CHAPTER I

INTRODUCTION

The present day is rightly described as "the age of technology". The importance of engineering education and profession in the progress of human civilisation is well-recognised. To a very large extent an engineer is himself its designer and builder. The society depends upon him. This dependence is more marked in a country like India, which is in the process of building up its national industries and development projects. As such, the engineer enjoys a prestige which is not always available to his contemporaries in other fields of science and arts. After attaining a degree of specialisation "the jobs seek after him". He can visualise a happier future. He also enjoys the satisfaction of having a better possibility for doing some concrete and useful work for his community.

The enviable position enjoyed by the engineer has resulted in a heavy demand for engineering education throughout the country. Any child who shows some calibre at the earlier examinations is encouraged by the parents and teachers to aspire for engineering education.

In India, good engineering institutions are rare. There is a heavy rush for admission in these institutions. The National Institutes, where the training facilities and future job possibilities are deemed to be comparatively more, are consequently faced with the problem of proper selection.

The usual methods of selection of students into engineering

colleges are based upon two different criteria: (1) proficiency in public examinations and (2) proficiency in entrance examinations conducted by the institutions. In addition to those, some institutions also have some physical fitness tests and also "personality assessment interviews" (as such interviews are called). Intelligence or aptitude tests have not yet been adopted for such selections.

The Public Examinations:

There are several shortcomings in the use of the public examinations as the sole criterion of selection. Firstly, students with different levels of academic qualifications are allowed to enter the engineering course at the same stage. While some students come after intermediate in science, some others come after B.Sc. or even M.Sc. No uniform criterion can therefore be possible under the circumstances. Secondly, different universities adopt different standards of marking and even courses of study. Hence, these results are not comparable. Also, there is the question of reliability and validity of these public examinations, which are mostly "essay type" in nature. Fortunately, the public examinations are not used as the sole criterion of selection by most of the important engineering institutions, but as "passports" to entrance examinations .

Entrance Examinations:

Entrance examinations test the proficiency of the candidates in the fundamental sciences, in english compositions, history and other humanities subjects besides "general knowledge". As the number of candidates appearing in these examinations is large, several examiners are employed for the assessment of the

answer papers. Different parts of the same papers might have different examiners. As such, maintaining a uniformity in standards of marking becomes difficult. Also, the shortness of time within which the answer scripts are to be evaluated makes a true assessment difficult.

Another factor affecting the validity of the entrance examination results is: because of the heterogeniety in the levels of academic background of the candidates, those with higher initial qualifications are at an advantage over the others. Useful as it may be in screening out the required number of students from among the candidates, there is always the possibility that a candidate selected through an entrance examination proves unsuccessful in the end. Nor can the method guarantee that among the screened out candidates there may not be persons who might have been successful. In spite of the present method of screening, there are cases of failures and "drop outs", a fact which goes to prove the inadequacy of such a method of selection.

Interviews:

After screening through the entrance examinations, candidates are generally called for interviews. Usually, different teams of teachers interview different groups of candidates for entry into a same institution. Generally, such interviews are hurried and are conducted by individuals, not adequately trained in the techniques of interviewing. Besides, interviews have their common

pitfalls like the "personal equation" of the interviewers (Eysenck, 1953) and unavailability of any criteria for their reliability & validity. These lacuna make interviews rather unscientific. As an adjunct to other methods, interviews may be useful; however, they cannot be depended upon as sole criteria for selection.

Alternative methods I:Intelligence Tests

Among the less conventional techniques of selection in vague, though not in India, in some other countries is the intelligence tests. After the initial success of the Stanford-Binet scales, the intelligence tests and related topics have occupied considerable space in psychological research and literature. Various aspects of intelligence have been discussed threadbare and the pros and cons of using intelligence tests in various jobs and situations have been considered. It has been shown that the intelligence test scores are good predictors of success at the high school and comparable levels. There is also evidence that such tests are useful in the Army and some other occupations Stein (1956) and others have expressed doubts about the validity of such tests at the "higher" levels. Some others, e.g. Eysenck(1953), point out that only a moderate degree of accuracy is to be expected out of the prediction based upon intelligence scales. There have been talks about "concrete intelligence" as differentiated from "abstract

