CHAPTER VI

PHYSICAL SCIENCES:

ENGINEERING & PHYSICAL SCIENCES GROUP;

ENGINEERING GROUPS

Gujarat University has so far two colleges of engineering affiliated to it for training students for its B.E. degree, one situated at Ahmedabad and one other situated at Surat in Saurashtra. These two colleges differ in size. B.E. Engineering College was founded in 1943, the oldest in the region and probably the biggest. Generally the administrative set up is under the State Government, department of technical education but the teaching, course curriculum, examination and conferring the degrees is under the University. For all practical academic considerations University is the authority to prescribe the direction and course of action.

B.E. College of engineering has at least three levels of course curriculum prescribed for various Diploma, degree and post-graduate level. Mainly there are three broad fields of specialization which a student can go into, after one year of study of the common subjects, when he is admitted to the degree course in the college. The three areas covered are Civil, Mechanical and Electrical engineer courses. As already stated there are diploma courses,
in all the above three specialized branches of engineering which can be pursued by relatively younger students. The college has an entrance examination for these diploma courses which I think is an examination of stiff second class Secondary High School level at which second class level Intermediate Science, Mathematics students can get admission successfully. Also there is no direct promotion from diploma course to degree of B. Engineering course. Everybody has to appear in another qualifying test provided as entrance examination to the course. There is further specification for this course that an overall first class or better percentage of marks should have been attained by a student at the High School and Intermediate level, before he can be considered for admission and the entrance test for the B.E. degree course.

When the student finally qualifies for admission to the college, he spends one year with his other same level colleagues and is taught the preliminary common course which is in a way the common element for all kinds of engineering specialization. After successful completion of this one year, two more years are spent in studying and allied laboratory work in learning the various details of the special courses in which ultimately the main degree shall be awarded. In other words, it takes at least 3 years after Intermediate Science of first class level, to complete the study for B.E. degree. It is an intensive course in which the college work takes about eight hours a day and laboratory work further more time occasionally. All the above
training generally results in employment in the second level of technical state or private organisation with a starting total emoluments of about £350/- It is interesting to note that the more famous firms dealing in the area usually need a period of six to nine months as apprenticeship covered by the engineering graduate before they consider a more permanent appointment at that level. State services usually do not require such apprenticeship but have one year's probation period to be successfully completed before confirmation.

The above details are provided to point out that engineering course is a highly specialized course which has further subdivisions of specialization. The standard of general ability and educational achievement are highest demanded. Further, at the end, it is found that despite these, engineering career is not easy to get into. Generally there is demand for really 'on the job' 'successful' technical men.

It should be reminded that one of the teachers was very interested in finding more about this study and any other method for which he could take help in weeding out the probable unsuccessful, by doing more thorough pre selection testing. He was very sceptic of the qualifications, conditions and entrance test which are provided at the beginning, despite which a large number of the students are not made into successful on the job workers.
The reception of the author at the time of the preliminary study was enthusiastic. At the time of final study it was found out that there has been changes taken place in the top administrative personnel of the college without whose permission and cooperation the testing would not be possible. It was found too late that with the exception of the laboratory work the boys never assembled at any given place as a whole class. On the other hand personal approach with two lectures helped the author in managing to get few more students. It should be said that even at a technical training college, periodical change in the top administration can bring about change towards some incoherence. Another cause of indifferent attitude of students was their apprehension that the test marks may be used as basis for determining the University examinations. Same how the report was not the case as before, despite all assurances. A lack of motivation was discernible in most group settings.

Data, Sample, method:

The data as usual consists of raw scores on tests administered to the groups together with the scores of achievement. As already pointed out there is full indication that the measures adopted as part of the policy of selection at the college achieve the desirable. The data here collected shows all the scores at High School, Intermediate, Last final examination and final examination.
As has already been pointed out there were two broad reasons which limited the sampling in the case of the present group. 1. The students indicated that more persons could be available for appearing in the test, if the testing had been started earlier in August or July. They indicated that very soon in January, the laboratory and practical examinations, which carry heavy weight towards the over-all written examination percentages, will be started and all the major preparations had to be finished before the winter break. 2. The college teacher in charge was not in the know of his students attitudes towards this type of volunteer help which resulted in getting fewer students. He failed to understand the requirements of the study and made for part of the shortage of sample in this group.

The method of collecting data has practically already been discussed and it can be added that the actual performance during the test administration phase was very good. Group testing with groups of 6 or more was done and generally the time, place, varied from group to group. All testing was done in the rooms of the college and there were no particular complaints from the students. In the case of one group who took the test after the college work, it was generally complained that they were tired, but the same group reported that on the whole the test was interesting. It can be said that due to the changes in places, times, no particular effect on test performance was noticeable. They were very interested in doing the test and took less
average time in understanding directions and doing the practice parts.

The sample distribution shows that a total of 326 students registered for the B. Engineering examination out of which 323 actually appeared for the examination in the three special fields. The present sample covered in the study is 36 out of 136 in Civil Engineering, 16 out of 53 in Electrical Engineering and 26 out of 134 in Mechanical Engineering. It should be understood that the students from the Norvi College were not covered at all. The percentage of total students included in this sample from the population is 24.6%. Further break down shows that the study covers 26.5% of Civil, approximately 33% of Electrical and approximately 26% of Mechanical Engineering students. The University records disclose that the total pass percentage for Civil, Mechanical and Electrical engineering examinations respectively is 55.14%, 77.61% and 73.53%. The data collected show that 83%, 67% and 96% passed in Civil, Electrical and Mechanical engineering groups respectively. The data further shows that there are hardly any 'Pass' class students amongst those who appeared for the tests, but the University records show that no more than 4 did get this grade in the University examination. The data has first, second and failures only.

It can be argued, whether the present sample of engineering students is representative of the total group of engineering students. In favour
of the contention that it may be a random representative sample, it can be said that total sample percentage, together with the spread of various distributions on various tests and examination scores does indicate that more likely than not the sample is random and representative. There is discrepancy in the comparative percent of pass at the university level and this sample, but it will be seen that those are not too meaningful to show qualitative differences. As already pointed out all shades of achievement and quality of performances have been sampled.

Further, the analysis of data show that this sample compared with other student groups is a highly selected sample. It reflects the top achievement sample in most respects both in the achievement examination scores as well as the test scores. The argument is that, for the purposes of comparisons with other group, the sample acts as an entirely different and superior group which is not representative of any of the other groups. Very few overlapping scores are available to say that probably none of medical students can interchange places with some of those.

Analysis of data has not been attempted to bring out the special fields, differences between the sub groups in engineering because the group as a whole barely is sufficient in size to make indicatively generalized statements. The smallness of the sizes of the sub groups will make results so unstable that no stable trend or difference will be discriminated.
Further, within this group age variations are not too wide and again subgroup divisions based on ages would be too small that no visible differential scores are likely to be achieved. Thirdly it can be pointed out as a general result that there is no question of analysis on the variable of sex. Engineering training is essentially thought to be composed of numerical, mathematical, laboratory, outdoor work which has little verbal back and essay type writing work as part of every day study. Girls tend to stay away from this type of course.

RESULTS:

1. Inspection of the data sheets show that it took 5 test sessions to cover the sample of 50. In the average per session 16 out of possible 20 were tested. It is the measure of sense of achievement, test sophistication and cooperation in this and other high ability and achievement groups. This is probably the best average achieved in this study.

2. In the whole the sample represents most levels and qualities of students of engineering. It emerges that probably at this high level of academic achievement, it is the levels of qualities represented which count more than the numbers covered in a sample. It cannot be denied that for this group it is a smaller number in the sample specially in mechanical and civil engineering groups.

3. In groups where any kind of achievement
test is going to be given within two months, it is best to test the sample in the beginning of academic session. Level of competition in high achievement group is felt to be 'tough' and the tension towards this is relatively higher than in other groups.

4. Age and Sex subdivisions have not been made in this group. There are no girls in the population of engineering students. Age differences can be shown by stating the range between the youngest and oldest. It is found that the youngest is 19 years 3 months and the oldest 24 years 11 months. The modes are likely to be at 1 year intervals between the ages 21, 22, 23 years because every successive year only, admissions are done for the course. There are no admissions in between the academic year.

