CHAPTER - VII

ANALYSIS AND DISCUSSION OF RESULTS
Details of analysis of data have been given in this chapter, with a view to test various hypotheses mentioned earlier in Chapter III, and arriving at meaningful conclusions and generalization. Various types of analysis followed by their discussion have been given in four sections. Section one deals with the nature of correlation of the variable of achievement in Biology with each of the measure of intelligence, SES, sixteen measures of personality, three measures of creativity and total creativity; Section Two deals with the results of factor analysis and rotation of factors involving twenty-three variables; Section Three deals with the discussion of results of step-up regression equations set up on the basis of those variables which were either found significantly related with in product moment correlation or clustered together with the criterion variable of achievement in Biology in factor analysis. In Section Four, technique of t-ratio was employed to find out the significant of differences between means of different groups of socio-psychological variables under study.
This section deals with the description and discussion of correlation of each of the twenty three independent variables namely, one measure of intelligence, one measure of SES, sixteen measures of personality, three measures of creativity and total creativity with the criterion variable of achievement in Biology.

Pearson's Product Moment Correlation were worked out between the variable of intelligence, SES, measures of personality and creativity taken one at a time on the one hand and achievement in Biology on the other in order to test the following hypotheses:

1(a) Intelligence of urban senior secondary students correlates significantly with the achievement of the students in Biology.

1(b) Intelligence of rural senior secondary students correlates significantly with the achievement of the students in Biology.

1(c) Intelligence of urban and rural senior secondary students correlates differentially with the achievement in Biology.
2(a) SES of urban senior secondary students correlates significantly with the achievement of the students in Biology.

2(b) SES of rural senior secondary students correlates significantly with the achievement of the students in Biology.

2(c) SES of urban and rural senior secondary students correlates differentially with the achievement in Biology.

3(a) Creativity of urban senior secondary students correlates significantly with the achievement of the students in Biology.

3(b) Creativity of rural senior secondary students correlates significantly with the achievement of students in Biology.

3(c) Creativity of urban and rural senior secondary students correlates differentially with the achievement in Biology.

4(a) Personality characteristics of urban senior secondary students correlate significantly with the achievement of the students in Biology.

4(b) Personality characteristics of rural senior secondary students correlate significantly with the achievement of the students in Biology.
4(c) Personality characteristics of urban and rural senior secondary students correlate differentially with the achievement in Biology.

The values of coefficient of correlation have been shown in table 7.1 for urban sample and in table 7.2 for rural sample. Only those correlations were considered for discussion which were found significant at least at .05 level.

I ACHIEVEMENT IN BIOLOGY AND INTELLIGENCE:

Variable of intelligence was found to be significantly correlated with the achievement of the urban students in Biology ($r = .387$ vide table 7.1) at .01 level.

Also intelligence emerged significant positively correlated with the achievement of the students in Biology in case of rural sample ($r = .614$, vide table 7.2) at .01 level.

The variable of intelligence has an important implication in teaching learning situation and as it was expected that empirically the variable of intelligence will show its associations in the present study. Accordingly the results of the present study revealed the presence of positive relationship between intelligence and achievement of the senior secondary students in Biology.
The above results are also supported by factor analysis results of the present study in which intelligence constitated itself with the measure of achievement in Biology in original factor III and IV in case of urban as well as rural sample. The interpretation for the significant positive correlation between the variable of intelligence and the achievement in Biology may be due to the nature of group test of general mental ability, which consists of number series.

**TABLE - 7.1**

Showing Coefficient of correlation between dependent variable of achievement in Biology and independent variables (Group I, Urban Sample, N=340).

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Variable Code</th>
<th>Coefficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ach. in Bio.</td>
<td>1.000*</td>
</tr>
<tr>
<td>2.</td>
<td>Intelligence</td>
<td>.387**</td>
</tr>
<tr>
<td>3.</td>
<td>SES</td>
<td>.414**</td>
</tr>
<tr>
<td>4.</td>
<td>Personality Factor A</td>
<td>-.020</td>
</tr>
<tr>
<td>5.</td>
<td>Personality Factor B</td>
<td>.021</td>
</tr>
<tr>
<td>6.</td>
<td>Personality Factor C</td>
<td>-.060</td>
</tr>
<tr>
<td>7.</td>
<td>Personality Factor E</td>
<td>.016</td>
</tr>
<tr>
<td>8.</td>
<td>Personality Factor F</td>
<td>-.104*</td>
</tr>
<tr>
<td>9.</td>
<td>Personality Factor G</td>
<td>.002</td>
</tr>
<tr>
<td>10.</td>
<td>Personality Factor H</td>
<td>-.016</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>11. Personality Factor I</td>
<td>-.050</td>
<td></td>
</tr>
<tr>
<td>12. Personality Factor L</td>
<td>-.146**</td>
<td></td>
</tr>
<tr>
<td>13. Personality Factor M</td>
<td>-.015</td>
<td></td>
</tr>
<tr>
<td>14. Personality Factor N</td>
<td>-.61</td>
<td></td>
</tr>
<tr>
<td>15. Personality Factor O</td>
<td>-.051</td>
<td></td>
</tr>
<tr>
<td>16. Personality Factor Q₁</td>
<td>-.018</td>
<td></td>
</tr>
<tr>
<td>17. Personality Factor Q₂</td>
<td>-.066</td>
<td></td>
</tr>
<tr>
<td>18. Personality Factor Q₃</td>
<td>-.099</td>
<td></td>
</tr>
<tr>
<td>19. Personality Factor Q₄</td>
<td>-.031</td>
<td></td>
</tr>
<tr>
<td>20. Fluency (F)</td>
<td>.172**</td>
<td></td>
</tr>
<tr>
<td>21. Flexibility (X)</td>
<td>.163**</td>
<td></td>
</tr>
<tr>
<td>22. Originality (O)</td>
<td>.157**</td>
<td></td>
</tr>
<tr>
<td>23. Total Verbal Creativity (TVC)</td>
<td>.066</td>
<td></td>
</tr>
</tbody>
</table>

Value of $r = .10$ is significant at .05 level.
Value of $r = .13$ is significant at .01 level.
* indicates significant at .05 level.
** indicates significant at .01 level.

**Table - 7.2**

Showing coefficient of correlation between dependent variable of achievement in Biology and independent variables (Group II, Rural sample, N = 160).
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Variable Code</th>
<th>Coefficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ach. in Bio.</td>
<td>1.000*</td>
</tr>
<tr>
<td>2.</td>
<td>Intelligence</td>
<td>.614**</td>
</tr>
<tr>
<td>3.</td>
<td>SES</td>
<td>.483**</td>
</tr>
<tr>
<td>4.</td>
<td>Personality Factor A</td>
<td>-.189*</td>
</tr>
<tr>
<td>5.</td>
<td>Personality Factor B</td>
<td>-.269**</td>
</tr>
<tr>
<td>6.</td>
<td>Personality Factor C</td>
<td>-.122</td>
</tr>
<tr>
<td>7.</td>
<td>Personality Factor E</td>
<td>-.100</td>
</tr>
<tr>
<td>8.</td>
<td>Personality Factor F</td>
<td>-.120</td>
</tr>
<tr>
<td>9.</td>
<td>Personality Factor G</td>
<td>-.265**</td>
</tr>
<tr>
<td>10.</td>
<td>Personality Factor H</td>
<td>.015</td>
</tr>
<tr>
<td>11.</td>
<td>Personality Factor I</td>
<td>-.169*</td>
</tr>
<tr>
<td>12.</td>
<td>Personality Factor L</td>
<td>.085</td>
</tr>
<tr>
<td>13.</td>
<td>Personality Factor M</td>
<td>-.122</td>
</tr>
<tr>
<td>14.</td>
<td>Personality Factor N</td>
<td>-.124</td>
</tr>
<tr>
<td>15.</td>
<td>Personality Factor O</td>
<td>-.122</td>
</tr>
<tr>
<td>16.</td>
<td>Personality Factor Q_1</td>
<td>-.055</td>
</tr>
<tr>
<td>17.</td>
<td>Personality Factor Q_2</td>
<td>.031</td>
</tr>
<tr>
<td>18.</td>
<td>Personality Factor Q_3</td>
<td>.041</td>
</tr>
<tr>
<td>19.</td>
<td>Personality Factor Q_4</td>
<td>-.105</td>
</tr>
<tr>
<td>20.</td>
<td>Fluency F</td>
<td>.243**</td>
</tr>
<tr>
<td>21.</td>
<td>Flexibility X</td>
<td>.192**</td>
</tr>
<tr>
<td>22.</td>
<td>Originality O</td>
<td>.213**</td>
</tr>
<tr>
<td>23.</td>
<td>Total Verbal Creativity TVC</td>
<td>.110</td>
</tr>
</tbody>
</table>
Value of $r = .152$ is significant at .05 level.
Value of $r = .191$ is significant at .01 level.
* indicates significant at .05 level.
** indicates significant at .01 level.

mathematical instructions, vocabulary similar, vocabulary opposite, classification, analogies, best answers and reasoning and the nature of achievement test in Biology which also consists of the items which requires above abilities. Another explanation of significant positive correlation between the variable of intelligence and achievement in Biology may be the similarity of nature of domain and conceptual framework measured by the two tests because in intelligence and biological sciences primarily cognitive ability is required.