intelligence", "social intelligence", "verbal" and "non-verbal intelligence" and "cognitive", "conative" and "affective or non-intellective" intelligence. Modern factor analytical techniques have segregated various primary abilities pointing out to definite psychological functions. Considerable research attention has also been directed towards the question of "constancy" of I.Q. The point at which intelligence attains maturity has also given rise to controversies. The mental age-range differs in each of the existing mental tests. Mostly conceived as a combination of speed and power, intelligence tests and their scores are exposed to the subjective condition of the testee. Thus, what intelligence test scores give us, will not be a measure of the intellectual competence alone but also a picture of his preparedness to react at the time of the testing, the so-called "available intelligence". Test scores have been found to be affected by various emotional stresses, anxiety states and injuries, especially of the nervous system. The degree of motivation the testee has the extent of his rapport with the tester and the perseverence he possesses will also affect his performance in intelligence tests. Woolley(1925) showed that emotional release and free stimulation could cause rapid increase of 20 to 30 points in intelligence quotient. From studies of a similar nature "it appears that part of the beneficial effect comes from a gradual setting free of attitude of confidence, with resulting ability

to use such wits as one has and that the very atmosphere of the test situation itself, by being more permissive may offer a rather free than a hostile challenge and permit the mobilization of latent capacities. "(Murphy,1948) the personality of the testees and the tester therefore affect both the scores and the predictive utility of intelligence tests. To quote Eysenck (1953).. intellectual achievement is the product of high speed of mental work coupled with persistent application...(persistence) is not an intellectual quality at all, but rather a function of personality organisation and emotional integration". This point is further illustrated by Garrett's report (1949) where he has summarised all the investigations on factors related to scholastic success in colleges of Arts, Science and teachers' colleges. He concludes that "a closer correlation exists between intelligence and college grades in the students motivated by similar goals". The same author has also pointed out that intelligence tests correlate "negatively or approximately zero" with the emotional tests. Modern psychology tends to believe that intelligence is not completely independant of other aspect of personality (Roe,1956), that "general intelligence is a function of the personality as a whole" and that, "other than strictly cognitive aspects are involved".

Regarding the predictability of the tests, it is important to take into account the type of examination

in which the performance is to be predicted. It has been shown that achievements in the "objective" type of examinations more accurately predictable through intelligence tests than the achievements in essay-type examinations.

Gough(1953) has given a non-intellectual intelligence test approach in his study of the relationship between intellectual measures and a series of opinions, attitude and self-descriptive items. Fifty two items were found to possess empirical validity. These items were assembled in a scale which yielded median validity of approximately.58 in 4 original samples. He reports, "Adjectival descriptions of subjects scoring high on the scale tended to stress factors of dependability, intellectual clarity, persistence and planfulness". This study is very significant in the sense that it suggests a possibility of replacing the intelligence tests by other biographical and personality variables with almost no loss of predictive value.

The following arguments can be stated against the use of intelligence tests for the purposes of selection.

(1) Intelligence tests are not "infallible".

(2) There is at present a lack of necessary tools of measurement standardized in this country.

(3) There is a lack of trained administrators.

(4) The available tests do not cover all the areas relevant for prediction.

(5) Intelligence is not independent of other personality variables.

(6) Gain in predictability over that by the conventional methods might not be high ehough to justify their use.

(7) Time required for the testing programmes is much more than any institution can reasonably afford ; for better predictive value, a programme should include not one but many tests administered together.

(8) Engineering education is a complex behaviour situation requiring a variety of adjustments and abilities which cannot be measured by the tests designedd for the purpose of measuring intellectual competence alone.

(9) Intelligence tests very often view the individual as "sufficient in himself" and apart from the social setup.(Sinha, 1960).

However, information about the level of intelligence of an individual is significant and helpful for selection and guidance purposes in more ways than one. The predictive value of such tests should therefore be carefully studied. In any case, the intelligence tests should always be used as suppliments rather than substitutes to the more conventional methods and such other personal-motivational abilities as proved to be predictive of

success in engineering education.