5. The pre-engineering entrance examination together with the requirement of first class at High School and Intermediate Science, Mathematics specialized combination, makes the selection of the group very stratified. The later results on the over all mean scores of this group will tend to show that in almost all respects these students are highest achievers. Later, engineering college achievement keeps lowering. The process of very high rate and level of selection takes a different meaning, when the very best of all schools assemble to compete with each other and a first class high school student finds himself an average or below average engineering graduate. In fact there were at least
three students came to get guidance because they thought that there was something wrong with them as they were not achieving as high as they used to at earlier levels of academic training.

6. The Mean of the sample on test 1 is 45.2 with a S.E.M of 1.06 and S.D. of 9.3. The Mean is 4 raw score points above the students sample, 2 points above the criteria group sample. The size of the S.E.M. indicates that there may not be any amount of overlap of the Mean scores of the criteria group and engineering group. The Mean is certainly different than the one obtained by the student sample. The size of the S.D. is not in any way different than obtained for other groups which shows that variability within the group is about usual.

The correlations obtained between this test scores and others are generally all positive and rarely neutral. A r of .21 is significant at .05 and that of .23 at .01 level. Correlations with test 2, 5, 6, Interg, Last Final and Final examination are significant at .05 level, out of this correlations with test 2, 5, Last Final examination are significant at .01 level also. Positive but very low correlations exist between the test and tests 3, 4, 7, High School. Significant, indicative correspondences are achieved with test 2, 5, 6, Interg, Last Final and Final examinations.

7. The Mean of the group on test 2 is 26.2 and the S.E.M. is .48 and the S.D. is 4.3. Compared with
the student total group mean score is about 3 score
points above and in comparison to the criteria group
mean score it is about 1.5 score points above. Comparing
the S.D.'s of the three groups, the mean of this group is
distinctly different from the other two. The homogeneity
of the group in this test is about of the same level as
of other groups.

Significant at .05 level correlations are
achieved between this test and test 1,4,5,6 out of which
correlation with test 1 and 6 are found significant
at .01 level. Near neutral correlations are achieved
between this test and test 7, High School, Intcr and Last
Final and Final examinations scores. It is unexpected
that though mean score of the sample is high yet the
relevance of the test with all the achievement tests is
near to neutral. Further, the significance obtained for
correlations with test 4 and 5 needs further discussion.

Mean of the sample on test 3 is 17.61 with
a S.D. .57 and 5.16. This mean score is higher than
5 raw score points from the mean scores of both the
criteria and the total student group. The mean is
equal to the 1 S.D. of these groups.

Significantly high correlations are achieved
between this test and test 5,7 and final examination
scores. Moderate though not too significant correlations
are achieved between test 3 and 2 and 4. High School
and Last Final examination. It is interesting to note
that nearly neutral correlations exist between test 3
and test 1, 6 and Inter. The fact that there is sufficient
correlation at the Final Examination level and good
indicative correspondence at High School level is notable.
It probably can be said that in this regard this group
is slightly different than other groups and the test can
be kept in mind to form a part of the group aptitude
pattern.

9. Mean of the group on test 4 is 14.0 with a
3.53 and 3.0. 4.74. The criteria group mean score is
17.3 and the total student group mean is 13.17. Other
student group mean scores hover around 14.0. It would be
expected for this group that as a rule they are not so
good in English vocabulary. They are supposed to be
strong in Mathematics. The fact that the mean score
of this group is about equal to the mean score of the
medical students shows this group to be of the highest
aptitudinal levels. Probably this measure differentiates
them from other samples of the Physical sciences
background. 3.5 is as large as the criteria group 3.9.

Significantly high correlations are achieved
between this test and tests 2, 6, last final examination
only. Of these the most significant r is achieved for
test 6. A low negative correlation is obtained with
inter, test 5 and 4. It will be expected for this
sample. Other correlations are positive but low.
Correlations with test 7, High School and final
examination are neutral.
Mean of the group on test 5 is 27.56 with 3.2m. 43 and a S.D. of 4.37. Compared to the criteria group and total students group this mean is at least two raw score points above each one of them, which makes it about .9 S.D. units above the mean of these two. For a group which actually has a very large amount of laboratory work as part of the school course work from the Intermediate level onwards, it will be expected that the mean score is high for this group.

The pattern of correlations however is not quite clear. Significant positive correlations exist between this test and test 1, 2, 3, 7. Very low negative correlation exists with test 4 and last Final examination marks.

General or very low correlations exist for test 6, High School, Intermediate and Final examination scores. It will be expected that the secondary level correspondence exists between the test and achievement examinations.

Test 6 Mean of the sample is 13.37 with a S.E.m. of .36 and S.D. of 2.37, compared to the criteria and total group Means on this test it is found that the present mean is 2 and 1 raw points above. Considering the size of the S.E.m. it seems that there are few chances of the present mean being overlapped by the mean of any of these samples. The size of the S.D. is indicative of the nature of the Test. There are generally leptokurtic distributions of the whole student samples and the S.D. sizes are generally small.
The correlations with tests 1, 2, 4 and final examination marks are significant at .05 or .01 level of confidence. They are all positive. Indicative, low positive correlations are achieved between this test and test 3, 5, 7 High School and last final examination. The one with Intermediate examination is neutral. Most of the above correlations up to degree are expected except the one with Intermediate.

12. Test 7 mean of the group is 23.65 with a S.E.m 6 and S.D. of 5.6. Compared with the criteria and the total student group this mean score is again 2 or more raw points higher. Once again the size of the S.E.m of these samples indicates that these mean scores are different than each other. The size of the S.D. in this group is generally as large as any other group. The distribution is fairly normal with a tendency towards very slight skew.

Significant correlations are achieved, between the test and test 3, 5 and final examination scores. Mild indicative positive correlations exist between the test and test 1, 2, 6, Inter examination. Neutral correlations exists with last final examination, High School and Test 4. All the significant correlations are to be expected in the case of this sample. The fact that with the exception of the final examination scores no other achievement examination shows any respectable correspondence with this test scores is to be commented upon.
Mean of the percentage of High School marks of this sample is 63.59 with a S.E. of 3.19. There are 16 in the II class and 47 in the first class and 22 in first class with distinction. The distribution is decidedly negatively skewed. It also shows two modes at 61% and 67% step intervals. When compared with the mean of the criteria group for this examination, a difference of 12 raw score points is found to be existing. On this score, considering the sizes of the S.E. for the two groups, it is estimated that this mean score is at least +1 I.D. of the criteria group mean.

It is interesting to note that at High School level there is no test of this battery which has any meaningful correspondence. Tests 2 and 3, 6 show positive low correlations, so low that they only indicate a trend of the commonality only. On the other hand correlations with later examinations show that it has significantly high positive correspondence with Intermediate and last final examination. There is only neutral positive correlation with the final examination. These statistics need further clarification, specially when we consider that High School examination has been found to be a significant achievement test for the criteria as well as the medical group.

Mean of the group for the percentage of marks gained at Intermediate examination is 62.63 with a S.E. of 3.5 and S.D. of 7.05. Compared with the criteria group mean of 49, the mean of the present group is +2 S.D.
above. It shows that the sample is distinctly different from that group. Considering that the criteria group sample has a representation of engineers, it will be seen that the high standard maintained by this group until this level of achievement is equal to their professional counterparts. There are 11 in II class, 53 in the I st class and 9 in the I class with distinction range. There is a fairly normal distribution of the scores and it seems that this examination tends to smooth out some of the discrepancies showed by the High School examination marks.

Significant positive correlations are achieved between the scores of this examination and test 1, High School and last Final examination. Neutral correlations exist between this examination tests 2,3,6 and mediocre low indicative correlations with tests 5,7, and Final examination. It can be seen that some kind of compensatory development of aptitudes takes place as compared to the one existing at High School level. Interestingly, a mediocre negative correlation exists between test 4 and Intermediate examination percentage of marks gained.

15. Mean of the last final examination, which is equal to a graduate examination of other groups in terms of the time at which it is taken, is 54.31 with a S.E. of 5.3 and S.D. of 5.34. Compared to the mean of the criteria group for this or equivalent examination, the mean of the present sample is still higher by about 3 raw score points which is about .5 S.D. above the criteria group mean. This is the second examination
taken up by the group after successfully entering and covering the first examination. It should be pointed out here that the percentage of marks obtained here do not reflect the achievement in the same general academic content, but do reflect the same level. The three special fields become bifurcated for this level of examination. The percentage here reflects the civil, electrical and mechanical examination content.