In the light of the above results hypothesis 1(a) that intelligence of urban senior secondary students correlates significantly with the achievement of the students in Biology, hypothesis 1(b) that Intelligence of rural senior secondary students correlates significantly with the achievement of the students in Biology and hypothesis 1(c) that Intelligence of urban and rural senior
secondary students correlates differentially with the achievement in Biology were accepted.

II. ACHIEVEMENT IN BIOLOGY AND SOCIO-ECONOMIC STATUS

The variable of SES depicted significant positive correlation (r = .414 vide table 7.1) at .05 level with the achievement of the students in Biology in case of urban sample.

The variable of SES in case of rural sample also showed a significant positive correlation with the achievement of the students in Biology at .01 level (r = .483 vide table 7.2).

The above findings revealed that a person scoring high on SES score will have a high score on achievement test in Biology and vice versa. The reasons for the higher achievement of the high socio-economic group as compared to the students of low socio-economic status may be due to the fact that students of higher socio-economic status have greatest educational opportunities and other physical facilities than the students of low socio-economic status which help them in promoting their achievement in the subject of Biology. In other words the present study showed that lower status in the society, poverty, big family size, less income, inadequate physical facilities, lack of literature etc., which are the aspects
of low socio-economic status prevent the students from taking full advantage of the educational opportunities.

The above results are similar to the results obtained by Burt (1937), Davis (1947), Furneaux (1954), Chopra (1964), Pathak (1972), Mcarthur (1980), Jagannandhan (1986) and Gakhar (1987) in their studies.

Therefore, in the light of the above findings hypothesis 2(a) that socio-economic status of urban senior secondary students correlates significantly with the achievement of the students in Biology, hypothesis 2(b) that socio-economic status of rural senior secondary students correlates significantly with the achievement of the students in Biology and hypothesis 2(c) that socio-economic status of urban and rural senior secondary students correlates differentially with the achievement in Biology were retained here.

III. ACHIEVEMENT IN BIOLOGY AND PERSONALITY:

(1) Factor A (reserved vs outgoing):

A person who scores high on personality factor A tends to be good natured, easygoing, emotionally expressive, ready to cooperate, soft hearted and adoptable whereas a person who scores low on factor A tends to be stiff, cool and aloof.
No significant correlation was obtained for personality factor A with the achievement of the students in Biology in case of urban sample.

But in case of rural sample, negative significant correlation was obtained with the criterion variable of achievement in Biology ($r = -0.189$, vide table 7.2) at .05 level. These results suggested that students scoring low on personality factor A will score higher in Biology. In other words rural students who were stiff, cool and aloof were the higher achievers in the subject of Biology.

In case of urban sample also same results were expected because nature of the subject of Biology requires aloofness, coolness on the part of the students but non-existence of such results in case of urban sample may be due to the fact that urban students are more exposed to the environment than the rural students and secondly the hope of the urban students to get some extra help from the teacher.

The results were in agreement with the findings of Dhaliwal (1971) and Sontakey (1988).

(ii) Factor B (more intelligent vs less intelligent):

The person scoring low on factor B tends to be slow to learn and his/her grasp is dull. The person
who scores high tends to be quick to grasp as fast learner.

Personality factor B was not found to be significantly correlated with the achievement in Biology for urban sample (vide Table 7.1).

But in case of rural sample personality factor B has significant negative correlation \( r = -.269 \) vide table 7.2) at .01 level. It means students who scored low on factor B would have high achievement in Biology. Thus the rural senior secondary students who tended to be slow to learn and whose grasping power was dull were generally good in Biology.

(iii) Factor F (Sober vs happy go lucky):

Sober is the more dominant trait of the individual scoring low on it whereas high scorer is more intended to be happy go lucky person.

The personality factor F in case of urban sample was found to be significantly negatively correlated with the achievement in Biology \( r = -.104 \) vide table 7.1) at .05 level. The findings of the study revealed that urban senior secondary students who were sober were generally high achievers in the subject of Biology whereas those students who were having the personality trait such as happy go lucky were the low achievers in the
subject of Biology.

No significant correlation was obtained for factor F with the criterion variable of achievement in Biology in case of rural sample.

(iv) Factor G (expedient vs conscientious):

A person scoring more on this factor has conscientiousness as dominant trait but if the score is low than expediency takes its place. A conscientious person is characterized by traits of conscientious and low scores i.e., expediency is a measure of expediency.

For urban sample no significant correlation was obtained between the personality factor G and the achievement of the students in Biology.

With regard to the rural sample factor G had significant negative correlation with the criterion variable of achievement in Biology ($r = -0.265$ vide table 7.1) at .01 level. This significant negative correlation revealed that expedient rural senior secondary students had higher score on the achievement test in Biology.

(v) Factor I (toughminded vs tender minded):

Personality factor I measure toughminded vs tender-
minded trait of the individual. Toughmindedness is indicated by a low score on it whereas the person is tender hearted if the score on it is high.

From the results of table 7.1 it was revealed that personality factor I had no significant correlation with the criterion variable of achievement in Biology.

Personality factor I was found to be significantly negatively correlated with the criterion variable of achievement in Biology at .05 level (r = -.169 vide table 7.2). Thus on the basis of these results, it was observed that toughminded rural senior secondary students scored higher on achievement test in Biology.

(vi) Factor L (trusting vs suspicious):

The person who scores low on this factor tends to be free of jealous tendencies, adaptable, cheerful and a good team worker. The person who scores high on factor L tends to be mistrusting and doubtful.

For urban sample, this factor had a negative significant correlation at .05 level with the criterion variable of achievement in Biology (r = -.146, vide table 7.1), indicating thereby that urban senior secondary students who were free from jealous tendencies adaptable, cheerful and good team worker had higher achievement in Biology.
No significant correlation was obtained for factor L with the criterion variable of achievement in Biology in case of rural sample.

From the above results following inferences can be drawn:

1) In both the samples none of the personality factor showed a consistent picture of relationship with the criterion variable of achievement in Biology.

2) Achievement in Biology was not correlated significantly and positively with any of the personality factors either in urban sample or in rural sample.

3) Achievement in Biology correlated significantly and negatively with the personality factor F (sobber vs happy go lucky) and factor L (trusting vs suspicious) in case of urban sample, whereas, in rural sample achievement in Biology correlated significantly and negatively with personality factor A (reserved vs outgoing) factor B (less intelligent vs more intelligent), factor G (expedient vs conscientious), factor I (tough-minded vs tenderminded).

4) Analytical picture of correlation of personality factors with the criterion variable of achievement in Biology obtained for urban senior secondary students was different to the one obtained for
5) Personality factors e.g. factor C (affected by feeling vs emotionally stable), factor E (humble vs assertive), factor H (shy vs venturesome), factor M (practical vs imaginative), factor N (forthright vs shrewd), factor O (placidness vs apprehensiveness), factor $Q_1$ (conservative vs experimenting nature), factor $Q_2$ (dependent vs self sufficient), factor $Q_3$ (undisciplined vs controlled) and factor $Q_4$ (relaxed vs tense) were not significantly correlated with the measure of achievement in Biology.

6a) The overall profile of personality of the urban senior secondary students with high achievement in Biology that emerged from the negative nature of correlation between personality and achievement in Biology characterized the students as sober, free from jealous tendencies, adaptable, cheerful, good team worker and trusting.

6b) The rural senior secondary students with high achievement in Biology were characterized by personality traits like reserved, stiff, cool, aloof, slow in grasping power, expedient, toughminded.

On the basis of the above results hypothesis 4(a)
that personality characteristics of urban senior secondary students correlate significantly with the achievement of the students in Biology; hypothesis 4(b) that personality characteristics of rural senior secondary students correlate significantly with the achievement of the students in Biology and hypothesis 4(c) personality characteristics of urban and rural senior secondary students correlate differentially with the achievement in Biology were partially accepted.

The results of factor analysis as discussed in Section Two identified the Original Factor I as 'Group Factor of Personality' in case of both urban as well as rural samples and hence confirming further that personality characteristics and criterion variable of achievement in Biology were correlated with each other.

The above results fall in line with those obtained by Vidhu (1968), Jha (1970) and Sontakey (1988).

