of test intercorrelations, Spearman (1927) formulated his celebrated "two-factor theory". According to this theory, the performance of

every cognitive task depends on general intelligence (g) and on another factor (s) specific to the particular task. He considered the s factors to be exceedingly numerous. The similarity between Spearman's theory and those of Spencer and Galton is clear; a fact that Spearman himself acknowledged. In his earlier papers, however, he rejected the notion of special aptitudes as a relic of the discredited "faculty" schools of thought. The only specific capacities he recognized were those "specific" to each particular test.

Spearman emphasised that his two-factor theory was an entirely new idea and distinguished it from three earlier conceptions of intellect i.e. the monarchic view, which holds that general intelligence is equally important in all tasks; the oligarchic view, which implies that there are several large abilities of roughly equal importance and the anarchic view, which makes every task dependent upon a specific ability. Although Spearman refused to identify g with intelligence he did offer tentative hypotheses as to its nature. He proposed that g be considered as the general "mental energy" of the individual and that the s factors were the "engines" through which it operates. Thus, we see that Spearman had a semi-monarchic view of intelligence. His conclusion, having studied those tests highly saturated with g, was that their outstanding psychological characteristic was the involvement of seeing relationships, or in his own words - "the eduction of relations and correlates".

Binet's conception (cf. Varon, 1936) of intelligence differed from those of his British counterparts in a number of important respects. He rejected Galton's approach of assessing intelligence by means of tests designed to measure sensory processes. Binet (1909) also rejected the belief in fixed intelligence by stating that the intelligence of school children may be increased. In defining intelligence he wrote:

> " ..... in the intelligence there is a fundamental faculty, the alteration or lack of which is of the utmost importance for practical life. This faculty is judgement, otherwise called good sense, practical sense, initiative, the faculty of adapting oneself to circumstances. To judge well, to comprehend well, to reason well, these are the essential activities of the intelligence ..... " (Binet and Simon, 1916, p. 42).

He regarded intelligence as complex and stated that the "faculties" of each subject were independent and unequal. In putting forward his theory of faculties, Binet showed that his view was essentially oligarchic. It appears though, that he was inconsistent, as he chose to adopt only a single score for his scale. It is obvious that he did not carry his conception of independent faculties to a logical conclusion in terms of measurement. It may be argued though, that his embryonic ideas were to reach fruition only in later years when the American factor analytic tradition became well established.

McDougall's view of intelligence during this period is worthy of comment. Basing much of his theory on the

physiological work of Hughlings Jackson and Sherrington (cf. Burt, 1955, pp. 160-161) he put forward a hierarchical model of the structure of the mind. McDougall (1932) recognized five main levels: reflex, sensori-motor, perceptual associative and relational. In the course of evolution and individual development, McDougall argued that qualitatively new processes emerge out of, and control, the older processes. He stated:

> "New abilities are not only formed by gradual differentiation out of pre-existing abilities, but also, when differentiated, continue to function as part of larger systems of which the parent ability remains an essential feature" (McDougall, 1932, p. 27).

Other hierarchical models will be discussed at a later stage and the concept of differentiation will also be examined.

At a meeting (Symposium, 1921) in Boston, a number of the world's leading psychologists were invited to express their views as to the nature of intelligence. Thirteen of the seventeen invited actually contributed to the symposium. The strikingly different conceptions which were offered have often been commented upon. Spearman's reaction, for instance, to the symposium was that " ..... 'intelligence' has become a mere vocal sound, a word with so many meanings that finally it has none ..... " (Spearman, 1927, p. 14). Notwithstanding this attitude, some of the views expressed at the symposium were particularly interesting. Boring created a mild

sensation by proposing an operational definition of the term. He pointed out that in the physical sciences our understanding of a quality is obtained by measuring it. In a similar manner, he argued, sounder progress would be achieved if intelligence were to be thought of in terms of what the tests measured. Although Boring's statement might seem facetious to some, it served the purpose of calling attention to a careful study of the tests themselves.

2. Later Conceptions of Intelligence

Burt (1955) in his definition of intelligence consolidated the British position. He wrote:

> " ..... first, it is a general quality; it enters into every form of mental activity; secondly, it is (in the broad sense of the word) an intellectual quality - that is, it characterizes the cognitive rather than the affective or conative aspects of conscious behaviour; thirdly it is inherited or at least innate; differences in its strength or amount are due to differences in the individual's genetic constitution. We thus arrive at the concept of an innate, general, cognitive ability" (p. 162).