The examination correlates significantly with test 1,2, High School, Intermediate and the later final examination. Mediocre positive correlations exist between this and test 2,3,6. There is neutral correlation with test 7 and a negative neutral correlation with test 5.

16. The final examination is taken 5 years after High School and 3 years after Inter. Ailment of marks differs from one field to another. It is equal to a post-graduate final examination in the sense that it is one year after the graduate level even though the degree awarded after successful training is only a B.E. degree. For this examination a person can only appear if he has successfully completed the other three examinations. The Mean of the total engineering group for this examination percentage of marks is only 57.91 with a S.E. of .72 and S.D. of 6.43. Compared with the final or equivalent examination Mean of percentage of marks for the criteria group, the present Mean is lower by about 1.5 raw score points.
Significant correlations are achieved between this examination and test 1, 3, 6 and last final examination scores. Moderately positive correlations are present for test 5, 7 and later. Neutral positive correlations arise for test 2, 4, and High School examination scores. It is rather surprising that at the end neither the vocabulary test nor the High School marks show any correspondence with this examination marks. Further it needs to be shown that the aptitudinal changes in this high achievement group takes several turns to indicate that probably potentiality aspects of this group are more sensitive than other low achievement groups.

METHODOLOGY:

The present sample is random and representative of all types of engineering students. Further, it can be said that because no sub-group profile scores are being established at this stage, it is not necessary to define that one or the other type of engineering sample is comparably insignificant. It is proposed that a profile for the engineering students may be suggested and sub-group indicators may be attempted to be isolated later, if possible. It will take intensive longitudinal study of this group of students to find out specifically what aptitudinal development of that degree at which stages goes to contribute towards a successful student and later a successful professional in different fields of engineering.
2. It needs to be stated here that generally the high ability and achievement groups like the present one tend to show more insight into research problems. They are more examination oriented and test sophisticated. Generally the picture derived is that they are lively, co-operative, more regular and intensive workers specially in tasks which are denoted to manifest their achievement in intellectual and problem solving behaviour. The self-assurance, heightened the threshold of tension generally, readiness to take up most type of verbal and physical intellectual problems as part of showing their powers seem to characterise the 'rapport' expressed by this sample.

3. Age in the present case may have an indirect bearing. It is generally found that older in a group are either more secure or they are slow achievers. It can be later shown that even with the same age as a common factor there are aptitude differences which probably cause the selection of study courses in student groups. To that and other such results, the whole group of students will be analysed as a separate entity of which this group will be a component.

4. It seems that any process of pre-training selection which has not been tested for its efficiency in predicting post training and training success may be of no use. It is seen in this sample that the
pre-training academic test is not capable of weeding out that core of students who may be alright at this examination but may fail at subsequent engineering examination as well as engineers. Multiple criteria used in the selection of these students also do not seem to be of any value in this regard. It can be shown that about at least 10 to 15 percent of the students selected are failures as engineering students and about more than 20 percent failures as average engineers. This misplacement becomes more acute when it is calculated that the whole process is cumulative and at every stage of engineering examination there is a lag of failures which keeps the general level of teaching and learning lower while the examination level remains the same.

It is evident from the comparison of the mean examination mean of percentage of marks that the mean achievement level of the same students keeps going down at each successive examination, with the effect that at least 25 percent students fail in the final and also the general percentage of marks gained by each student is lowered. It seems indicated that the selection at the outset probably is based on the blind faith that the most able and highest achievers at the early stages are likely to do best later in this training. The level of motivation, regular habits, study attitudes, progressive competition and relative achievement, levels of development of relevant attitudes and special abilities
together with interests in and manner of work are to be considered before a better selection procedure can be structured to make it a success.

There are other factors like the demand of the kind of engineers as well as levels at which the demand exists. It is apparent that engineering profession at the top level has at least managerial, executive, administrative, planning, manufacturing, supervisory, desk as well as field work as part of its essential duties. There are now jobs which may mean general office administration work as it exists in civil engineering offices. Handling of people becomes more essential as ability than handling engineering problems. Accounts and numerical work in some cases is more important. These skills and related aptitudes are not usually measured at the time of the entrance to the engineering college.

3. The level of clerical perceptual ability displayed by this group is unusually high. It is known that for only desk, accounts and such office supervision work, this aptitude is generally found to be an asset. In this sample the aptitude shows high relevance with numerical ability followed by mechanical matching further followed by the three later achievement tests. The general picture derived is that the sample shows close relationships between clerical perception, numerical ability and academic achievement. It must be understood that the group shows itself to be the
top level student group and at this level this conglomeration of aptitudes becomes significantly allied. In its proper order it will be seen that clerical or 'verbal element matching' together with numerical ability followed by academic achievement and slightly related two dimensional perception go to make the main aptitude structure of this group. It should be noted here that with the exception of the high school level, at all other levels of academic achievement clerical perception seems to have close enough correspondence to suggest that probably there is high commonality between them.

6. There is another rather unusual conglomeration of matrices for test of computation. On the one hand high correspondence with clerical perception and numerical reasoning test is present. Appreciable commonality exists between three dimensional visualization test as well as the verbal reasoning test. This set of variables seems to show that the general ability tests are closely related with computational ability in this group. Conceptually it will seem to be expected. The group shows higher than the average achievement on all these four aptitudes ranging about +1 S.D. above the student's group mean scores. Further, it should be understood that most primary nucleus of abilities are to be attached with by some secondary special abilities. In this case computational numerical ability seems to be the special ability which may
not have correspondence with academic achievement at any level, but there is closer relations with tests of abilities which are also loaded with the G factor. Also it can be pointed out that there is slight relation with High School and L.P.

7. Three dimensional visualization test has a loading of G and the mean of this group is far higher than all other groups of students and also the criteria group. As expected it corresponds with the tests of two dimensional perception in various forms. Approachable correspondence is noted between this ability test scores and computation, verbal reasoning, High School examination marks, last final and final examination marks. These are, though not all, significant but the specific trend of correspondences cannot be ignored. It can be imagined that this sample at High School level probably started with a high degree in this ability and has been using it as part of the general ability structure, specially in the College achievement tests. It seems that the ability of this type is one of the foremost indicators of the engineering type student. On the other hand it is not at all related with the numerical reasoning and clerical perception, at the same time clerical perception and arithmetical reasoning are found to be significantly related with the final examination marks. It may be pointed out that the three of them go to make a profile which is partially essential in this professional training. Even though
verbal reasoning by itself is not ultimately found to be related with academic achievement generally, in this group, but probably the G factor accounts for the indicative relationship the test of this ability shows with the test of verbal reasoning scores.

6. Another picture presents itself with regard to the correspondence of scores of the verbal reasoning test and other ability scores. The group scores nearly next to the criteria group score in this test on the Norm. It is found to have significant relation with computational test score, the arithmetical reasoning test and last final examination marks. On the other hand, with most academic achievement scores there are neither negative correlations achieved or nearly neutral ones. Most unusually there is high correspondence with arithmetical reasoning test scores, which makes it imperative to conclude that probably there is closer relationship between arithmetical reasoning and verbal reasoning in this group than there is between English vocabulary and three dimensional visualization. On the other hand it cannot be overlooked that at least with one academic examination and with one of the tests which have a loading of G factor, the test scores correspond positively. The fact that it has very little relationship with academic results only shows that at this level of ability probably more special than general abilities come into force.
9. The matching test in two dimensional perceptual ability shall be high as this group spends a large amount of their time in laboratory work of mechanical nature. The fact that clerical perception goes along with two dimensional perception probably indicates that in this group the common demand is for ability to match accurately. The accurate matching whether in clerical verbal or mechanical areas seems to be the common or group factor which is developed in plenty. Mechanical matching ability is part of the development in training yet, no special weight seems to be given to this in relation to the examinations in engineering studies. It i probable that the practical examination marks may have higher relationship with scores on this test.

10. Notable fact about this group is that verbal and arithmetical reasoning together with clerical perception are closer together than other scores. It should be pointed out that spatial visualization test which has a loading of 0 is not as close as the above are, with arithmetical reasoning test. It can be suggested that the nature of reasoning process differs as soon as the essential elements of reasoning change. The numerical differs from verbal less than it does with the concreteness tested on the spatial visualization test. Essential perceptions also change as soon as the elements of the perceived situation change. The nature of test makes
sharp differential cut-off scores difficult to establish. This implies that the test is relevant for inclusion as part of the engineering group aptitude profile. It has significant correlation with final examination marks, which further points out the importance of the test as a diagnostic sub-test.