**TABLE - 7.3**

Showing coefficient of correlation between dependent variable of achievement in Biology and independent variable of intelligence, SES, measures of personality and creativity in case of urban as well as rural sample.
<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dependent Variable: Achievement in Biology.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban Sample</td>
</tr>
<tr>
<td>Intelligence and SES</td>
<td>Intelligence</td>
</tr>
<tr>
<td>variables which corre-</td>
<td>SES</td>
</tr>
<tr>
<td>lated significantly with</td>
<td></td>
</tr>
<tr>
<td>the achievement in</td>
<td></td>
</tr>
<tr>
<td>Biology.</td>
<td></td>
</tr>
<tr>
<td>Personality factors</td>
<td>F,L</td>
</tr>
<tr>
<td>which correlated</td>
<td></td>
</tr>
<tr>
<td>significantly with the</td>
<td></td>
</tr>
<tr>
<td>achievement in Biology</td>
<td></td>
</tr>
<tr>
<td>in case of urban sample</td>
<td></td>
</tr>
<tr>
<td>Personality factors</td>
<td>A, B, G, I.</td>
</tr>
<tr>
<td>which correlated</td>
<td></td>
</tr>
<tr>
<td>significantly with the</td>
<td></td>
</tr>
<tr>
<td>achievement in Biology</td>
<td></td>
</tr>
<tr>
<td>in case of rural sample</td>
<td></td>
</tr>
<tr>
<td>which were not signifi-</td>
<td>M,,N,O, Q₁, Q₂, Q₃, Q₄</td>
</tr>
<tr>
<td>cantly correlated</td>
<td></td>
</tr>
<tr>
<td>with the achievement</td>
<td></td>
</tr>
<tr>
<td>in Biology in urban and</td>
<td></td>
</tr>
<tr>
<td>rural sample.</td>
<td></td>
</tr>
<tr>
<td>Measures of creativity</td>
<td>F,X,O</td>
</tr>
<tr>
<td>which were significantly</td>
<td></td>
</tr>
<tr>
<td>correlated with the</td>
<td></td>
</tr>
<tr>
<td>achievement in Biology.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Measures of creativity namely fluency (F), flexibility (X) and originality (O) had significant positive correlation with the criterion measure of achievement in Biology in case of urban sample as also in case of rural sample.

Coefficient of correlation between fluency (F) and achievement in Biology was found to be significant \( r = .172 \), vide table 7.1 at .01 level in case of urban sample and correlation between fluency (F) and achievement in Biology was also positively significant \( r = .243 \), vide table 7.2 at .01 level in case of rural sample. The value of correlation between flexibility (X) and achievement in Biology was positive and significant \( r = .463 \) at .01 level for urban sample and for rural sample, flexibility (X) correlated significantly with the achievement in Biology \( r = .192 \) at .01 level. Significant correlation of originality (O) was observed with the achievement in Biology \( r = .157 \) at .01 level for urban sample and similarly significant correlation of originality (O) was also observed with the achievement in Biology \( r = .213 \) at .01 level for rural sample.

No significant correlation of total verbal creativity (TVC) emerged with the achievement in Biology in both the urban as well as rural samples.
From the above results it may be concluded that:

1) Urban as well as rural senior secondary students with high scores on creativity had higher achievement in Biology.

2) The results of the study suggested that urban as well as rural secondary students who prefer greater number of relevant ideas whether of the same (fluency) or of different type (flexibility) and original responses (originality) had high achievement level in the subject of Biology as compared to those students who lack fluency, flexibility and originality. In other words both urban as well as rural senior Sec. students, when forced to comply overtly with greater number of relevant idea of the same are of different type and possess original thinking, then modification occurs to justify the new overt behaviour which automatically results in the subject of Biology. It may thus, be concluded that fluency, flexibility and originality abilities had their influence in increasing the achievement of the students in the subject of Biology.

3) Total verbal creativity was not related with the achievement of the urban as well as rural senior secondary students in Biology.
The above results led to the acceptance of hypothesis 3(a) that creativity of urban senior secondary students correlates significantly with the achievement of the students in Biology; hypothesis 3(b) that creativity of rural senior secondary students correlates significantly with the achievement of students in Biology and hypothesis 3(c) that creativity of urban and rural senior secondary students correlates differentially with the achievement in Biology.

The results of the factor analysis discussed in section Two also supported the above findings for urban as well as rural sample because measure of creativity shared significant loadings with Original Factor III (urban sample) and Original Factor II (rural sample).

Findings of the present study were identical with the findings of Torrance (1962), Wallach and Kogan (1965) Iwata (1968), Passi (1971), Gupta (1979), Mishra (1978), Vijalakshmi (1980) and Dutt (1988).
After having examined the relationship between independent variables of intelligence, personality, creativity, SES and dependent variable of achievement in Biology, an attempt was made to examine the relationship between predictor variables in terms of factor structure where a large number of inter-related measures were to be reduced to a few underlying factors.

Statistically, the purpose of factor analysis was to transform the correlation matrix (23 x 23), into a factor matrix with a view to understanding the factor structure underlying one measure of intelligence, 16 measures of personality, one set of scores on SES and four measures of creativity. According to Fruchter (1967), factor analysis is a method of analysing a set of observations from the intercorrelations to determine whether the variations represented can be accounted for adequately by a number of basic categories smaller than with which the investigation was started. By applying factor analysis the set of relationship could be explained in the form of clusters attributing to variations and similarities in the characteristics and contribution of each factor.

This section thus devoted to the study of Factor Analysis for urban and rural samples separately in order
to test the following hypothesis No. 5(a), 5(b) and 5(c) mentioned earlier in Chapter III and which are reproduced below:

5(a) Intelligence, SES, Creativity and personality factors cluster together in group factor/s with the achievement in Biology in case of urban senior secondary students.

5(b) Intelligence, SES, Creativity and personality factors cluster together in group factor/s with the achievement in Biology in case of rural senior secondary students.

5(c) The factor structure underlying the measure of intelligence, SES, Creativity, Personality and achievement in Biology of urban senior secondary students differ from that of rural senior secondary students.

Principal axis method was used for factorization because it extracts the maximum amount of variance and gives the smallest possible residual (Fruchter, 1967). The decision as to the number of significant factors was taken in accordance with Humphrey's rule (vide Fruchter 1967, p. 79). In all, eleven factors were extracted.

The factor loadings were further subjected to another criterion, namely, the Scree Test (vide Kazelskis, 1972) for ascertaining the significant number of factors for
the purpose of rotation. From the results obtained in table 7.4 and 7.5, the Scree Test revealed the second major drop after third factor for urban sample as well as for rural sample followed by relatively negligible drops in the subsequent factors indicating that the percentage variance after fourth factor in case of urban sample as well as in case of rural sample considerably decreased. In view of this as also to keep the number of factors comparable in both the samples, it seemed plausible to retain four factors for the purpose of rotation in each of the two samples. These factors were subjected to rotation by applying Kaiser's (1964) computer programme of Varimax rotation. It seems in order to point out here that any set of rotated factors explains exactly the same variance as the original factors, but they slice it up in a way that is more simple in structure and meaningful and interpretable (Nunnally 1967).

To discuss the results of factor analysis, the following two points were kept in view:

1) Since "the unrotated factors are as good in statistical sense as any rotation of them" (Nunnally 1967) the discussion has therefore, been based upon original as well as rotated sets of factor loadings. Further only those factors have been discussed wherein one or more variables of intelligence, SES, Personality, and Creativity shared common variance with the criterion variable i.e. achievement in Biology.
### TABLE - 7.4

Showing Scree Test for number of factors

(Grpup-I, Urban Sample)

<table>
<thead>
<tr>
<th>Factor Sr.No.</th>
<th>Eigen Value</th>
<th>Eigen Value Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>7.21</td>
<td>1.85</td>
</tr>
<tr>
<td>II</td>
<td>5.36</td>
<td>2.20</td>
</tr>
<tr>
<td>III</td>
<td>3.16</td>
<td>1.84</td>
</tr>
<tr>
<td>IV</td>
<td>1.32</td>
<td>.36</td>
</tr>
<tr>
<td>V</td>
<td>.96</td>
<td>.16</td>
</tr>
<tr>
<td>VI</td>
<td>.80</td>
<td>.06</td>
</tr>
<tr>
<td>VII</td>
<td>.74</td>
<td>.06</td>
</tr>
<tr>
<td>VIII</td>
<td>.68</td>
<td>.02</td>
</tr>
<tr>
<td>IX</td>
<td>.66</td>
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## TABLE - 7.5

Showing Scree Test for number of factors

(Group-II, Rural Sample)

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<th>Factor</th>
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<th>Eigen Value Difference</th>
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2) Only those variables have been considered for discussion which shared loadings greater than or equal to ± .28. The limits of loadings are directly based upon Humphrey's rule (Fruchter, 1967, pp.79-80).