Alternative methods II: Personality & Aptitude testing

More recently the personality-oriented approach has been adopted in selection policies and researches. As Thresher(1959) rightly pointed out, "Tests are useful, in fact, and indispensible, aids to intellectual selection; but tests deal only with peripheral aspects of behaviour. The energy and drive that lead to great achievement have their root deep in the vital energies of the soul(sic). The last half century in psychology has given us glimpses of this turbulant inner world but we are still far from understanding it".

Stein and others (1956) report, "once the question of minimal intellectual competence had been resolved, critical importance would then be attached to such matters as the manner in which a student could get along with his classmates, the extent to which he was accepted and the significance which he attached to such responses from others, the character of his relationship with the teacher, and the extent to which he might be free from sources of anxiety and concern which might interfere with his capacity to absorb and integrate the academic experiences being offered him."

Since achievement in engineering, just as in any other vocation, depends on native endowments conducive for and acquisitions of a variety of abilities

and adjustments, it is reasonable to expect that inclusion of a systematic personality assessment in the selection criteria will be useful and effective.

The advantages of personality and aptitude tests over the tests of intelligence are many. For one thing, the "minimal intellectual competence" of the student need not be assessed again. Mostly by the time a student enters an engineering institution such minimal competence can safely be assumed to be present. Then, the factor which differentiates the successful from the unsuccessful student lies in the area of personality and motivation .

To quote from Garrett's report (1949) :

"Although admirable Progress has been made in discovering and attempting to measure the factors which contribute to scholastic success in college, all writers agree that there remains a unique unmeasurable factor, or perhaps many factors, lost in the unpredictable intricacies of human personality".

Tests of aptitude have taken a comparatively larger share in selections. As pointed out by Garrett (ibid), general aptitude tests correlate more highly with college grades - when long periods of college work are used as a criterion than when short periods are used. Probably this has something to do with the influence of the college on the general aptitude of its students. The latter point, however has not been established clearly.

Garrett also reports that intelligence has a better correlation with grade averages when the group tested is "similarly motivated" that when it is not. Motivation, it appears ,provides the necessary direction of effort. The effort which the given individual is capable of exerting is, though closely related, quite independent of intelligence. The need for comprehending the direction and intensity of motivation is thus acute for any kind of prediction. Needless to say that this has suffered considerable neglect in the existing selection policies.

Engineering education: a complex behaviour situation

Engineering education, viewed from the professional angle, is a lot more than just acquisition of some information of fundamental sciences or of engineering or industrial research. Engineering students learn the sciences as a means of acquiring habits of thoughts and fundamental knowledge to prepare themselves for something which they will not start doing till afterwards, namely, applying them to practical problems created by the needs of the community. In doing this, knowledge of the physical sciences is an important element, but it is only one. Others, equally important, are business judgement, administration and accounting, tact in human relation and what may be called the "electic faculty": the power to range over wide and varied fields of knowledge picking out the bits that can be used and adapting these to one's purpose.

With these must go a sense of proportion ; a skill in approximation, and an ability to make decision from incomplete data (Holmstrom, 1960). During the training as a part of their course, as in the profession, the engineering student has to meet and work with a number of individuals. The education of an engineer therefore is a complex behaviour situation. Not only the dealings of students with other individuals in their respective "fields" in industries or elsewhere, but also their dealings with teachers and peers become important during the engineering course, due to the amount of team-work required in most of the engineering curricula.

Intelligence alone therefore, cannot serve as the predictor of success in engineering education, and far less in the profession. Since the individual student is to adjust in such a complex behaviour situation, information for correct prediction should include two broad divisions:

(1) about the requirements, roles, expectancies and "presses" of the environment i.e. the institution and

(2) about the nature of the individual in question, that is, information regarding his personality structure, biographical background and the degree to which the individual meets the requirements of the environment.

Engineering Institution: a Subculture.