11. It has near significant correlation with the final examination marks, though other academic achievement scores only show neutral correspondence with the scores on this test. When it is considered that the spatial visualization test has high correlation with academic achievement at the later stage and the same is true of this test, it can be considered that at least as far as this sample is concerned, these tests together can be used as measure of differential diagnosis for this group.

12. High School examination marks assume importance in this group, when comparison of percentage of marks is done within the student groups. The group scores highest mean percentage of marks of all groups including the criteria group. In this respect engineering group shows itself to be an entirely different sample than the rest. Analysis will show that at no level the mean achieved by this group can overlap with any other group mean. At this level of achievement, this examination does not show any reliable relationship with any of the test scores. Post-diction based on the test scores can be only
relevant when exam scores are considered. It is further pointed out that High School percentage of marks gradually and progressively lose correspondence with other later academic tests as the time goes on. The final examination percentage of marks shows no correspondence at all. It should be pointed out that essential prerequisite for entrance to engineering College is that a student should have achieved a first class in High School. The fact that High School achievement is a factor on which stratification of this sample is partially based, makes the marks at this examination as part of the group profile.

12. Intermediate science with the physical sciences background is another prerequisite to this training. Most of the highest scorers are admitted. This is evident from the very high mean percentage of marks achieved in this group. It shows higher correspondence with last final examination marks but little with final examination. There are no sub-tests of GATB which can be found to be related, except in the sense that the mean scores in relation to the mean scores of other groups of students are different and higher for this group. The relationship with clerical ability at this level is to be explained in terms of the lowered marks at this examination in this group. It is possible that the type of scoring reduces the variance between the two scores which increases the correlation. It can
be pointed out that the examination is the terminal point at which a few choices with regard to getting into various types of training can be made by a student. Characteristically, the percentage of marks at this examination is lowered probably showing that it is probably a bit more varied course curriculum resulting in wider educational adjustment which is not manageable by all students equally. The examination is confronted at a period of heightened stress at the time of adolescence, which, despite of the high ability level of this group, still shows negative effect upon achievement.

12. The academic examination at the engineering college need special discussion because of several unexpected indications presented by the results. The last final examination is taken after two years of training in engineering courses. It shows a very much lowered percentage of marks, even though the group is known to be the highest achieving group at earlier levels. In fact, it is considered that some very low achieving groups show about the same percentage of marks at the corresponding levels, in their courses, this group's group does not differ from them. It is seen that this group does not lose in ability but they show lowered achievement. It is most probable that the earlier achievement is not meaningful to the present curriculum and, therefore, the best do not show themselves. The marks gained by the students
are average second class and the talent is first class.
It seems that the method of examination is too subjective
and verbal for a type of curriculum which is highly
loaded with practical and laboratory work of mechanical
type. It seems that main ability pattern is clerical
perceptual, verbal and arithmetical reasoning together
with space visualization forming the nucleus of general
ability structure at this level.

14. Final examination percentage of marks
show positive and significant correlations with
clerical, spatial visualization, arithmetical reasoning
and last final examination scores. The emergence of
the clerical perception test as meaningfully related
with the engineering achievement tests is though un-
expected but interesting. It is not simple name
matching but English language alphabet matching
accurately which is done by our samples. The tests
of space visualization and two dimensional perception
show increased meaningfulness to this examination.
This will be expected. On the other hand, the mean
of the percentage of marks goes further down. The
fact that it comes to mere 51.9% is rather sad and
seems to imply that the examination system is much
too subjective. The very high level of competition
between very highly talented students can result in
a very confused assessment of relative achievement,
but it should not bring down the level of attainment.
Medical group has shown this trend and their
examination, if not to the same level also has this
defect. More enquiry is needed of the determinants of examination scores, subjects, levels, persons doing the examining. In the whole, the picture presented shows that either the students selected are not responding or the selection is not based upon related criteria or the mode of examination is not suitable to the group or it is very difficult for the examiners to clearly differentiate between these students or all of these.


deficiency:

1. Report in this group, has been found to be disturbed by extraneous factors. Change observed was towards having students attitudes of apprehension towards the author, aim of the test and nature of study. Quantitatively it probably resulted in having reduced number of students per test session. Considering other groups, this group showed far better approach to the test and the administration procedure. Despite the above negativeizing points; per test session was attended by the largest average number of students compared with other group of students.

2. The sample is representative of the engineering students of the University. Differential diagnostic profile can be based on the basis of the available data as far as engineering versus the other groups are concerned. Inter engineering subgroup profiles are neither stipulated to be derived nor can they be, because in each sub-group the number of sample is too small to yield relatively stable results.
Sample as a whole is random and representative of engineering students.

3. The age and sex scores in the group cannot be derived. There are no girls in the group. The differences based on age may be very unstable as they will be based on few cases. It can be concluded that they represent the brightest young sample of the University students. They are all full time students with the additional requirement that most of them live in hostels.

4. It is a highly pre-selected and stratified sample. Data indicates that the stratification is based upon the achievement scores of the students at high school and intermediate levels. They are all physical science background students and show themselves as an altogether different group as compared to other student groups with regard to their order of achievement and talent. Further study of intensive longitudinal type is recommended for finding developmental picture of various meaningful abilities and aptitudes in this professional area of study.

5. Level of competition is felt very high and tough. General nature of problem amongst these students are, the feeling of inadequacy resulting from lowered achievement in relation to other same level achievement and talent. They show more insight into intellectual tests and their meaning.
6. There is a significant conglomeration of clerical matching, mechanical matching and computational ability existing in the scores of this group. This trio of special abilities, its matrices and correspondence with each other force the conclusion that these three types of special abilities go together on one hand in this group. It can be concluded that clerical perception is part of the aptitude structure of the group with which probably the academic achievement is highly related, if not as a primary, at least as important secondary aptitude.

7. It has to be concluded that three dimensional perception test is another one of the test variables which will form the part of the aptitude profile of this group. Further, in case of this test, the level of scores achieved is also to be noticed for the purpose of individual diagnostic weight. It follows that this test together with other two tests of two dimensional perception may probably make differential diagnosis more accurate and relevant. It is concluded that three dimensional visualisation is one of the strongest variables which differentiates this group from other groups.

8. Verbal reasoning and arithmetical reasoning are nearer together than verbal reasoning and other test scores are. It does not show relevance with other examinations or test scores except the last final examination. The achieved
level of this group on this test cannot be denied. The fact that last final examination is followed immediately by the final has to be considered. It is concluded that this test has to be included in the profile of this group.

9. The two dimensional perception tests may by themselves show relevance, but of only ordinary degree. Taken alone they may not be considered for inclusion in the aptitude profile of the group, but for detailed diagnosis they may carry weight. Specially test 7 attains indicative high degree of relationship. They can be good supplementary indicators specially when taken together with the scores on the three dimensional perception test. They can act as indicators of facility in lab. work.

10. Arithmetical reasoning and numerical computation test, together show high correspondence. For this group, the test can not be omitted as part of the profile. Numerical work, further, show that it is an essential part of all kinds of work in which literacy is required.

11. High School does not show the same meaningfulness in this group as it does in the criteria and medical groups. It has to be concluded that, at this level of achievement, the score which represents the achievement is not very stable. There are all the possibilities that later examinations and these scores of the same sample tend to cancel
and compensate the previous marks which results in showing those marks as unstable. It has to be concluded that high school achievement is also part of the profile but of the same value as any other. No special weight can be given to these marks in this group.

12. Intermediate examination marks in this group show the same trend of relevance with later examination as high school. It seems that slight differences in the motivational level in this group can change the relative position of a student in this group which can affect the variance resulting in low correlation. The level of achievement of this group at this examination cannot be ignored specially when it is considered that it is the terminal stage for this group from the point of view of general education, after which specialized engineering courses are started after due choice. It is concluded that certain consideration has to be given to achievement in this examination, but not necessarily to total consideration.

13. The two engineering college examinations considered here distinctly show that they are probably as different from the usual early academic achievement examinations as they are with the SAT. In some instances test correlations are higher than correlations between these and earlier examination. It has to be concluded that within the two of these examinations, they are nearer together in correspondence than any
other variable used in the study of this group. The level of achievement is lowered at each successive step and it is brought down to a level where the significance of percentage of marks lose their comparable meaning as related to other equal level of percentage of marks obtained by other groups. Percentage of marks become useless as measures of ability, achievement and potentiality related with such marks of other groups. It has to be concluded that they may be relevant for some amount of predictive value only in engineering group.