The result of two sets of factor analysis for urban sample in respect of original and varimax factors have been presented in table 7.6 to 7.13 and that of rural sample in respect of original and varimax factors have been presented from tables 7.14 to 7.21.

**URBAN SAMPLE**

**FACTOR - I**

The significant factor loadings in descending order of magnitude on original Factor I along with Varimax Factor for urban sample have been given in table 7.8.

The Original Factor I was characterised by significant positive Loadings of the order of .862, .842,
TABLE - 7.6

Principal Axis (Original) Factor Matrix (N=340) for Urban sample.

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<th>Sr. No.</th>
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<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
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Sum of Squares 7.21 5.36 3.16 1.32 0.96 0.80 0.74 0.68 0.66 0.62 0.54 0.52 0.45
% of total Variance 31.39 46.04 59.78 65.56 69.75 73.25 76.48 79.45 82.36 85.08 87.47 89.75 91.72
% of common Variance 34.22 50.19 65.17 71.47 76.04 79.46 83.38 86.62 89.48 92.76 95.36 97.85 100

* P = Personality
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<th>III</th>
<th>IV</th>
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<th>VI</th>
<th>VII</th>
<th>VIII</th>
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<th>X</th>
<th>XI</th>
<th>XII</th>
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<td>0.103</td>
<td>0.043</td>
<td>0.046</td>
<td>0.123</td>
<td>0.050</td>
<td>0.028</td>
<td>0.144</td>
</tr>
<tr>
<td>18</td>
<td>Personality Factor P</td>
<td>0.068</td>
<td>0.137</td>
<td>0.006</td>
<td>0.005</td>
<td>0.114</td>
<td>0.104</td>
<td>0.090</td>
<td>0.006</td>
<td>0.123</td>
<td>0.097</td>
<td>0.014</td>
<td>0.060</td>
<td>0.130</td>
</tr>
<tr>
<td>19</td>
<td>SEE</td>
<td>0.625</td>
<td>0.046</td>
<td>0.155</td>
<td>0.066</td>
<td>0.313</td>
<td>0.347</td>
<td>0.302</td>
<td>0.277</td>
<td>0.312</td>
<td>0.355</td>
<td>0.013</td>
<td>0.056</td>
<td>0.360</td>
</tr>
<tr>
<td>20</td>
<td>Fluency F</td>
<td>0.536</td>
<td>0.019</td>
<td>0.955</td>
<td>0.035</td>
<td>0.021</td>
<td>0.065</td>
<td>0.015</td>
<td>0.001</td>
<td>0.004</td>
<td>0.008</td>
<td>0.101</td>
<td>0.119</td>
<td>0.031</td>
</tr>
<tr>
<td>21</td>
<td>Flexibility X</td>
<td>0.039</td>
<td>0.003</td>
<td>0.929</td>
<td>0.038</td>
<td>0.022</td>
<td>0.026</td>
<td>0.002</td>
<td>0.007</td>
<td>0.014</td>
<td>0.036</td>
<td>0.138</td>
<td>0.082</td>
<td>0.021</td>
</tr>
<tr>
<td>22</td>
<td>Originality O</td>
<td>0.03</td>
<td>0.003</td>
<td>0.925</td>
<td>0.037</td>
<td>0.027</td>
<td>0.013</td>
<td>0.024</td>
<td>0.022</td>
<td>0.016</td>
<td>0.032</td>
<td>0.071</td>
<td>0.003</td>
<td>0.013</td>
</tr>
<tr>
<td>23</td>
<td>Total Verbal Creativity</td>
<td>0.073</td>
<td>0.033</td>
<td>0.442</td>
<td>0.012</td>
<td>0.038</td>
<td>0.008</td>
<td>0.012</td>
<td>0.017</td>
<td>0.037</td>
<td>0.017</td>
<td>0.987</td>
<td>0.004</td>
<td>0.040</td>
</tr>
</tbody>
</table>
TABLE 7.8

Showing significant loading on Original and Varimax Factor I in descending order of magnitude.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Loadings</th>
<th>Variables</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personality Factor E</td>
<td>0.862</td>
<td>Personality Factor A</td>
<td>0.925</td>
</tr>
<tr>
<td>Personality Factor H</td>
<td>0.842</td>
<td>Personality Factor E</td>
<td>0.923</td>
</tr>
<tr>
<td>Personality Factor G</td>
<td>0.839</td>
<td>Personality Factor H</td>
<td>0.919</td>
</tr>
<tr>
<td>Personality Factor A</td>
<td>0.836</td>
<td>Personality Factor G</td>
<td>0.916</td>
</tr>
<tr>
<td>Personality Factor F</td>
<td>0.836</td>
<td>Personality Factor I</td>
<td>0.898</td>
</tr>
<tr>
<td>Personality Factor I</td>
<td>0.824</td>
<td>Personality Factor E</td>
<td>0.805</td>
</tr>
<tr>
<td>Personality Factor B</td>
<td>0.799</td>
<td>Personality Factor C</td>
<td>0.700</td>
</tr>
<tr>
<td>Personality Factor C</td>
<td>0.778</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>0.664</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q₁</td>
<td>0.454</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor M</td>
<td>0.429</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q₂</td>
<td>0.394</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor O</td>
<td>0.393</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q₄</td>
<td>0.379</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q₃</td>
<td>0.377</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor L</td>
<td>0.328</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor N</td>
<td>0.326</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achievement in Biology</td>
<td>0.289</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
.839, .836, .824, .799, .778, .664, .454, .429, .394, .393, .378, .377, .328, .326 and .289 by the variable of personality factors E, H, G, A, F, I, B, E, SES, personality factors Q₁, M, Q₂, O, Q₄, Q₃, L, N and Achievement in Biology respectively.

The range of loadings was from .862 to .288 in which highest loadings were shared by all the sixteen variables of personality. The loading on the criterion variable was of the order of .289. Therefore, all the factors of personality along with the criterion variable of Achievement in Biology shared variance of significant magnitude. As Original Factor I demonstrated predominance of significant loadings on all the sixteen measures of personality, therefore, Original factor I may be identified as "Group Factor of Personality".

Factor I accounted for 31.39% of total variance which was 34.22% of the common variance explained by all the factors.
In Varimax Factor I as the criterion measure of Achievement in Biology had no significant loading (vide table 7.8), therefore, it is beyond the scope of present study and hence had not been named and discussed.

The obtained "Group Factor of Personality" also find a support in the results of coefficient of correlation as discussed in Section-one where the factors of personality were found to be positively significant correlated with criterion variable of Achievement in Biology.

**FACTOR II**

Significant factor loadings on Original Factor II alongwith Varimax Factor have been arranged in descending order of magnitude in table 7.9.

The Original Factor II in case of urban sample which was bipolar in nature, had been characterised by significant positive loadings of the order of .670, .590, .507, .495, .483, .457, .425, .412 and .295 on the variable of SES, personality factor $Q_2$, $Q_4$, $L$, $O$, $N$, $Q_1$, $Q_3$, $M$ and Achievement in Biology. The range of loadings was from .670 to .295. This factor was also characterised by significant negative loadings of the


### TABLE - 7.9

Showing significant loading on Original and Varimax Factor II in descending order of magnitude

<table>
<thead>
<tr>
<th>Original Factor-II</th>
<th>Loadings</th>
<th>Varimax Factor-II</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>SES</td>
<td>.670</td>
<td>Personality Factor L</td>
<td>.947</td>
</tr>
<tr>
<td>Personality Factor Q₂</td>
<td>.590</td>
<td>SES</td>
<td>.346</td>
</tr>
<tr>
<td>Personality Factor Q₄</td>
<td>.507</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor L</td>
<td>.495</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor O</td>
<td>.483</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor N</td>
<td>.457</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q₁</td>
<td>.425</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q₃</td>
<td>.412</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor M</td>
<td>.412</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluency (F)</td>
<td>-.387</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexibility (X)</td>
<td>-.380</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor A</td>
<td>-.345</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Originality (O)</td>
<td>-.333</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor I</td>
<td>-.330</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor G</td>
<td>-.315</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor H</td>
<td>-.312</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor E</td>
<td>-.303</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ach. in Bio.</td>
<td>.295</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
order of -.387, -.380, -.345, -.333, -.330, -.315, -.312
and -.303 on the variables of Fluency (F), Flexibility
(X), personality factor A, Originality (O), personality
factor I, G, H and E respectively. The range of loadings
was from -.387 to -.303. Since the highest loadings
had been shared by variable of SES, therefore, Original
Factor II may be named as "Factor of Socio-economic Status",
which shared variance with personality and creativity.

Factor II accounted for 46.04% of the total variance
which was 50.19% of the common variance explained by
all the factors.

Varimax Factor II had a positive loadings of the
order of .947 and .346 on the variable of personality
factor L and variable of Socio-economic-Status. However,
this factor did not share significant loadings with the
criterion variable of Achievement in Biology and thus
does not fall within the scope of the study which aimed
at identifying constellation of variables which go with
the Achievement in Biology of the urban senior secondary
students.

