Chapter III

EXAMPLE SHAST OF FINDING
CRITICAL INFLUENCES
The terms fluid and crystallized intelligence were first introduced by R. B. Cattell about 30 years ago (Cattell, 1941) and since developed (Cattell, 1943; 1950; 1957a; 1957b) into a well-knit theory of intelligence.

In its present form (Cattell, 1963a; 1965; 1967a; 1967b; Horn, 1965; 1968; 1970; Horn and Bramble, 1967; Horn and Cattell, 1966a; 1966b; 1967) it questions the notion of general intelligence and considers it as an amalgam of two components: fluid (Gf) and crystallized (Gc) intelligence.

The Gf represents the influence of biological factors on intellectual development, whereas Gc is the result of skills and concepts, which have become established through cultural pressures, education, and experience. Both these abilities involve performances commonly said to indicate intelligence and, as such, each is regarded worthy of the name "intelligence."

The operationally defined concepts of Gf and Gc resemble somewhat Hebb's (1949) and Vernon's (1950) concepts of A and B intelligence and Burt's (1949) and Vernon's (1950) distinction between general-verbal-educational (V: Ed) and general practical mechanical
In Piaget's (1950) terminology Gc can be compared with "Schema", which has become independent of the neurons after the completion of its synthesis, whereas, Gf, is the innate potentiality for forming, retaining, and recombining "schemata." The concepts of Gf and Gc can as well be compared with Ferguson's (1956) use of "ability" and "learning set," and Newland's (1962) use of "process" and "product" respectively. The resemblance is, however, superficial, since they differ from these concepts with respect to both: (a) specification of the abilities which go into the major dimensions and (b) the development of abilities in childhood and adult years.

Thurstone's (1944) acceptance of more than one second order general factor obtained from the intercorrelations of primary abilities also fits well in the framework of the theory of fluid and crystallized intelligence. Almost the same kind of distinction in mental abilities was made when Babcock (1930), Hunt (1943), Shipley (1940), Wechsler (1944) referred to "Hold" and "Don't Hold" tests to indicate the level of mental deterioration. Traces of this idea in its rudimentary form can be seen in the works of (Arthur, 1925; Cornell and Coxe, 1934; Ferguson, 1920; Healy and Fernald, 1911; Pinter and Peterson, 1917; Seguin, 1907; Stusman, 1931), when they
advocated the use of performance tests of intelligence in preference to verbal tests of intelligence.

In verbal terms; Horn and Cattell (1966b) define fluid intelligence as an ability "that involves the processes of perceiving relations, educing correlates, and maintaining span of immediate awareness in concept formation and attainment, reasoning, and abstracting." As such, it is quite similar to Spearman's concept of "G" (Spearman, 1904; 1927; Spearman and Jones, 1950). Cattell (1963a) maintains that it can best be assessed by tests in which problems tend to be either novel for all subjects or else extremely common, overlearned elements of the culture of these subjects.

Crystallized intelligence, too, has been defined (Cattell, 1963a) as intellectual ability "involving the processes of education and perception of relations, reasoning, and abstracting, etc." But unlike Gf it is measured by more conventional intelligence tests based on comprehension and manipulation of learned materials, especially verbal.

More recently Horn and Cattell (1966a) have suggested additional second order factors or generalized aspects of performance in mental tests; these include General Visualization (Gv); General Fluency (F); General Speediness (Gs); and Carefulness (c). Both Gf and Gv are often assessed by
spatial tasks but they appear separately in factor analytic research and are thus independent functions.

The General Speediness factor Gs and Carefulness(C) are attributes of test-taking and produce variance in the intellectual tasks indirectly. The factor C was first identified by Fruchter (1950, 1953) and was regarded as a dimension of unwillingness to give an incorrect answer to ability test problems. Logically it would appear to be the inverse of the Speediness function but researches by Horn (1965), Howie (1962) suggest that the two factors are quite independent.