Following Stein (1956) it can be said that an engineering institution, like any other social organisation, is a subculture or subsystem within a wider culture of society. It has specific organisation of values, status relationships and rewards through which it accomplishes its goals. Some of these may be common with other educational institutions while it may also have some unique features. The constellation of these has its "attraction value" for individuals seeking admission. It may have "avoidance value" for others. It has its own "selective orientation" in terms of which it selects and recruits its students. It demands of the individuals who get placed in it, a set of roles to be fulfilled. What exactly these are can be ascertained only after careful study. It can however be suggested that a student has a number of roles which he is expected to fulfil and thereby satisfy the "significant others", which is the faculty. In the role of a student he is expected to keep abreast with the progress made in the class, maintain a proper study habit, express himself effectively orally, in writing as well as graphically, and observe certain rules and maintain a proper code of conduct e.g. regularity in attendance, obedience and the like. As a scientist he is required to keep pace with the recent developments in the basic and engineering sciences. He should possess, as the Report on Evaluation of Engineering Education(1955) puts

it," a knowledge of the fundamental scientific principles associated with any branch of engineering, including a knowledge of their limitations and of their applications to particular problems, such as development of materials, machines or structures as well as the ability to make critical scientific and economic analyses and to organize these into clear, concise and convincing oral reports." Besides, he has a professional or technical role. He is expected to bring his scientific knowledge to bear upon the development of certain skills in a particular direction like electrical, mechanical and so on. He is expected to have a preparation for the performance of the function of analyses and creative design or of the function of construction, production or operation where a full knowledge of analysis and design of structure is essential. The prescription of these three roles is largely codified in the form of syllabi of various departments, and the students' conduct rules. In addition to the above three roles there is a fourth role which one has to learn through personal experience. Every institution expects certain levels of relationship to be maintained with others in thec class or in the campus. The student has to fulfil certain social relation roles, some of which express themselves in the extra-curricular activities and other informal spheres outside the classroom.

Within an institution there are values which people may appreciate, as well as practices determined

by tradition and purpose. Just as in a business organisation there are roles and practices assigned to the typist, the foreman and the executive, in the educational institution there are roles assigned to the student and the teacher. These may differ in various organisations and even within an institution.

The teaching procedures used in an institution serve to define the student-teacher roles and have much to do with determining the activities expected of students and teachers. Such teaching procedures often follow from the "implicit" or "explicit" objectives laid down by the faulty. In a purely lecture situation, the student has a relatively passive role of a receipient of information communicated by the teacher. In a discussion session, there is cooperative attack upon a problem and a more active role is expected. In a practical class, active participation in planning and execution as well as a degree of initiative are demanded.

For an adequate definition of the institutional and other "presses" that decide the roles of an individual, the teaching procedures as well as equipments the student is expected to use, the content of the subject matter and the systems of reward and punishment peculiar to the institution under study should be considered.

Based on the prescription of these roles, the faculty builds up certain "expectancies." Formulation of the student roles normally serves as the basis for

the judgement of the students by the faculty, just as engineers are judged by the "significant others" in their environment of work according to their scientific, professional, business and social relation roles. If the student is able to fulfil these roles (as judged by the faculty), he is considered as successful ; if he falls short of the expectancies he is declared a failure.

Requirements of Engineering Education:

In the words of Lynch(1947) "the aim of engineering education" should be "to impart judgement rather than skill, knowledge rather than training". However as Dugherty(1947) indicates, engineering education has two distinct facets: the "scientific-technical", including a knowledge of the physical and engineering sciences, acquairing the related skills in using tools and instruments and an ability to apply them to practical problems ; and the "humanistic-social", including the ability to express oneself and communicate with others, an appreciation of the humanistic aspects of situations as also the development of a sense of duty in the student as a member of the community. In fact, with the progress of human civilization, the "humanistic social" aspects of the engineer's role in society are gaining importance.

Modern technology is as much concerned with creation as with re-creation. For the execution of the

role of researcher-inventor, a role which becoming increasingly important in the engineering fields, the student of engineering requires certain types of traits, certain dispositions within himself. As Denseath(1956) indicates:

> "In research we want men who are insistent on self-discipline, men who are meticulously curious and observant of small distinctions... with a natural call to study and an inborm spirit of enquiry ; ..... never those not suited to its continual disappointments."

The role of the Institution in the development of its students.