The above results of factor analysis have been
supported by significant value of coefficient of correlation
given in section One which indicated the relationship
between variable of SES and achievement in Biology of
the urban senior secondary students.
FACTOR - III

Table 7.10 gave the significant loadings on Original and Varimax Factor-III, in descending order of magnitude in case of urban sample.

**TABLE - 7.10**

Showing significant loadings on Original and Varimax Factor III in descending order of magnitude.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Original Factor-III</th>
<th>Loadings</th>
<th>Varimax Factor-III</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency (F)</td>
<td>.855</td>
<td></td>
<td>Fluency (F)</td>
<td>.955</td>
</tr>
<tr>
<td>Flexibility (X)</td>
<td>.833</td>
<td></td>
<td>Flexibility (X)</td>
<td>.929</td>
</tr>
<tr>
<td>Originality (O)</td>
<td>.818</td>
<td></td>
<td>Originality (O)</td>
<td>.925</td>
</tr>
<tr>
<td>TVC</td>
<td>.598</td>
<td></td>
<td>TVC</td>
<td>.442</td>
</tr>
<tr>
<td>Int</td>
<td>.406</td>
<td></td>
<td>Ach. in Bio.</td>
<td>.297</td>
</tr>
<tr>
<td>Ach. in Bio.</td>
<td>.282</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Original Factor III exhibited significant positive loadings of the order of .855, .833, .818, .598, .406 and .282 on the variable of Fluency (F), Flexibility (X), Originality (O), TVC, Intelligence and Achievement in Biology respectively. The range of loadings was from .855 to .282. By virtue of the fact that as highest loadings were shared by the measures of creativity followed by intelligence; this factor may be identified as "General Factor of Cognition", which shared common
variance with the criterion variable of Achievement in Biology along with the four measures of creativity and variable of intelligence.

This factor accounted for 59.78% of total variance whereas contribution to percentage of common variance was 65.17%.

Varimax Factor III shared significant positive loadings of the order of .955, .929, .925, .442 and .297 on measures of creativity-fluency (F), flexibility (X), Originality (O), TVC and Achievement in Biology respectively. Hence Varimax Factor III due to its highest loadings on measures of creativity may be named as "Group Factor of Creativity".

Above results also resembled with the findings of the present study based on the statistical technique of coefficient of correlation given in Section one of this chapter.

FACTOR - IV

Significant factor loadings on Original Factor IV along with the Varimax Factor have been given in descending order of magnitude in table 7.11.
TABLE - 7.11

Showing significant loadings on Original and Varimax Factor IV in descending order of magnitude.

<table>
<thead>
<tr>
<th>Original Factor</th>
<th>Varimax Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Loadings</td>
<td>Variables Loadings</td>
</tr>
<tr>
<td>Ach. in Bio:</td>
<td>Ach. in Bio.</td>
</tr>
<tr>
<td>.736</td>
<td>.968</td>
</tr>
<tr>
<td>Intelligence</td>
<td>.696</td>
</tr>
</tbody>
</table>

Original Factor IV shared a significant positive loadings of the order of .736 and .696 on variables of Achievement in Biology and Intelligence. Since significant positive loadings of the order of .696 was only shared by the variable of Intelligence with the criterion variable of Achievement in Biology, therefore, Factor IV maybe named as 'General Factor of Mental Ability'. This factor shared 65.56% of the total variance which was equal to 78.46% of the common variance shared by all the factors.

In Varimax Factor IV the highest of the loadings have been associated with the measure of Achievement in Biology, which has the loadings of .968. Thus in view of the highest loading of the order of .968 shared by the criterion measure, Varimax Factor IV may be named as 'General Factor of Biological Achievement'.
Further, to see the relative contribution of criterion variable of Achievement in Biology and independent variables that is Intelligence, 16 measures of Personality, SES and four measures of creativity in each of the factor I, II, III and IV; percentage of total factor variance of each of the above variable was calculated. Table 7.12 and table 7.13 gave the percentage of total factor variance in case of Original and Varimax Factor respectively for urban sample.

**TABLE - 7.12**

Showing percentage of variance explained by the variables of Achievement in Biology, Intelligence, Personality, SES and Creativity in each Original Factor in case of Urban Sample.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Percentage of Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Ach. in Bio.</td>
<td>8.35</td>
</tr>
<tr>
<td>Intelligence</td>
<td>-</td>
</tr>
<tr>
<td>Personality</td>
<td>48.72</td>
</tr>
<tr>
<td>SES</td>
<td>38.08</td>
</tr>
<tr>
<td>Creativity</td>
<td>-</td>
</tr>
</tbody>
</table>
TABLE - 7.13

Showing percentage of variance explained by the variables of Achievement in Biology, Intelligence, Personality, SES, and Creativity in each Varimax Factor in case of urban sample.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percentage of Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Achievement in Biology</td>
<td>-</td>
</tr>
<tr>
<td>Intelligence</td>
<td>-</td>
</tr>
<tr>
<td>Personality</td>
<td>72.01</td>
</tr>
<tr>
<td>SES</td>
<td>-</td>
</tr>
<tr>
<td>Creativity</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 7.12 revealed that (i) 79.07% of total factor variance was explained by criterion variable of achievement in Biology of which 8.35%, 8.61%, 7.95% and 54.16% was explained by Original Factor I, II, III and IV respectively. (ii) Also contribution of intelligence in Original Factor III and Original Factor IV was 59.49% of which 16.48% was explained in Factor III and 43.01% in factor IV, whereas the percentage of total factor variance in Original Factor I and II was zero. (iii) The total factor variance explained by personality factors was 51.50% of which 48.72% and 2.78% variance was explained by Original Factor I and II respectively. (iv) Similarly total factor
variance as explained by SES variable was 82.97% wherein 38.08% and 44.89% variance was explained by Original Factor I and II, respectively. (v) Percentage of total factor variance as explained by measures of creativity was equal to 46.72% in which 11.08% and 35.40% factor variance was explained by factor II and III respectively. (vi) It was also revealed by table 7.12 that highest percentage of variance in Original Factor I was shared by personality factor (48.72%) followed by SES variable (38.08%) and achievement in Biology (8.35). (vii) Intelligence did not share any percentage of variance in Original Factor I. (viii) In Original Factor I, criterion variable of achievement in Biology, personality factors and variable of SES shared common element and there was more nearness between the criterion variable of achievement in Biology and personality factors (ix) In case of Original Factor II highest percentage of variance was shared by SES variable (44.89%), followed by creativity (11.08%), achievement in Biology (8.61%) and personality factors (2.78%). Again intelligence did not share any variance in this factor. In this factor there was greater nearness between the criterion variable of achievement in Biology and variable of SES. (x) Similarly, it was also noticed that highest percentage of variance in factor III was shared by measures of creativity (35.40%) followed by intelligence (16.48%) and criterion variable of achievement in Biology (7.95%). In Original Factor III, therefore, there was greater closeness between the achievement in Biology and measures of creativity. (xi) In case of Original Factor IV the maximum variance was shared
by Criterion variable of achievement in Biology (54.16%) followed by variable of intelligence (43.01%). No other variable except the variable of intelligence shared total factor variance with the criterion variable of achievement in Biology in Original Factor IV and hence it established the closeness between the criterion variable of achievement in Biology and variable of intelligence.

From the results of Varimax Factor, as entered in table 7.13, it was noticed that (i) the total percentage of variance as explained in all the three factors i.e. Factor I, III and IV by the variable of achievement in Biology, personality factors and measures of creativity was 99.52%, 72.01% and 19.53% respectively. (ii) Further, the result showed that in Varimax Factor III only the measures of creativity had the sharing of 19.53% and the achievement in Biology contributed 8.82% variance. (iii) In Varimax Factor IV, the highest contribution was only by the criterion variable of achievement in Biology which explained 90.70% variance.