14. The conclusion is forced that the engineering training and examinations are not to be considered to have a large number of elements common with High School, Intermediate examinations. The criteria of selection of this group which is heavily weighted by the above two measures seems to be rather arbitrary because the relevance of these measures keeps progressively getting lost as engineering examinations follow.

15. The most conclusive statement may be made, that the engineering student group is the highest achievement group in most respects on most test and examination scores. They are highly competitive, enthusiastic, co-operative, examination oriented and in general test sophisticated. Generally, a student who is better than the 25 percent of the student sample on most of the variables used in this study can be guided to choose this training with high assurance of success.
The Physical Science teaching at the postgraduate level is done at four centres affiliated to the Gujarat University. It covers the studies in Physics, Chemistry, Botany, Zoology, Ecology, Microbiology, Mathematics and Statistics. The prerequisite required for these studies generally is a graduate science degree of a recognized University. There are some courses listed here in which a strictly biological science graduate degree will be required for getting admission, e.g. Botany, Zoology, Microbiology. From the point of view of this study, a physical science student is considered to be one who has Mathematics, Physics, Chemistry training at the undergraduate level. Other science students shall be categorized in other categories.

The recent changes in the University structure has resulted in locating all the postgraduate areas of study of this group at Ahmedabad essentially, but other Colleges found equipped with the minimum required physical teaching in various specialized postgraduate study areas in physical science are allowed to have these areas of study.

The duration of continued study for a postgraduate degree in one of the physical science departments is six years after High School. The set up is parallel to the arts and social science and such other courses. Admission to these
courses is only restricted to the number of seats available at various centres. There is a representation of most levels and calibre of students admitted in science courses.

In the preliminary study these areas were represented. The author had some experience of the group and naturally was careful about making earlier contacts. It should be pointed out that the samples within this broad group are located at various places in the city and are under the general administration of different people. Several people had to be contacted for the purpose of getting the permission to contact the students. The reception of the study and author was different at different places. It should be pointed out that some of these institutions and schools had been started at the University campus only during the course of the year previous to the starting of the field work for this study. Mathematics, Physics and a branch of Chemistry had been started in this fashion. First admissions for Botany were started in the session of 1960-61 and there were no students appearing for the examination of that year in the final of the M.Sc. class. It was observed that the co-operation at the administration level of the schools located at the campus was easier and quicker to get than from people located at the colleges.

The system of examination in Physical Sciences does not differ from other arts courses except in
that they award first class to a student when he achieves 65% marks in the total, instead of the customary 60%.

Pass class is achieved above 40% and second class above 50%. There are eight papers in all and most papers have some laboratory experimentation as part of the requirement of the course.

**DATA COLLECTION AND ANALYSIS:**

The data of this group does not differ from other groups under study. Part of the data had been collected at the time of the preliminary study. The students who did not appear for their final examination the earlier year and appeared the next year, for which all the data was available, have been added to the sample. The method of testing does not differ from any other group only places do. As already pointed out the cooperation of the students, can be rated as 'better than average'. The change observable between the engineering and these students on the basis of motivation for testing, it should be pointed out that these students showed a decidedly lowered motivation. In fact in this regard, these students do not seem to differ from any average arts students. The level of tension, will to do the task, will to show fight and competition, was generally not observable as it was in the brighter counterparts - the engineering students.

The sample of 72 students covered in the
study is comprised of 10 Physics, 12 Mathematics, 12 Organic Chemistry, 20 Inorganic Chemistry, 18 Statistics students. There were 33, 46, 119 and 21 registered for the courses respectively out of which 100 appeared for the examination. A total of 72 students were tested for which data has been treated. It can be seen that the sample covered is about 33% of the total registered for these courses. The University record shows 29 students taking drop after registration and a total pass percentage of 72.5. In the sample covered for the study, record of 55 students’ marks obtained at 4.00. has been available. The total drop outs is 17 out of 72. There is a slightly higher proportion of drop outs in the test sample than in the total University sample. There are 6 failures out of 55 whose examination record has been available, showing a slightly higher proportion of Passes in the test sample.

Two points can be made with regard to the sampling in this group. All qualities - drop outs, failures, pass, second and first class students have been covered. The number of sample is adequate though not ideal for statistically significant analyses. Secondly, the group has become heterogeneous, in so far as it covers at least four different courses of study in Physical Sciences. It can be mentioned that there are curricular differences and also the actual operations of study in the courses differ from each
other. Preliminary study had indicated that the statistics group differs from the Physical Science group rather appreciatively in several aptitudes. That group has been included in the present sample as part of this pooled group. Also, it can be seen that the levels of various types of operations involving vocabulary, numerical ability, perceptual ability, differ from course to course within this major area of study. It has to be accepted that contamination resulting in suppression of variance will result which may yield insignificant looking quantitative proforma for the group.

The samples from each area of study were covered separately. The number of testing sessions needed for covering the 72 students representing four major areas of post-graduate study in Physical Sciences was 6. An average of 12 per session was achieved, which comparably is quite high and satisfactory.

The method of data analysis does not change either. Descriptive statistics relevant to normative research have been used here. Sex groups have not been isolated for the reason that very few girls have been represented in this group. Age groups also have not been separated because any such control will not yield any meaningful general result contrary or different from the over all age trend typical of total student sample. Quite a few respondents in the sample show a record of part time present employment
or past employment. The number is too small and therefore the analysis of the structure of these people's aptitude structure has been left for later discussion where it is intended to see how the part time employed differ from the whole time students as a whole. Separate specialised study group by themselves are too small to yield any stable and significant motives for the purpose of differential analysis. It cannot be denied that the present mixing of the group seems rather unmethodical, specially when differences in training, content methods and specialities are considered.

RESULT:

1. Inspection of data sheet shows that it took 6 testing sessions to cover approximately 60 respondents in this group. As an indirect measure of test sophistication, self confidence in volunteering for co-operation in doing intellectual tasks, it may be said that the group is just about average in these respects. Their motivational, attitudinal levels are also about average.

2. Informal discussion with the teachers' in charge brought the point about the selection of students. It seems that some tacit standards based upon the record of past achievement in Physical Science courses and certain type of 'impression' made by the students on the admitting teacher becomes the basis of selection in these sections of
Physical sciences. Personal acquaintance, an average or marginal average record seems to be the sole criteria of getting admitted in the course.

6. Age and sex variables have not been made basis of analysis for the reason that the groups will be too small to yield any stable matrices. However the range of age is quite large. From 19 years 6 months to 27 years 6 months is the age range in the group. It also shows that the group consists of students who should be at the peak of their ability levels as well as at highest efficiency.

5. The group has a Mean score of 40.35 with S.E.M. 1.2 and S.D. of 10.1 on test 1. There is a difference of about 2.5 raw score points between this group and the criteria group which is higher on this test score. The size of S.E.M. indicates that there is no significant difference between this group Mean and total student sample Mean, while as there is a suggestion that the criteria group Mean may be significantly different than that of this group. Of the science background groups, it is the lowest Mean score achieved on this test. The distribution is slightly positively skewed and has slight Kurtosis. The average of correlations is .27. Higher than average correlations exist between this test and tests 2, 4, 5, 6, 7. Nearly neutral correlations are achieved between this test and test 3, R.S., Int., Grad., and post-graduate examination marks. Correlation
with .30, makes it low negative. The correlations above .23 and .30 are significant at .05 and .01 for this size of sample. One peculiarity of this group in this respect should be noted that all correlations which are above average are also significant at .01. Others are neutral or very low. All academic examinations do not correlate with the test at all. All the tests of the battery except test 3 have high correlations with this test scores for this sample.

6. The distribution of scores of the sample on test 2 is near normal. The mean score of the sample is 23.0, S.E.M. is .55 and S.D. is 4.65. Mean score and the S.D. do not seem to be significantly different from those of the total student sample. Compared with the criteria group the mean of this sample is lower probably significantly while as the S.E.M. and S.D. are only very slightly different. There is a slight tendency towards leptokurtic distribution.