In contrast to Burt, Hebb (1949) having assessed clinical evidence, distinguished two kinds of intelligence. The first kind (A) is innate potential and amounts to a heredity factor. The second (B) determines an average level of performance or comprehension and may therefore be regarded to be largely environmental. This conception of intelligence corresponds to the geneticist's distinction

between genotype and phenotype. Neither type is observed directly. Intelligence A refers to the individual's inherited potentialities for growth. Intelligence B on the other hand depends on the interaction between that which is inherited and the environment. It is essentially the product of nature and nurture. Intelligence A cannot be measured although there is a great deal of evidence for its existence. Intelligence B, which Hebb defined in terms of accumulated knowledge and skills, can be measured by traditional intelligence tests.

To Hebb's dichotomy, Vernon (1955) suggested adding Intelligence C i.e. the score obtained on an intelligence test. His reason for proposing this third kind was that intelligence tests are no more than a sample of the skills which are regarded as intelligent. He pointed out that tests are standardized for particular groups and if used on different groups lose their validity. This is an important aspect, especially if the special cases of non-Western cultures are taken into account. Whereas in the 1920's intelligence tests were regarded as measuring innate capacities the current belief is largely that intelligence tests sample aspects of Intelligence B. It would appear from Vernon's writings that he, himself, accepts three senses of the term: biological, environmental and operational.

Freeman (1950) divided the descriptions of intelligence into those emphasising (a) adaptation of the individual to his total environment (b) ability to learn and

(c) ability to carry on abstract thinking. The first description appears in a number of conceptions of intelligence and refers to the evolutionary aspects of man's mental life. The importance of the second description has been exploded by Guilford (1967) and again more recently by Fleishman and Bartlett (1969). The last description stems mainly from Terman's definition but the term "abstract" is in itself difficult to define. In the same chapter Freeman discusses Stoddard's definition which in many ways is one of the better definitions to have appeared.

Stoddard (1943) defined intelligence as:

> " ..... The ability to undertake activities that are characterized by (1) difficulty, (2) complexity, (3) abstractness, (4) economy, (5) adaptiveness to a goal, (6) social value, and (7) the emergence of originals, and to maintain such activities under conditions that demand a concentration of energy and a resistance to emotional forces" (p. 4).

His definition is partly an elaboration on Boring's proposal that intelligence is what intelligence tests measure. The first five characteristics refer to aspects typically present in intelligence tests. By implication Stoddard also appears to be taking into account the appropriateness of tests for particular groups - a feature which enters Vernon's Intelligence C. The inclusion of "social value" as an attribute is debatable. This criterion is a matter of subjective evaluation and as it is open to so many different interpretations it is best discarded. "The emergence of

originals" refers to "divergent" thinking as opposed to "convergent" thinking. Its inclusion in his definition was highly appropriate as later work on creativity has shown. The last two conditions: "concentration of energy" and "resistance to emotional forces" very definitely enter into test performances and probably account for a great deal of individual variation in the testing situation. Stoddard meticulously defined all his terms and although it is possible to find fault with some of his explanations, his description is one of the few attempts to provide an operational definition.

Wechsler (1958) wrote: "Intelligence, operationally defined, is the aggregate global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment" (p. 7). He followed his definition by commenting on the terms "aggregate", "global", "purposefully" and "rationally" but he did not supply empirical referents for them.

According to English and English (1961) an operational definition defines a term by " ..... stating the operations or procedures employed in distinguishing the object referred to from others" (p. 357). Guilford (1967) insists that definitions which satisfy the needs of univocal communication must contain referents in the real world. Most definitions of intelligence unfortunately have the defect that they contain undefined terms.

As far back as 1929 Lashley wrote:

> "The concept of intelligence is becoming essentially a statistical one; it is the correlation between certain of the activities of the organism which are closely related among themselves and relatively independent of other activities. Among such groupings of activities, what correlations constitute intelligence as opposed to other capacities? There is no accepted statement which really defines the concept" (Lashley, 1929, pp. 11-12).

Finding intercorrelations among tests is a step in the direction of factor analysis which, if well-designed, leads to conclusions regarding the underlying variables, each measured in common by a sub-group of tests. If these underlying variables are repeatedly verified on the same groups of tests then it is justified to give them names. Many writers, who are themselves not avowed factor analysts, have suggested this approach as a possible solution to the problem of definition (cf. Bayley, 1955; Spiker and McCandless, 1954 and Wechsler, 1958). Butcher (1968) sums up the situation well by writing:

> "In the long run, if this area of study is ever to form an integral part of scientific enquiry and to evolve beyond the status of quasi-science, the latter view [operational definitions] must prevail and the loose, 'open' concept be replaced, for experimental and statistical enquiries by an agreed and measurable dimension or set of dimensions" (p. 36).