From the results of table 7.12 and 7.13, variable of intelligence, factor of personality, variable of SES measures of creativity shared common variance with the criterion variable of achievement in Biology but were independent of each other in case of factor I, II, III and IV in terms of Original and Varimax Factor structure.
In the light of above findings the hypothesis 5(a) that variable of intelligence, SES, creativity and personality factors cluster together in group factor/s with the achievement in Biology in case of urban senior secondary students was accepted.
Table 7.14
Principal Axis (Original) Factor Matrix (K=160) for Rural Sample

<table>
<thead>
<tr>
<th>S.No</th>
<th>Variable Code</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
<th>h^2</th>
<th>1-NP^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ach. Bio</td>
<td>.352</td>
<td>.457</td>
<td>.481</td>
<td>.315</td>
<td>.279</td>
<td>.296</td>
<td>.010</td>
<td>.110</td>
<td>.063</td>
<td>.086</td>
<td>.186</td>
<td>.067</td>
<td>.214</td>
<td>.830</td>
<td>.170</td>
</tr>
<tr>
<td>2</td>
<td>Int.</td>
<td>-.245</td>
<td>.584</td>
<td>.371</td>
<td>.283</td>
<td>.159</td>
<td>.271</td>
<td>.148</td>
<td>-.376</td>
<td>.664</td>
<td>.073</td>
<td>.142</td>
<td>.040</td>
<td>.009</td>
<td>.834</td>
<td>.196</td>
</tr>
<tr>
<td>3</td>
<td>F. Factor A</td>
<td>.339</td>
<td>.039</td>
<td>.337</td>
<td>.172</td>
<td>.259</td>
<td>.129</td>
<td>.171</td>
<td>.244</td>
<td>.591</td>
<td>.022</td>
<td>.188</td>
<td>.146</td>
<td>.219</td>
<td>.236</td>
<td>.961</td>
</tr>
<tr>
<td>4</td>
<td>F. Factor B</td>
<td>.283</td>
<td>-.118</td>
<td>.401</td>
<td>.208</td>
<td>.140</td>
<td>.407</td>
<td>.271</td>
<td>.282</td>
<td>.397</td>
<td>.032</td>
<td>.161</td>
<td>.164</td>
<td>.055</td>
<td>.907</td>
<td>.093</td>
</tr>
<tr>
<td>5</td>
<td>F. Factor C</td>
<td>.392</td>
<td>-.072</td>
<td>.306</td>
<td>.209</td>
<td>.342</td>
<td>.144</td>
<td>.192</td>
<td>.298</td>
<td>.536</td>
<td>.119</td>
<td>.140</td>
<td>.095</td>
<td>.223</td>
<td>.828</td>
<td>.172</td>
</tr>
<tr>
<td>6</td>
<td>F. Factor D</td>
<td>.357</td>
<td>.181</td>
<td>-.172</td>
<td>.170</td>
<td>.224</td>
<td>.301</td>
<td>.193</td>
<td>.302</td>
<td>.244</td>
<td>.129</td>
<td>.212</td>
<td>.095</td>
<td>.095</td>
<td>.705</td>
<td>.126</td>
</tr>
<tr>
<td>7</td>
<td>F. Factor E</td>
<td>.536</td>
<td>.067</td>
<td>.041</td>
<td>.311</td>
<td>-.099</td>
<td>.249</td>
<td>.175</td>
<td>.053</td>
<td>.23</td>
<td>.111</td>
<td>.167</td>
<td>.485</td>
<td>.037</td>
<td>.874</td>
<td>.126</td>
</tr>
<tr>
<td>8</td>
<td>F. Factor F</td>
<td>.546</td>
<td>-.016</td>
<td>.142</td>
<td>-.059</td>
<td>.396</td>
<td>-.056</td>
<td>.343</td>
<td>.170</td>
<td>.025</td>
<td>.171</td>
<td>.007</td>
<td>.059</td>
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% of common Variance: 20.58 37.23 56.18 53.71 60.53 67.05 72.96 78.12 83.20 87.80 92.22 96.22 100.00

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Table 7.15
Varimax Rotated Factor Matrix (K=150) for Rural Sample
RURAL SAMPLE

The results of Original as well as varimax factors have been entered in table 7.14 to 7.21.

FACTOR - I

Significant factor loadings in descending order of magnitude on Original and Varimax Factor I in case of rural sample have been given in table 7.16.

**TABLE - 7.16**

Showing significant loadings on Original and Varimax Factor I in descending order of magnitude.

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Original Factor I was characterized by significant loadings, shared by personality factor N, G, SES, personality factors F, O, M, I, Q₂, Q₁, C, E, achievement in Biology, personality factors A, L, H and Q₃ with loadings .554, .546, .542, .536, .512, .476, .463, .420, .417, .417, .392, .357, .352, .339, .318, .303 and .284 respectively. The highest of these loadings have been associated with personality factors. In view of the maximum positive significant loadings on personality factors, Original Factor I may be labelled as "Factor of Personality" in case of rural sample.

This factor contributed a total variance of 17% which come to 20.58% of total common variance contributed by all the factors.

Varimax Factor I had significant positive loadings on personality factors Q₁ and Q, SES and TVC with loadings .806, .588, .365 and -.329 respectively. As the criterion measure in achievement in Biology had no significant loading on Varimax Factor I (vide Table 7.16) therefore, this factor was not discussed.

**FACTOR - II**

Table 7.17 depicted the significant factor loadings on Original and Varimax Factor II on descending order of magnitude.
TABLE 7.17

Showing significant loadings on Original and Varimax Factor II in descending order of magnitude.

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<th>Loadings</th>
<th>Varimax Factor II</th>
<th>Variables</th>
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Significant positive loadings of the order of .915, .894, .875, .584, .467 and .289 were characterized by variables of fluency (F), Flexibility (X), Originality (O), Intelligence, achievement in Biology and TVC respectively. The highest of these loadings have been associated with three measures of creativity. The range of significant loadings on measures of creativity were found to be .915 to .289 (vide table 7.17). Intelligence accounted for loading of .584, achievement in Biology shared loading of .467. As Factor II characterized by significant loadings on all the measures of creativity, intelligence and achievement in Biology, therefore, this showed that the variable of creativity and intelligence alongwith its various
measures and achievement in Biology belong to the same cognitive domain. Thus, Original Factor II may be named as a "General Factor of cognition".

Original Factor II accounted for 30.76% of total factor variance which came to be 37.23% of the total common factor variance shared by all the factors.

The varimax factor II emerged clearly as a "Group Factor of creativity" with significant loadings on fluency (F = .957), flexibility (X = .919), Originality (O = .909) and total verbal creativity (TVC = .284). This factor also shared variance with achievement in Biology (with loadings equal to .286).

FACTOR - III

Significant factor loadings on Original Factor III along with Varimax Factor have been arranged in descending order of magnitude in table 7.18.

Original Factor III was bipolar in nature with positive significant loadings of the order of .481, .478, .398, .376, .371, .358, .347 and .333 on the variable of achievement in Biology, personality factor Q₁, SES, personality factor Q₂, intelligence, personality factors L, O, Q₃ respectively and significant negative loadings of the order of -.407, -.337 on personality factors B and A. This factor seemed to be specific factor of "Factor of Socio-economic Status".
TABLE 7.18

Showing significant loadings on Original and Varimax Factor III in descending order of magnitude.

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<tr>
<th>Variable</th>
<th>Original Factor III</th>
<th>Loadings</th>
<th>Varimax Factor III</th>
<th>Variables</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement in Bio.</td>
<td>.481</td>
<td></td>
<td>Achievement in Bio.</td>
<td>.836</td>
<td></td>
</tr>
<tr>
<td>personality Factor Q1</td>
<td>.478</td>
<td></td>
<td>Intelligence</td>
<td>.818</td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>.398</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q₂</td>
<td>.376</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intelligence</td>
<td>.371</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor L</td>
<td>.358</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor O</td>
<td>.347</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q₃</td>
<td>.333</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor B</td>
<td>-.407</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor A</td>
<td>-.337</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This factor contributed a total variance of 38.15% which came to be 46.18% of total variance contributed by all the factors.

Varimax Factor III had significant positive loadings on the variables of intelligence and achievement in Biology (loading = .818 and .836 respectively vide table 7.18). This factor appeared to be "Factor of General Mental Ability" as separate than creativity which did not show any significant loading on this factor.
FACTOR - IV

Table 7.19 gave the significant factor loadings on Original and Varimax Factor IV in descending order of magnitude in case of rural sample.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Loadings</th>
<th>Original Factor IV</th>
<th>Variable</th>
<th>Loadings</th>
<th>Varimax Factor IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ach. in Bio.</td>
<td>.315</td>
<td></td>
<td>Personality Factor Q3</td>
<td>-.907</td>
<td></td>
</tr>
<tr>
<td>Personality Factor M</td>
<td>.314</td>
<td></td>
<td>Personality Factor N</td>
<td>-.353</td>
<td></td>
</tr>
<tr>
<td>Personality Factor F</td>
<td>.311</td>
<td></td>
<td>SES</td>
<td>-.316</td>
<td></td>
</tr>
<tr>
<td>TVC</td>
<td>-.310</td>
<td></td>
<td>TVC</td>
<td>-.314</td>
<td></td>
</tr>
<tr>
<td>Personality Factor Q3</td>
<td>-.310</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor H</td>
<td>-.310</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality Factor C</td>
<td>-.309</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intelligence</td>
<td>.283</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Original Factor IV in case of rural sample showed dichotomy in polarity. Significant positive loadings were shared by achievement in Biology, personality factors M, F, and intelligence with loadings .315, .314, .311 and .283 respectively and significant negative loadings
were shared by TVC, personality factors $Q_3$, $H$ and $C$ with loadings $-0.310$, $-0.310$, $-0.310$ and $-0.309$ respectively. Loadings on SES and three measures of creativity were insignificant on this factor. In the light of highest positive loading contributed to this factor by achievement in Biology, Original Factor IV may be named as "A Group Factor of Biological Achievement", sharing just significant common factor variance with four factors of personality, TVC and intelligence.