The average of correlations for test 2 is .195. It is not significant at any accepted levels of significance. The correlation between test 2 and tests 1, 4, 6 are significant. Other correlations are in some cases higher than average but not significant. Neutral correlations exist between the test and examination marks at all levels and test 3. It should be pointed out that significantly high positive correlations between test 2, 4 and 6 seem to indicate that the general ability manifested in these two tests is contributed by the scores on this test also. It
will be expected that high relationship exists between numerical computational test and arithmetical reasoning test but the fact that test is also shows close high positive relation has to be discussed further. Normally it would be expected in this sample that numerical aptitude and the ability to do quick computations will have some relation with some of the academic examination achievement. It does not seem to be true of the present sample. Also it does not show any peculiarity in the distribution to point out that computational ability is in any way a special factor for the present sample compared with any of the others discussed so far.

7. Physical Sciences training partly consists of doing work with laboratory devices and also to manipulate and at times correct some of the laboratory instruments. It will seen a differential development of the three dimensional perception of higher order. The engineering group showed this in terms of the achievement of a mean score of 17.61 compared with the criteria group mean of 12.3. The mean score of this sample is 12.99 with a S.D. of .6 and 2.5. 5.1. This mean is slightly higher than the total students' sample mean score but is not significantly different. However, there are other indications to show that three dimensional perception is a meaningful ability for academic achievement of this group.
The average of correlations for this test 3 is .176. It is not near the level of significance. Correlations with tests 4, 5, 6, 7 are all significant at one of the accepted levels of significance. Above than average correlations are achieved with test 7 and Inter examination marks. Neutral and near neutral relationship has been achieved with Graduate, Post-graduate and arithmetical, numerical tests.

There is very high correlation with test 4 suggestive of the general ability related with three dimensional space perception and verbal aptitude. High correlations with High school and Intermediate marks suggests that academic achievement in the formative stages of this group had a meaningful relation with three dimensional visualization. It is possible that the correlations achieved with graduate and post-graduate marks have been contaminated by the mixing of several differently trained group who do not necessarily have sameness of the magnitudes of general and special abilities.

3. The Mean of the sample on test 4 is 13.49, S.E.m. 6.68 and S.D. 5.79. The score of this sample does not seem to be significantly different from any of the student groups discussed so far. It is certainly very much lower than the Mean of the criteria group and seems to be nearest to the Pharmacy group. It is expected that English vocabulary is not necessarily a strong point for this sample.
The average of correlations achieved between the test and other tests is .30 which is significant at .01. With the exception of correlations achieved between this and Graduate, Post-graduate marks all other intercorrelations of the test are significant at .05. Above than average correlations are achieved between this test and tests 1, 3, 6, 7 and Int. There are at least three notable points. The correlations with test 3 and 6 for this sample with this test show the expected higher degree. No other test has the same type of intercorrelations. Further inspection shows that the relationship of test 4 with tests 1, and 2 is high but not as high as the relationship with tests 5 and 7. The test seems to be the common factor which seems to underlie all the aptitudes of this sample. The examination marks at High School and Intermediate levels show significant correlations with this test. It will be later shown that at later levels there are hardly any test and examination scores which show any meaningful relationship for predictive purposes.

9. It will be expected for this sample that they do better on the test 5 which is tool matching because of their laboratory background and training. The Mean score of the sample on this test is 25.67 with a S.D. .56 and S.E. .4.92. Mean score is slightly but insignificantly higher than that of criteria group and about equal to the total students group. It seems significantly lower than the Medical
The average of correlations for the test is .26. Above average correlations are achieved between this test and tests 1, 3, 4, 6, 7. Higher correlations shall be expected between this and tests 3 and 7 which are .277 and .555 respectively. The fact that significantly high correlations are achieved between this and test 1 and 6, needs further explanation. There seems to be numerical reasoning also positively related with tool matching or elemental two dimensional perception. The test has negatively neutral and neutral correlations with all the academic achievement examinations. It is possible that elemental matching as represented in this test is one of those functions which exists in this type of sample but meaningful only to the performance in laboratory.

10. The mean of the sample on test 6 is 11.6, S.D. 3.55 and S.E. 2.94. It will be expected in all these physical sciences that numerical reasoning is most practiced function, but contrary to this fact it is observed that the mean and the engineering groups. It is not too significantly different from the mean scores of other similar background groups. It is a leptokurtic distribution on this test.

The average of inter-correlations of tests with this test is .28 which is significant.
at .05. Higher than average correlations are achieved between this test and tests 1, 2, 4, 5, 7, 8, 9, and Int. Nearly neutral correlations exist with test 3, graduate and post-graduate examination marks. There are some interesting features of these. It can be expected that the two 6 loaded tests correlate high also that two numerical computational tests correlate high. However, it will need further discussion that the third 6 loaded test 3 does not show any of the above while as the two dimensional perception tests 5 and 7 show high correlations with arithmetical reasoning test. Probably the convention that numerical and two dimensional perceptual aptitude go together in this sample, even though the two do not seem to be related with academic achievement in the graduate and post-graduate stages especially, seem to be borne out by these inter-correlations.

Correlations with academic achievement examinations gradually decline as the level of examinations goes towards progressive specialization.

11. Test 7 is one of the two tests which go to make the two dimensional perception aptitude in the battery. The mean of the sample on this test is 22.25, S.E.M. .66 and .87 in 5.56. The mean is higher than that of the total students group and about equal to that of criteria group. The test measures the finer perceptual discrimination for forms and is meaningful for mechanical finer operations. It will be expected in the sample that the mean score is higher.
The average of the inter-correlations of the test with others is .245. Higher than average correlations are achieved between this test and tests 1, 4, 5, 6. Correlations with academic examination marks are entirely neutral sometimes slightly negative and neutral. Higher correlation with test 4 and 6, the tests which are very different in factorial loadings need further discussion. There is a possibility that this sample develops aptitudes in all the three directions i.e. verbal, numerical and perceptual. Perceptual aptitude seems to be the common ground from which the other two become operative. It can be visualized that academic learning is generally based upon the two dimensional percepts which are to be studied through English language and treated numerically. It seems that this factor has little commonality with examination marks at any level. It seems that examinations are examining only the memory and reproductive capacity for these percepts. It is not the same as examining the ability to learn the percepts through spoken and written word or seeing the students treat these percepts in numerical reasoning form and content.

12. High School examination for this group seems having a predominantly general science course. The Mean of the percentage of marks gained at High School is 60.5, S.Dm. 1.15 and S.E. is 9.35, Compared with the Mean of the same examination marks, this Mean is higher than the criteria group mean score and the Pharmacy students' mean score. In this
case it should be noted that the differences of the
means are significant. The average of the inter-
correlations of the examination marks with other
tests and examinations is .312. Higher than average
correlations are achieved with test 3, 4, 6 and
Intermediate. It should be noted that for this sample
there are other important special aptitudes but at
the High School level the three most significantly
related tests are the same as those having loadings
of factor 6. It is interesting to note that the
correlations with special aptitude test scores are
neutral or negative while as with Post-graduate and
Graduate examination marks, they are slight but
positive. It seems rather contrary to expectations
that High School examination marks though on the
average very high in terms of percentages are not
very meaningful for predictive purposes. It is known
that longer the time for which prediction is made
less accurate the prediction is likely to be. There
are 30 students in first class, 35 in second class and
only 7 in the third class. This distribution also
gives hints about the early higher order of training
in this group but suddenly the drop in average performance
becomes sharply noted in this group.

13. The mean of the percentage of marks at
the Intermediate examination for this sample is
51.5%, S.E. 8 and S.E. is .35. There is a drop
of at least 8 percent points compared with the
percentage of marks gained at High School. Compared
with the criteria group in this respect, it is very significant that both the trend and the magnitude is maintained by this group and none other. On the other hand there is another fact to be noted. All the other professional groups like medical, engineering and pharmacy show that though the trend of lowered Intermediate marks after High School is present yet the drop is never more than 4 percent points in any group. It may be one of the most significant points noted about the difference between the academic type of training and the professional type that the students in whatever division trend to maintain their relative position at most levels of examinations. They do not suddenly seem to go down with the levels and time and type of training as it seems to happen with non-professional students.

The average of inter-correlations for the Intermediate examination marks with other tests and examination marks is .253 which is significant at .05. The correlations with High School, Graduate and Post-graduate examination marks are all significantly high though they keep progressively lowering themselves. The examination seems to be the connecting link between all the examinations. On the other hand, it is nearer to High School than any other examination as far as the test variables are concerned. The correlations with test 3, 4 and 6 are just a bit lower than those achieved for High School examination marks and these tests. It should
be pointed out that High School, Intermediate and general ability factors go closer together in this sample than any other combinations. The distribution changes radically. There are 7 in first class, 40 in second class and 25 in the third class. It should be further noted that Intermediate examination is usually taken by students during the stressful period of adolescence.