Evidence from recent researches also indicates that ability to recall quickly elements of language, viz., words into immediate awareness, i.e., factor F, is largely independent of comprehension of concept as represented in Gc. Surprisingly, it is also independent of the Gs and C factors. Inspite of the fact that Gc and F are different abilities, they are very much associated with the subjects familiarity with language.

As discussed above it appears that factors Gv, Gs, F and C are non-intellectual influences in performance on intelligence test. The exact nature of these factors, however, has not yet been explored.

The two aspects of intelligence - Gf and Gc -
cooperate and are difficult to separate, particularly among children. In the period of childhood both the abilities develop rapidly. The growth of Gf is influenced by the rapid rate of neural maturation, whereas Gc grows through the interaction of neural maturation and intense acculturation processes. The rate of development of Gf slows to a stop at a point where neural maturation ceases. This limit, in general, is attained by the age of the late teens or early twenties. In the case of Gc, this slowing occurs at the age of 28 or beyond, depending upon the cultural learning period for the given sub-culture. Moreover, the decline, when it sets in, is much faster for Gf than for Gc.

The decline, probably, is due to irreversible damage to the central nervous system (CNS) and other physiological structures which support intellectual functioning. There are innumerable ways in which damage to the CNS could occur, for example, carbon monoxide poisoning, lead poisoning, high fever, blow to the head, anoxia resulting from a wide variety of causes, etc. This process is slow but accumulative. Its impact is felt most directly in the development of Gf and somewhat more indirectly in the development of Gc. Moreover, in the case of Gc its impact is masked by the growth of this ability in adulthood through acculturation influences. This accounts for the rapid decline in Gf and
comparatively slow decline in Gc. It also explains why the gap in Gf and Gc increases with age particularly after the early twenties when Gf has reached its peak.

Evidence (Cattell, 1937; 1955; 1957b) also suggests that the variability as denoted by the standard deviation of IQ is about 24 to 25 on Gf measures and 12 to 16 points on Gc measures. The small standard deviation of Gc is the result of suppressing the intelligent and promoting the dull children through formal or informal education towards average performance. Such a squeezing of individual differences is not possible in the case of the Gf being physiologically determined. The fact that the nature-nurture ratio is higher for Gf than for Gc (Cattell, Stice, and Kristy, 1957) also supports the assertion that Gf is physiologically determined whereas Gc is dominantly a product of environmental influences.

It has also been hypothesized (Cattell, 1963a; Lansdell, 1962; Pribram, 1960) that the reversible moderate moment-to-moment fluctuation in the cortical functioning of the subject will have greater effect on Gf than on Gc. Investigations by Kundal and Gupta (1967), Singh (1970) support this hypothesis. They induced reversible changes by administering stimulant (Dexedrine) and depressant (Phenobarbitone) drugs in the first experiment and through hard physical exercise in the second experiment.
Evidence also suggests that the effect of general brain damage is more pronounced in Gf than in Gc.

The theory of fluid and crystallized intelligence as outlined above may be regarded as an extension of Spearman's theory of general factor. It breaks the single general factor into two general factors, Gf and Gc, and is more general than Spearman's original theory since it is based on intercorrelations between factors. However, Humphreys (1967) does not regard Gf and Gc as general factors because their factorial structures do not conform to the conventional criteria of a general factor. He has raised some methodological objections to Cattell's study and also maintains that the factors located by Cattell are indeed group factor of abstract and visual reasoning and crystallized ability. The location of general factor of intelligence is possible in the third order factor analysis.

The theory of fluid and crystallized intelligence also questions Guilford's (1956; 1959; 1966; 1967; 1968) arguments to "splitter" the intellectual domain into a very large number of narrow, slightly distinct abilities.

A review of the literature (Eysenck, 1967) concerned with the relationship of mental abilities and the learning tasks suggests that serial learning and paired associate learning tasks correlate highly with Gf and Gc respectively.
The writer agrees with Vernon (1969) who maintains that Cattell's theory of Gf and Gc is a well integrated theory of mental development and is helpful in the understanding of complex and hitherto somewhat chaotic results of factorial research, that Cattell's oblique second order factors of Gf and Gc are psychologically more intelligible than g and group factors.