As pointed out earlier, the complexity of adjustment makes engineering education unique as compared to the other fields of study. Several technical and "shop" skills along with several fundamental scientific principles must be acquired during the time scheduled for the course. Added to these the executive, persuasive and social skills have got to be developed. Most of the existing engineering institutions leave these developments to the individual student's own responsibility. But the institutions will do well to recognise their share in developing these traits and nourishing the native endowments in their students. The institutions should remember that they are handling so many human beings, thinking, feeling and potentially creative individuals and not just machines where some

muscular skills might be incorporated. Colleges should keep full information of the individual student's potentiality and should appraise at every stage what can be done about them in the college. It should be logical to construe that some individual might have potentially lesser resistance to develop such qualities as required in the profession than the others, and, for the best benefit of the institution and the society at large, such individuals must be selected and given the training appropriate for the profession of engineering.

Importance of "Personality" factors

From the foregoing discussion it would seem clear that we cannot hope to cover much ground in the prediction of vocational suitability of an engineer by means of spatial, perceptual, manual or by rote-memory, attention and other types of tests. It might be worthwhile to explore the relevance of the already established factors, but it appears unlikely that vocational guidance can be reduced to the application of a battery of tests measuring all the main ability factors and expecting an individual's pattern of factor scores to tell us what jobs he is suited to. The "factorists" also recognise the X factor, the factor of general personality. The success of guidance and selection procedures depend largely on the proper assessment of the "general motivation or X, and more specific attitudes to the jobs under consideration (Vernon, 1951).

Personality factors have relevance in two distinct planes. Firstly they play an important part in the vocational choice of the individual, because, due to the peculiarity of the personality patterns certain individuals are better suited to certain jobs than the others, or more interested in certain jobs ; also due to their peculiar position in society such as the financial position of the family and other biographical factors, the individuals choose certain jobs.

The second plane in which the personality factors operate is : success in the vocation. Such success will be governed by the native endowments of the individual as well as his ability to adjust to the complex and novel situations peculiar to the vocation in question.

Engineering education, being by nature a "pre-professional" course, entails all the requirements of the profession of engineering plus those specific to the branch of engineering and the "subculture" in which the individual has to transact. As noted earlier, the varied adjustments and role-demands upon the individual student of engineering makes the personality factors particularly important. It is obvious that the analyses of the roles, presses and expectancies must precede any systematic investigation into the psychological requirements of student of engineering in order that a valid personal-motivational orientation

be given to the selection procedure of such institutions. But, apart from the sociological analyses of the "roles" and "institutional press", the individual himself must be analysed. The individual, in other words, must not be regarded as a passive participant who becomes adapted to and moulded by externally imposed sets of circumstances. Thus, data on environmental press would have to be translated into psychologically meaningful statements of social roles and role fulfilments in terms of needs and personality characteristics required for most effective functioning of the students' role.

Some researches have been conducted with the same approach in other fields and though more rarely, also in engineering fields. A brief outline of some relevant studies will be given here. Such studies have given new orientation to the problem of personality and motivation, vocational choices, success and failure and have suggested better possibilities of reducing wastage of manpower. They have thrown light upon the neglected sides of vocational and occupational psychology.

Studies in non-Engineering areas:

Various studies using the personal-motivational approach to problem vocational choice and success have been carried out in non-engineering fields. Given below are the findings of some such studies.

Chown (1959) found that confidence & sociability are significant factors in determining the choice of vocation in grammar-school children. Some other studies (e.g. Lehman & Witty, 1936) indicate sex-differences in vocational choice. Roe (1948) indicates a possible relationship between interests and proneuess to certain occupations. Van Zeist & Keer (1954) found that the productivity & creativity of the scientific & technical personnel was positively related to their self-assessment.

Among others, Helper etal (1953) Stein et.al (1955), Tyler (1954) Ghiselli & Burthol (1956), Leeds (1956), Henry (1954), Holt & Lubrosky (1958), Kelly & Fiske (1951) & Roe (1956) have conducted similar investigations.

Studies in Academic Achievement.