3. Factor-analytic Approaches to Intelligence

A single correlation is relatively easy to interpret. If a correlation coefficient is squared, an index of

determination is obtained. This index expresses the proportion of the variance in the dependent variable that is determined by the independent variable. High correlations indicate considerable variance overlap while low correlations indicate little overlap. If one is faced, however, with a large table of correlations the task of explaining all the complex interrelations is impossible. Factor analysis provides one method of summarizing these relations and thereby makes it easier to interpret and explain them. Harman (1960) described the aim of factor analysis lucidly when he wrote:

> "The principal concern of factor analysis is the resolution of a set of variables linearly in terms of (usually) a small number of categories or 'factors'. This resolution can be accomplished by the analysis of the correlations among the variables. A satisfactory solution will yield factors which convey all the essential information of the original set of variables. Thus, the chief aim is to attain scientific parsimony or economy of description" (p. 4).

The basic equation in the factor analysis model is as follows:

$$z_{ij} = a_{j1}z_{i1} + a_{j2}z_{i2} + a_{j3}z_{i3} + \cdots a_{jq}z_{iq} + a_{js}z_{is} + e_{ij}$$

where:

z_{ij} = standard score of individual I on test J.

a_{j1} = factor loading of test J for factor 1, a_{j2} = same for factor 2, and so on for all <u>common</u> factors 1 through to factor Q.

z_{il} = score of individual I on scale of factor 1, and

other z terms for factors 2 through to factor Q indicate corresponding values.

z_{is} = score for individual I for the specific component in the test, i.e. the test's unique contribution; and

a_{js} is its weight, just as other a terms serve as weights for their respective components.

e_{ij} = error component for individual I in taking test J (adapted from Guilford, 1967, p. 48).

The equation means that a person's obtained score (in standard form) is a linear combination of weighted contributions from his status on common factors, a specific factor and an error component. The main objective in a factor analysis is to find the a coefficients (factor loadings) for the common factors.

Common factors are factors present in more than one test in a set being factorized, but are not present in all. They are also known as group factors. A general factor accounts for some of the variance in all the tests, a unique factor defines that part of the variance of a test which is not shared with the other tests being factorized and a specific factor accounts for variance in only one kind of performance. These terms are presented at this point, by way of explanation, as they will be encountered during the course of this exposition.

Because of its extensive use in psychology the technique of factor analysis has often mistakenly been considered as

a psychological theory. It is, rather, a branch of statistics which has been applied to psychological theories in an attempt to explain human abilities and behaviour. There have been many different approaches to the factor problem but this discussion will be confined primarily to the more important theorists who have contributed to an understanding of the structure of intellect. The actual techniques used will not be described as they have been exhaustively dealt with in a number of textbooks (Fruchter, 1954; Harman, 1960 and Horst, 1965). The attention of the reader will be directed, rather, to the better-known factor analytic models of the structure of intellect that have been proposed.

The psychological theory of Spearman has already been described. At this point a few remarks will be made about the current assessment of his theory. Thomson (1939) has criticised Spearman's technique by pointing out that although the tendency to zero-tetrad-differences was strong they were not universal enough to permit an explanation of all correlations between tests in terms of g and specifics. Thomson was clearly referring here to Spearman's neglect of group factors which, while less than g, were certainly not specific. One of the reasons his work failed to yield group factors was that he was seldom able to test large samples. Therefore the residual overlap which did appear was usually not significant. In the face of this criticism

and the evidence of other investigators he was willing to concede that his theory did not coincide with the observed facts (Spearman and Jones, 1950). Having considered the evidence for group factors he nevertheless felt that they were either small or rare.

After Spearman, the ideas of Burt probably had the strongest influence on British psychologists' conceptions of the structure of intelligence. During the twenties and thirties a great deal of evidence was amassed to show that group factors did exist (cf. Kelly, 1928; Stephenson, 1931 and El Koussy, 1935). As these newly discovered factors increased in number it soon became clear that a logical systematization of these factors was called for. Like others before him Burt (1949) conceived of a hierarchical model. Spearman's concept of g was retained and the additional evidence of group factors was also incorporated in the model. The hierarchy contained successive dichotomies, each sub-division of a higher factor giving two immediately lower. In other words he saw abilities as forming an hierarchical tree with descending degrees of generality. At the top of the tree at the "relations" level he conceived of two aspects: g and practical. At the second level he placed "associations", "perception" at the third level and "sensation" at the fourth. Processes of the lowest level consist of simple sensations and movements as measured by tests of sensory threshold and reaction time. The next level included the more complicated