This factor contributed 44.37\% of total variance which came to be 54.77\% of total common variance contributed by all the factors.

Varimax Factor IV in case of rural sample had significant negative loading of the order of $-0.907$, $-0.353$, $-0.316$ and $-0.314$ on the variables of personality factors $Q_3$, $N$, SES and TVC respectively. However, it does not fall within the scope of discussion in relation to the insignificant loading on the dependent variable of achievement in Biology.

To examine the relative contribution of the criterion variable of achievement in Biology and independent variables of intelligence, sixteen measures of personality, SES and four measures of creativity in each of the Factor I, II, III and IV in case of rural sample, the percentage of total factor variance for the above variables was
calculated, the values of which have been given in tables 7.20 and 7.21 for original and varimax factors respectively.

**TABLE - 7.20**

Showing percentage of variance explained by the variable of Achievement in Biology, Intelligence, Personality, SES and Creativity in each Original Factor in case of rural sample.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Percentage of Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ach. in Bio.</td>
<td>I  12.53 II 21.80 III 23.13 IV 12.92 Total 70.38</td>
</tr>
<tr>
<td>Intelligence</td>
<td>-            I 34.10 II 13.76 III 8.00 IV 55.86</td>
</tr>
<tr>
<td>Personality</td>
<td>24.14        II 2.10 III 8.00 IV 25.48</td>
</tr>
<tr>
<td>SES</td>
<td>20.37        II - III 15.84 IV - Total 36.21</td>
</tr>
<tr>
<td>Creativity</td>
<td>-            I 8.35 II - III 9.61 IV 17.96</td>
</tr>
</tbody>
</table>

**TABLE - 7.21**

Showing percentage of variance explained by the variable of Achievement in Biology, Intelligence, Personality, SES and Creativity in each Varimax Factor in case of rural sample.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percentage of Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ach. in Bio.</td>
<td>I - II 8.17 III 69.88 IV - Total 78.05</td>
</tr>
<tr>
<td>Intelligence</td>
<td>-          I - II 66.91 IV - Total 66.91</td>
</tr>
<tr>
<td>Personality</td>
<td>-          I - II - IV - Total -</td>
</tr>
<tr>
<td>SES</td>
<td>-          I - II - IV - Total -</td>
</tr>
</tbody>
</table>
| Creativity     | -          I 8.60 II - III - IV 8.60 Total
Table 7.20 revealed that (i) 70.38%, 55.86%, 35.48%, 36.21% and 17.96% of total factor variance had been explained by the criterion variable of achievement in Biology, variable of intelligence, personality factors, variable of SES and creativity respectively. (ii) After analysing the results it was found that like urban sample in case of rural sample too, the highest percentage of variance in factor I was shared by personality factors (24.14%) and variable of SES (20.37%). These results showed that in Original Factor I the personality factors in comparison to other variables had greater association with the criterion variable of achievement in Biology. (iii) In Original Factor II, however, there was close relationship between criterion variable of achievement in Biology and the variable of intelligence. (iv) Likewise in Original Factor III there was more nearness between the variable of SES and achievement in Biology than any other variables. (v) In Factor IV maximum variance was contributed by achievement in Biology (12.89%) followed by measures of creativity (9.61%), personality factors (9.24%) and variable of intelligence (8.00%). The results also led to the finding that although variable of intelligence, personality factors, variable of SES and creativity constellated with the criterion variable of achievement in Biology yet they were independent of each other. (vi) Further, 78.05%, 66.91% and 8.60% of total factor variance was explained by achievement in Biology, independent variable of intelligence and measures of creativity in
case of Varimax Factor (vide table 7.21). (vii) In Varimax Factor II measures of creativity shared 8.60% of variance with the criterion variable of achievement in Biology, whereas in Varimax Factor III the variable of intelligence shared 66.91% variance with the criterion variable of achievement in Biology. In other words in Varimax Factor II, there was closer proximity between achievement in Biology and measures of creativity and in Varimax Factor III there was closeness between variable of intelligence and achievement in Biology.

Therefore, in case of rural sample also, the results of factor structure confirmed the hypothesis 5(b) that variable of intelligence, SES, creativity and personality factors cluster together in group factor/s with the achievement in Biology in case of rural senior secondary students.

In may be inferred from above mentioned findings through factor analysis and rotation of factors in respect of both urban and rural samples that :-

1) In urban sample four Original Factors (Factor number I, II, III, IV) and two Varimax Factor (Factor number III and IV) were identified. Similarly in rural sample four Original Factors (Factor number I, II, III, IV) and two Varimax Factors (Factor number II and III) were identified wherein measure of achievement in Biology
shared common variance with the variable of intelligence, personality factors, variable of SES and creativity.

2) The variable of intelligence shared significant loading with the criterion variable of achievement in Biology in Original Factor III and IV in urban sample as well as in Original Factor II, III, IV and Varimax Factor III in case of rural sample.

3) Personality factors revealed factorial constellation with the criterion measure of achievement in Biology in Original and Varimax Factor structure in urban sample and in Original Factor structure in case of rural sample.

4) Variable of intelligence and creativity showed a structural unification with the criterion variable of achievement in Biology and thus may be conceived as belonging to the same domain in both the samples in Original as well as in Varimax Factor structure. It implied although variable of intelligence and creativity belong to the same domain, yet they were factorially distinguishable from each other.

5) Although a number of relevant factor identified for urban and rural samples are nearly comparable yet pattern of constellation of various variables namely, variable of intelligence personality factors, variable of SES and creativity with the criterion measures of achievement in Biology was different in case of urban
and rural samples.

6) Criterion measure of achievement in Biology shared the maximum variance on relevant factors in factor analysis with variable of SES, intelligence, personality and creativity in descending order of magnitude in Original Factor structure and it shared maximum variance with personality and creativity in descending order of magnitude in Varimax Factor structure in case of urban sample.

7) Variable of achievement in Biology shared maximum variance with the variable of intelligence, SES, personality factors and creativity in descending order of magnitude in Original Factor structure whereas it shared maximum variance on relevant factors with the variable of intelligence and creativity in Varimax structure in case of rural sample.

8) Measures of personality constellated themselves with the criterion measure of achievement in Biology in case of Original Factor I and II and Varimax Factor I in case of urban sample and Original Factor I, III and IV in case of rural sample.

9) Measures of creativity were grouped with the criterion measure of achievement in Biology in Original Factor II and III and Varimax Factor III in the urban sample and Original Factor II and IV and Varimax Factor II in case of rural sample.
10) Variable of intelligence and SES constellated themselves with the achievement in Biology only in Original Factor structure and not in Varimax Factor structure in urban sample.

11) Variable of personality and SES constellated themselves with the criterion measure of achievement in Biology only in Original Factor structure and not in Varimax Factor structure in case of rural sample.

12) "Group Factor of Personality" and "Factor of SES" sharing common variance with the achievement in Biology appeared in both the samples (Original Factor I and II in urban sample and Original Factor I and III in rural sample).

13) "General Factor of Cognition" sharing common variance with achievement in Biology also appeared in both the samples (Original Factor III in urban sample and Original Factor II in rural sample).

14) "General Factor of Mental Ability" sharing common variance with the criterion variable of achievement in Biology also appeared in both the samples (Original Factor IV in urban sample and Varimax Factor III in rural sample).

15) "General Factor of Biological Achievement" also appeared in the urban as well as in rural samples (Varimax
Factor III in urban sample and Original Factor IV in rural sample.

Thus in the light of the above results hypothesis 5(c) that factor structure underlying the measure of intelligence, SES, creativity, personality factors and achievement in Biology of urban senior secondary students differ from that of rural senior secondary students was accepted.
SECTION - THREE

(Step-up Regression Equations)

Although all variables in table 7.1 and 7.2 do not correlate significantly in a bivariate analysis, yet it is likely that some of these measures to a great extent account for the significant variance for achievement in Biology when they are combined in a multivariate analysis. Further, step up regression equations were set up by adding one independent variable to the previous one at a time with the criterion variable of achievement in Biology separately and examined for their efficiency in predicting the achievement of the students in Biology for both the urban and rural senior secondary students. The technique of multiple correlation and multiple regression equations were applied to test the following hypotheses 6a, 6b, 6c and 6d which are given below for ready reference:

6a) Intelligence, SES, Creativity and Personality Factors are differential predictors of achievement in Biology in case of urban senior secondary students.