Willots' (1953) study on secondary school children revealed the importance of orientation, family background, adaptation to studies & particularly the methods of teaching on their academic success. Mc Quarry (1954) found that over achievers among college students were more likely to have had a less fortunate background. Billes (1953) found that the successful educational leader is "democratic both towards himself & other people and a measure of this democratic attitude is an adequate criterion for judging success in the field.

A series of researches over a period of 4 years conducted at The University of Oklahoma (1952) showed

that an over achiever is characteristically more self-aware and willing to take responsibility. On the other hand, an under achiever is guided by mutually contradictory motives and is not aware of their conflicting nature. The investigators conclude that intellectual variables can function effectively only to the extent the personality function is integrated.

Studies in the field of engineering

Various aspects in the choice of and success in engineering education have been investigated, though the number of such studies is meager . Layton (1954) compared the predictability of engineering grades. High school averages, mathematics tests and aptitude tests, were found to be the three best predictors of engineering grades.

A comparison of the achievement of engineering students with their responses to the Strong vocational interest blank was made by Melville and Frederiksen(1952). They concluded that the average engineering student has high interest in activities associated with scientific work and business sales and administration and is relatively low in his interest for activities associated with men in certain welfare, biological science and business detail activities.

In contrast to this a study conducted by Long, Louis, and Perry (1953) in the city college of New York

shows that the correlation found between a weighted four-year grade-point average and the scores in the Strong and Kuder Interest Blanks were "not high enough to warrant inclusion of the interest measures in the selection battery."

The book editted by Layton (1954) gives an excellent compilation of researches in "selection and counselling students in engineering". Schimitz and Holmes (1954) studied and relationship of certain measures of abilities with freshman engineering achievement. Palmerton (1954) has given "a counselling philosophy custom built for engineers" where he suggests that if evidence of strong aptitude and great motivation is found, the "grades", years of schooling and patterns of subject matter in an applicant" should be overlooked. Jurgenson (1954) has developed procedures for selecting engineers for industry. A special analogies test for the evaluation of graduate engineers has been developed by Dunnebie (1954).

Berdie's research (1943) reveals that the relationship between interests and abilities of the various groups of students is only very small. His enquiry was directed to find out the factors in the individual's background that are related to the "measured vocational interests" and to the vocational choice. Of relevance here are the results obtained from the engineering group. Students with vocational

interest in engineering were seen to be low in social adjustment scores " as do people with measured interests in the skilled trades". Such students were also seen to be participating in fewer religious and cultural activities, as compared to students with interest in social welfare. They were "likely to come from the poorer families. Their fathers will tend to be skilled tradesmen and businessmen. These students will most likely have superior ability, but will be lacking in social interests or skills. They are also likely to have masculine interests and to have interests typical of those of men in lower level occupations. They will exhibit hobbies related to engineers - woodwork, model planes, etc. and claim to have special abilities, drawing, mechanical and mathematical. In high school their favourite teachers taught mathematics and they were not enthusiastic about their Ehglish and social science teachers. They tend to admire people in engineering and fewer of their values center about people."

A similar investigation by Norman and Reldo(1952) took seven groups of students majoring in different academic subjects who were contrasted with each other. The engineering group revealed "tendencies similar to M.C.P.(Mathematics, Chemistry and Physics). "The personality demands of this group seem to imply a stability of behaviour, low over-activity, reduced interest in people and masculinity".

As a part of the orientation testing in the Illinois Institute of Technology, the Kuder Preference Record was administered to all new entrants. A comparison of the Freshmen and Alumni , reported by Speer (1948), revealed that the "Persuasive", "Social Service" and the "clerical interests" were significantly different between the alumni and the freshmen.

More recently Venables (1960) has studied the "placement problems among engineering apprentices in part time technical college courses". His results show that "by the use of two or three standardized tests colleges could place their students more effectively in three types of course available, and be in a position to offer them more realistic help in the event of failure or other difficulties."

From the above report it seems clear that the importance of the "non-intellectual" aspects of the personality demands in engineering has been realised. It is sought in the present study to examine whether any selection based on the assessment of personality factors can be recommended for the purpose of engineering education. For this purpose, the preditability of achievement in engineering education by using the biographical information, a number of test scores and responses to inventories is examined in the present study.