14. The mean of the percentage of marks at the graduate examination is 53.25 with S.E.M. 93 and S.S. 7.95. With the exception of the criteria group mean score at the corresponding examination the mean percentage is lower than of any of the Science group students. There are 13 in third class, 41 in second class and 12 in the first class.

The average of the inter-correlations achieved between other test and examination scores and scores of this examination is .17. The correlations with inter and Post-graduate examinations are the only two which are above average, and also significant at .01. There is no particular test variable which seems to have any meaningful relationship with this examination marks. Only predictive value achieved is by the Intermediate examination, until which it can not be said on the basis of the exploration of the present variables that achievement at graduate physical science level can be predicted or even shown to have significant commonality with.
It seems indicated that probably it will be wrong to say that no special or general aptitudes seem to be related with this examination marks, but that the group as it is made in the present sample is much too diverse to yield any particular common or general factor. It is possible that Mathematics, Physics, Chemistry, Statistics are too far apart from each other to form any general graduate training even though at this level there may be some minor general course imparted to those various optional subjects.

15. Mean score of the present sample at the post-graduate examination is 51.1 in terms of percentage of marks. The N has changed from 72 to 55. Seventeen results were not available either because the student did not appear for the examination after finishing the course or just did not present themselves during the days of the examinations. The S.D. is 1.5 and 5.0. It is interesting to note that in this group the S.D. is very large compared with those of the criteria group and other professional groups. It may be important pointing out the trend of scores in this academic group and professional groups. It should be pointed out that in no other group such a large S.D. has been achieved. It is twice as large as any other for the corresponding examinations of other groups. Drop outs at the examination in order to avoid a lower percentage of marks at this level of marks can be guessed to be the main reason for
for each drop outs. The mean score does not seem to be significantly different from that of the criteria group.

The average of the inter-correlations achieved between the percentage of marks of this examination and other tests and examinations is .459. Neutral correlations are achieved between this examination and test 1, 2, 3, 4, 5, 6, 7. High School, Intermediate and Graduate examinations have significantly higher positive correlations. Once again further discussion is necessary to account for such a situation. There is another factor to be noted that at the post-graduate level, the subgroups within this broad category of Physical Sciences differ significantly from each other. Also the content of curriculum, methods and operations differ from course to course in these groups.

DISCUSSION:

1. It is obvious that general science is taught at High School level which contains of introducing physical and biological science content to the student at that level. At the Intermediate Science level there is a major change. The option to choose either the Physical Science course or Science biology course is made available. To the best of information available, there is no psychodiagnostic approach on which the choice is made dependent. There are usually extra considerations which
determine the choice of one or other option. Probably High School examination marks, willingness to try, parental pressure and a general halo around science study are main determinants of this choice. Further, it should be mentioned that the brightest and some of the most highly motivated of the physical science group usually tend to take up engineering training. The left overs seem to be those who started as bright high school students but are aptitudinally too immature or who have kind of over-spent themselves at that level. They seem to stick to the science post-graduate training in various special branches of study. A certain insight into the intellectual limitations takes place among this type of students after the adolescence period is over. It is also too late to go back to any other better suited training of this advanced stage.

2. On the other hand, it has to be seen that Physical Sciences do not have a common general training except at the introductory levels. This training is imparted at levels from where progressive selection and specialized training become more acute. The differences in the content of courses, methods of teaching, operations of learning are, it seems too wide and naturally analysis in terms of a group becomes limited and suffers from all kinds of suppressor effects. Moreover, the total sample barely makes acceptable total. The Physical distribution of the students in all the post-graduate science Colleges
in the state, make it very difficult to arrive at some clear cut general conclusions. We can't say that the sample does not represent the total population of students in these areas of study, but it should be stated that the sample is just barely large enough to pass the minimum acceptable total.

3. The range and order of correlations has shown the existence of some peculiarities. There is no contextual similarity between this test and tests 5 & 7. It may be suggested that high correlation can be due to the 'ability to match elements' as already suggested for the medical group. There could not be any function except this one with which students acquire ability to copy or match. Another interesting point that can be made is the middle order correlations of this test with the two general ability, verbal and arithmetical reasoning tests 4 and 6. There does not seem to be any pattern which fits this combination. It seems that the essential relationship could be that no one hand the sample indulges in numerical operations while as essential learning takes place through vocabulary and mainly note copying, in which process the clerical and two dimensional perceptual specialities become co-adjacent with each other and general ability manifests itself through verbal and arithmetical reasoning.
4. Arithmetical computational ability surprisingly does not acquire the magnitude, it could be expected to, in this sample. It can be suggested that numerical work and vocabulary go along each other as part of the learning of this group. It goes with clerical perception also, which suggests that a small pattern, probably a secondary one exists in which $4,1$ are predominant, but are not too influential.

5. Average ability for three dimensional perception is manifested by this group. The results indicate that it has little relation with the clerical and numerical aptitudes in this sample. One important fact is clear that this is a pertinent test at least as far as general and spatial perceptual abilities are indicated to be related with two of the academic examination marks. There is a suggestion that though the magnitude of this ability may be not so high, yet it has its independent relationship with academic achievement in this area. Probably, these students essentially use this type of aptitude in understanding quite a bit of their laboratory and class work. Another important point to be noted here is that within the structure of general ability in this group, this aptitude is nearer to verbal ability than it is arithmetical reasoning.

6. Verbal reasoning score of this group is also near to the average of the total student sample
and can be said to be a bit different than what would be expected from a Physical Sciences group. Importantly still, is the fact that the correlations of the test with others and also the examination marks are all significant at the .05 level. It can be suggested that probably it is not the simple factor of verbal reasoning but also the general ability loaded in this test which can account for such high correlations. It is suggested that verbal reasoning is the common general factor with which arithmetical reasoning and three-dimensional space perception combine in that order to form the total general ability, which seem to be connected with clerical perception on the one hand and two dimensional perception on the other.

It is clear here that independently none of the special abilities make any numbing in forming the aptitude structures because their magnitude is not too striking but they go very closely with verbal reasoning and other tests of academic achievement.

7. Test 5, contributes to the final score on two dimensional perceptual ability. Once again the score of this group only suggests mediocre level of attainment contrary to expectations. Like the clerical perception, the test shows high intercorrelations with the tests of the battery. Most notable unexpected relationship is obtained with test 1, the clerical perception test. The test has significant correlations with the tests which are loaded with G factor and within these highest r
is obtained with the cost of arithmetical reasoning. It may be suggested that part of general ability in this group manifests in at least abetting the two-dimensional element matching ability. It should be further indicated that more two-dimensional perceptual ability is expected to be desirable than clerical perceptual.

3. It seems that this arithmetical type of reasoning in this group does develop even as part of every day routine work but at average level. The test shows its meaningful relationship with two of the early academic examinations and to a slight extent with the graduate examination also. It suggests itself that numerical ability and arithmetical reasoning is the nucleus of the aptitude structure of this group. With the exception of the three dimensional perception, most correlations are higher and distributed over a large number of variables, larger number than test 4 or test 1. It seems that in an average group like the present one, arithmetical reasoning probably will be one of the decisive diagnostic factors in differentiating the verbal or arts from the science, but the level will be not a good criteria. It is possible that these students' so to say 'do not mind' numerical work while as arts students want to 'stay away' from this type of work. It will be easy to see that though the average or inter-correlations is next higher but the magnitude's of these and the larger number of the variables showing positive
correlations tend to point out that arithmetical reasoning is the one essential common link between the scores of this sample.

9. Test 7 is the second component of two-dimensional space perception ability. The test is multiple choice in which matching of forms from a large number of these is the main task. Surprisingly the test score does not have a significant correlation with test 3 score, but has very high correlation with verbal ability, clerical perception, tool matching and arithmetical reasoning tests. It is possible that the task confronted in the test is an entirely novel, and its form is unexpected. It looks as if general ability is again the factor with which the two dimensional perception discrimination aspect is most related with. The fact that it does not get related with academic achievement does not seem to be accounted for by the data available in its present form.