The Present Study

The problem of the present study is to examine the personality patterns of the High and Low achievers in engineering education with special reference to predictability of their achievement through some non-intellectual or personality factors. The aim of such an investigation is to provide basis for sounder selection by the inclusion of the personality variables.

The basic assumption of the investigation was that if any test or a number of tests discriminate between a group of high achievers and a group of low achievers, the trait or traits which such tests measure might be taken as predictors of success in engineering education.

For this purpose, fifteen students in each of the High and Low extremes of achievement in three departments of engineering were taken as the sample for this study. All these students were admitted to the Indian Institute of Technology, Kharagpur, India, on the same year.

A number of tests involving the emotional balance, extraversion intraversion, neurotic tendencies, business judgement, intelligence, social adjustment, attitude towards teachers, anxiety and concepts of the ideal figure were selected for investigation. A comprehensive personal data sheet including the items: reasons for choice, ideal self-image, fears, ambitions, wishes, self-esteem, hobbies and interests etc. was

also administered. A series of pre-defined traits was also to be rated by the students for relevance to success in engineering education. Besides the differential analysis of the high and low schievers, the study includes the problem of criterion, where the operational definition of high achievement is sought to be given ; analyses of the "institutional expectancy", i.e. the qualities desirable for engineering students and profession, as conceived by the teachers and students of engineering in this institution are made.

A shift of emphasis in selection methods from the cognitive and motor skills to personality dynamics and inter personal behaviour is attempted here. The presemt study, it must be admitted, does not cover the whole ground ; however, it is intended to yield preliminary information regarding the possibilities of utilising personal data for prediction. The individual has been viewed in the context of his social surrounding and not as "sufficient in himself". Thus, the biographical information and the analysis of the institutional expectancies become relevant.

Another shift of emphasis attempted in this study is from the "average" to the "pure" case. The occurence of the pure cases, i.e. the ideal students or their opposites, should not be taken as due to chance, but as due to the operation of some laws. These are probably determined by the relevance of

the native endowments of the individual in the particular context. Conventional techniques of prognosis, guidance and selection have, as a rule, emphasised the "average". Any departure from the average seen from their frame of reference, loses entirely the scientific interest and significance. For them, a departure from the average is equivalent to a departure from "lawfulness".

However, if a student is a high achiever, (and thus, a departure from the average) it should be not because of chance ; in fact it is more because of certain laws operating behind one's being a high achiever. These laws should logically operate from within as well as from without. Occurence of the "pure" case, therefore, is predictable to a considerable extent if these native endowments and the direction and intensity of their functioning can be properly ascertained. This leads to personal-motivational orientation.

Limitations of the present study

Ideally, the number of tests should have been much larger, to cover as much area of personality as possible. In view of the time factor, however, this was reduced considerably. The sample was scattered throughout the campus and group tests were to be administered only according to their Halls of residence. This increased the time requirements to as much as five

times, there being five undergraduate Halls of Residence in the Institution under study, These testing sessions were interrupted by periods of examination, entertainment and other campus-programmes such as extension lectures, academic film shows, language and other evening classes etc. Added to this was the question of keeping appointment. Since the whole data was to be collected by the investigator single-handed, simultaneous collection of data was impossible. In order to avoid formal or official appearance, and to gain better rapport with the Ss, test-administration was done through personal contact alone. Sundays were the only days of the weak when test administration could be arranged in the hostel common rooms and libraries.

Originally, this investigation intended to use some aptitude tests, notably those of Physical Sciences and Mechanical Comprehension. In view of the difficulty of obtaining them from foreign countries, the idea had to be dropped. Thus the selection of the test materials depended upon their availability in India.

The sample of this study was selected from the Civil, Mechanical and Electrical Engineering departments. It is doubtful whether the conclusions would equally apply to all the other branches of engineering. Because of the rather intensive nature of the investigation, the number also had to be kept

small. Generalisations based on such a small number of subjects might be questionable. Detailed clinical information about the Ss was also not available, chiefly due to lack of time.

However, further research on the same lines will be rewarding. Systematically conducted over a number of years, with follow-ups and validational analyses, such researches will reduce much of wastage of manpower in the field of engineering.