10. High school examination marks show that about no less than two thirds of this group should be able to achieve professional jobs if this examination is the criteria. Also they are better than at least one professional group in this respect, i.e. the Pharmacy. Also on the other hand quite a large number of them say not be admitted to this course.
High School marks of this group show two distinct trends. It can be seen that High School marks indicate general ability or nearest to it. High School marks progressively lose efficiency for prediction for later examinations. It has to be understood that probably higher marks at High School level are the chief inducers of carrying studies to higher levels in this group. Probably they are interpreted as indicators of academic potentiality and later examination marks never achieve or are analysed with the same optimism. The fact that High School examination marks lose efficiency of prediction is not too exceptional but when it is accompanied with the major fact that there is a drop of approximately one standard deviation or about eight percent points in this sample in the next higher examination, it becomes clear that probably high school marks were the result of most overstretched book learning in the group. English vocabulary, arithmetical reasoning and spatial perceptual ability probably were the decisive factors in obtaining the marks at High School level as different from other groups.

11. Intermediate Science result, as has been already seen is characterised by mediocre achievement compared with the general student population. It seems that the bunch of students who are able to weather this storm and show consistently high achievement usually manage to get into the related
professional course, the left over, for one or the other reason choose the higher studios with one of the specialisation. The student takes the easiest or probably the most interesting or parent advised special optional paper. The three tests of general ability are shown to be meaningful to a degree with achievement score at this level. Again, English verbal reasoning and arithmetical reasoning are found to be more predominantly related than the spatial three dimensional perception and its aspects of general ability. It could be guessed that the main difference between engineering and Physical Science students is this ability of the latter students to visualise perceptual details in terms of three dimensional space to a lower degree than the former. It will not be too wrong to say that lecture system in science courses at Intermediate Science level leads to lesser development of the ability for three dimensional space visualization and turns students to more bookish, verbal, clerical type of learning. The examination marks at Intermediate Science show no relationship with any of the special ability test scores. In relation to the higher examinations, like all tests of general ability it shows higher correspondence with immediately earlier and later examinations than the latest post-graduate examination.

12. The graduate examination of this group shows no particular outstanding relationships of any kind with any of the test variables. It shows
higher mean score of achievement compared with the criteria group at the corresponding level. It should be understood that science is offered as a course of study at various colleges and not in all. There is a certain heterogeneity in many respects contributed partly by examination evaluation method and procedure and partly by the colleges. There is more heterogeneity at this level. It will have to be suggested that too many independent elements in the form of the type of optional courses, type of college of study, place, internal and external examination, are all factors which make this examination as an independent looking, unrelated examination.

13. Postgraduate examination marks are based upon a lowered number from the sample covered. Only significant correlations achieved are with intermediate and graduate marks. Within the structure of examination marks and the test scores, this examination certainly represents a very varied type of examination, content, training, procedure and method of study, teaching, motivation etc. Also it is not known as to what makes the basis of selection of subjects at this level of study. Probably the graduate examination marks are the main basis of such decision. There can be other personal reasons like availability of part-time job in the institution or fees exemption or a teacher to persuade the student. The mistake of combining marks so gained to treat as representing each other or
belonging to the same type of percentage in all courses is brought here when the total group does not show any appreciable relationship of marks with any of the test scores. It will have to be suggested that sub-group differences should be determined to arrive at any indicative scores which show any valid meaning. Test of English vocabulary is one of the indicated tests which may have some meaning otherwise there is nothing notable.

CONCLUSIONS:

1. The number of the sample in this group is barely adequate to arrive at relatively stable statistical results. In the case of some of the sub-groups, it should be concluded that some increment would be required to make the sample representative.

2. Qualitatively, all types of students belonging to the group are represented. There are dropouts, fails, passes, second and first class. They are not proportional to the University records for these various categories.

3. The results suggest to conclude that such a variety of training as represented here should not be grouped together even though earlier background of these students may have been the same. Physical Science is a misused term. As it seems, there are indications that the students go through a very large variety of different educational experiences probably of a nature which acts as suppressors of variance in
many respects. There does not seem to be anything in common between Physics, Chemistry, Mathematics and Statistics. They differ in content, code of examination, calibre of students choosing these and type of teaching done in all of them. They are different from each other even at the graduate level, about as different as any of the major groups.

4. The rating of attitudes and motives can be stated that the students as a whole are just about average. They are indifferent, co-operative if reached through authority, certainly less competitive than professional area students.

5. The clerical perception in the sample is not an asset, neither it has any meaning to the academic achievement examination marks. Though it shows some highly unconventional relationships within the test battery sub-tests. It seems reasonable to conclude that in this sample, the ability to see elements of both linguistic and physical two dimensional structures is apparent. It seems as if it is one secondary ability which is used by this sample for purposes of comparing, matching and differentiating. The function of the ability is to readily help in copying, matching the elemental aspects of structures.

6. Contrary to all general expectations numerical computational ability is neither outstanding nor meaningful for the Physical Sciences. Surprisingly computational and verbal reasoning seem to be related
abilities in this sample. It can be concluded that verbal reasoning contributes to a certain amount of learning of numerical type in this group. It is not numerical work but the verbally expressed, written numerical context which is confronted for learning as content.

7. Three dimensional space perception is an independent aptitude which has relation with at least early achievement in Physical sciences training. It shall be concluded that it is one of the essential aspects of ability structure of this group, but its dimension and magnitude is not too impressive. It will need to be supplemented with other tests to form aptitude structure of these areas. Probably Physics and Mathematics areas may be isolated on the basis of three dimensional perceptual ability from other related groups.

8. Once again, contrary to popular expectations English vocabulary and verbal reasoning has wider-spread meaningful relationship with other test and examination variables than other aptitudes. Mediocre magnitude is again the hurdle to make it a differentially diagnostic variable. Also, it should be concluded that it is one of the primary intellectual functions through which this sample receives and expresses the learnings of various aspects of Physical Science training. In other words, we conclude that academic achievement is frontally related with verbal reasoning. Verbal reasoning in its place has three dimensional and two
dimensional and clerical perception on one side, so attached with arithmetical reasoning that they keep three dimensional perceptual variance separate from it, but attach it to English verbal reasoning as part of general ability.

9. The dimensional perception is again rather unexpectedly found entirely unrelated to academic achievement at any level. It is concluded that this ability is probably secondary ability, an important one. Probably they are more meaningful for the structure of aptitudes in this sample than the clerical perception is.

10. Like the verbal reasoning, arithmetical reasoning shows to have wider positive relationship with academic achievement scores and other test variables. It is also one of essential parts of abilities of this group. It should be seen that again the sample does not show any outstanding mean score which makes it difficult to be used for differentiating students.

11. High School and Intermediate examinations are the two academic examinations which have closest relationship with tests of general ability in this battery. On the other hand it should be noted that
despite a fall of about eight percentage points on
the mean, the inter-relationship between these two
is still very high. Further, it can be hinted that
misdirected choice of course at one of these levels
leads to the rather disappointing after effects
presented in the form of average achievement of
Physical Sciences group. Lack of meaningfulness of
these examinations to the later examination results
is again rather a disconcerting phenomenon.

It shall have to be concluded that these
early examination results are hardly the factors to
influence or predict later performance and results
at post-graduate level. In this group, it is possible
that too many contaminating factors are operating
hindering clear cut results.

12. Graduate and post-graduate marks do not
show any correspondence with any of the aptitude
test scores. They do have highly reliable correspondence
with each other. It should be concluded that those
examinations test other variables than those included
in the battery. Also considering that achievement
level at high school compared with one at these
examinations is probably what decides the students
to pursue this level of study it shows unadjustment.
When there is no correspondence between these examination
achievement scores and the earlier ones, it should be
pointed out that there is certainly cause to believe
that this group is having the most profit, misguided,
unadjusted students amongst the lot who start with
High School science course. A better co-ordination and selection seems to be the recommended course of action for these students and these courses.

13. The study area structure based on aptitudes will be OMISP in this order. The levels of these will have to be further cut off by considering other groups. It can be hinted that the group shows itself to be the middle most of the total student sample on the basis of aptitude scores.

14. It has to be concluded that the graduate and post-graduate examinations are too unpredictable. They are unpredictable because probably they are too unstandardized despite the University regulations. They are too unstandardized also probably because the internal examinations for laboratory work is not too co-ordinated with the external theory examinations.

15. The sex differences in this group have little validity. It can be concluded that only a very few, negligible number of girls take physical science courses.