6b) Intelligence, SES, creativity and personality factors are differential predictors of achievement in Biology in case of rural senior secondary students.
6c) Conjoint effect of the variables of intelligence, SES, creativity and personality factors is higher as compared to their separate prediction in predicting the achievement of the urban senior secondary students in Biology.

6d) Conjoint effect of the variables of intelligence, SES, Creativity and personality factors is higher as compared to their separate prediction in predicting the achievement of rural senior secondary students in Biology.

Factors of personality, intelligence, SES and creativity which were found significantly related or clustered together with the students achievement in Biology were taken as predictors or independent variables and the variable of achievement in Biology was taken as criterion variable or dependent variable. The multiple 'R' and multiple regression equations with different combination of independent variables by stepping up one variable at a time were computerized for both urban and rural samples. To test the significance of difference between the value of 'R' from one specific combination of independent variables to the subsequent variable explaining the stepping up of an additional variable to the previous-combination, 'F' ratios were also computerized. 'R', multiple regression equations and F ratios and regression coefficients of predictors for urban sample have been shown from table 7.23 to 7.29 and for rural sample the value of multiple
'R', multiple regression equations, F ratios and regression coefficient of predictors have been shown from Table 7.30 to 7.38. Variables symbols as entered in all the regression equations have been given in Table 7.22.

Sixteen regression models-seven for urban sample and nine for rural sample, were discussed for testing the hypotheses 6(a), 6(b), 6(c) and 6(d) and to study the predictive values of independent variables which were found significantly related while taking in different combinations and to identify independent variable which could be used as predictors of achievement in Biology.

Only those predictors were considered for discussion which emerged as potent predictors of achievement in Biology, reaching at least at .05 level of significance as shown by 'F' test. Simultaneously a reference was made to product moment correlations of these variables with achievement in Biology and the factor loadings which these variables shared in constellation with achievement in Biology of the senior secondary students in order to give a consolidated and integral picture of the result obtained. Further, regression equations were set up on the basis of those variables which were either found significantly related with (in product moment correlation) or clustered together with criterion variable (in factor analysis).
**TABLE - 7.22**

Showing Variables Symbols as Entered in Regression Equation.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Variable Name</th>
<th>Symbol</th>
<th></th>
<th>Sr. No.</th>
<th>Variable Name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Intelligence</td>
<td>$X_1$</td>
<td></td>
<td>1.</td>
<td>Intelligence</td>
<td>$X_1$</td>
</tr>
<tr>
<td>2.</td>
<td>SES</td>
<td>$X_2$</td>
<td></td>
<td>2.</td>
<td>SES</td>
<td>$X_2$</td>
</tr>
<tr>
<td>3.</td>
<td>Personality Factor F</td>
<td>$X_3$</td>
<td></td>
<td>3.</td>
<td>Personality Factor B</td>
<td>$X_3$</td>
</tr>
<tr>
<td>4.</td>
<td>Personality Factor L</td>
<td>$X_4$</td>
<td></td>
<td>4.</td>
<td>Personality Factor G</td>
<td>$X_4$</td>
</tr>
<tr>
<td>5.</td>
<td>Creativity Fluency (F)</td>
<td>$X_5$</td>
<td></td>
<td>5.</td>
<td>Personality Factor G</td>
<td>$X_5$</td>
</tr>
<tr>
<td>6.</td>
<td>Creativity.Flexibility (X)</td>
<td>$X_6$</td>
<td></td>
<td>6.</td>
<td>Personality Factor I</td>
<td>$X_6$</td>
</tr>
<tr>
<td>7.</td>
<td>Creativity.Originality (O)</td>
<td>$X_7$</td>
<td></td>
<td>7.</td>
<td>Creativity.Fluency (F)</td>
<td>$X_7$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.</td>
<td>Creativity.Flexibility (X)</td>
<td>$X_8$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9.</td>
<td>Creativity.Originality (O)</td>
<td>$X_9$</td>
</tr>
</tbody>
</table>
A step up regression analysis in the present study was based upon the statistical analysis, devised by Benett and Franklin (1954), whereby at each step the variable entered into the regression equation was that which explained the greatest variance i.e. variable with the highest partial correlation with the dependent variable was entered into the first step and so on in a descending order till the last step of regression equation.

**URBAN SAMPLES**

**Model - I :**

Model I was designed to show how much variance towards the criterion variable of achievement in Biology was accounted for by the linear variable of intelligence. The value of \( r \) between intelligence and achievement in Biology as entered in table 7.23 was equal to .387. It was significant at .01 level. Also value of multiple correlation i.e. \( R \) was equal to .387.

The value of \( R^2 \) was found to be .150 which explained that variable of intelligence contributed to 15.0% of variance in the criterion variable. In other words 15% of the individual differences in the achievement of urban senior secondary students in Biology could be attributed to the differences in their intellectual level.
**TABLE - 7.23**

Showing R between Independent variable of Intelligence and criterion variable of achievement in Biology (Urban sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>DF</th>
<th>%age of Variance</th>
<th>F</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int</td>
<td>Achievement</td>
<td>$y = 20.3 + .25x_1$</td>
<td>.150</td>
<td>.387</td>
<td>338</td>
<td>15.0</td>
<td>59.65</td>
<td>.387</td>
</tr>
</tbody>
</table>

**TABLE - 7.24**

Showing R between Independent variable of Intelligence, SES and criterion variable of achievement in Biology (Urban sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>DF</th>
<th>%age of Variance</th>
<th>F</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int &amp; SES</td>
<td>Achievement</td>
<td>$y = 30.1 + .26x_1 - .31x_2$</td>
<td>.169</td>
<td>.411</td>
<td>337</td>
<td>16.9</td>
<td>33.54</td>
<td>.410</td>
</tr>
</tbody>
</table>
# Table 7.25

Showing R between independent variable of intelligence, SES personality Factor F and criterion variable of achievement in Biology (Urban sample).

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>R</th>
<th>DF</th>
<th>%age of F Variance</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int &amp; SES</td>
<td>Achievement</td>
<td>$y = 32.6 + .26x_1 - .25x_2$</td>
<td>.182</td>
<td>.427</td>
<td>336</td>
<td>18.2</td>
<td>-.104</td>
</tr>
<tr>
<td>+ in Biology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

# Table 7.26

Showing R between independent variable of Intelligence, SES, personality factor F, L and Criterion variable of Achievement in Biology (Urban sample).

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>R</th>
<th>DF</th>
<th>%age of F Variance</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int + SES + P Factor F+</td>
<td>Achievement</td>
<td>$y = 34.2 + 27x_1 + 1.17x_2$</td>
<td>1.87</td>
<td>.433</td>
<td>335</td>
<td>18.7</td>
<td>-.146</td>
</tr>
<tr>
<td>P Factor F+ in Biology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table - 7.27

Showing R between independent variable of Intelligence, SES, personality factors F, L, and criterion variable of achievement in Biology (Urban sample).

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>$DF$</th>
<th>%age Variance</th>
<th>$F$</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int &amp; SES</td>
<td>Achievement</td>
<td>$y = 32.19 + 0.25x_1 - 0.18x_2$</td>
<td>.191</td>
<td>.437</td>
<td>.334</td>
<td>19.1</td>
<td>15.7</td>
<td>.172</td>
</tr>
<tr>
<td>+ P FactorF in Biology</td>
<td></td>
<td>$y = -0.31x_3 - 0.03x_4 + 0.04x_5$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P FactorL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Fluency (F)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table - 7.28

Showing R between independent variable of Intelligence, SES, personality factors F, L, Fluency (F), and criterion variable of achievement in Biology (Urban sample).

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>$DF$</th>
<th>%age Variance</th>
<th>$F$</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int &amp; SES</td>
<td>Achievement</td>
<td>$y = 31.89 + 0.25x_1 - 0.18x_2$</td>
<td>.192</td>
<td>.439</td>
<td>333</td>
<td>19.2</td>
<td>13.1</td>
<td>.163</td>
</tr>
<tr>
<td>+ P FactorF in Biology</td>
<td></td>
<td>$y = -0.31x_3 - 0.03x_4 + 0.001x_5 + 0.05x_6$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P FactorL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Fluency (F)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>+ Flexibility(X)</td>
<td></td>
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</tr>
</tbody>
</table>
### Table 7.29

Showing R between independent variable of Intelligence, SES, personality factor $F$, L, Fluency ($F$), Flexibility ($X$), and criterion variable of achievement in Biology (Urban sample).

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>DF</th>
<th>%age of F Variance</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int + SES</td>
<td>Achievement</td>
<td>$\text{\gamma} = 31.18 + 0.26x_1 - 0.18x_2$</td>
<td>0.196</td>
<td>0.442</td>
<td>332</td>
<td>19.6</td>
<td>11.5</td>
</tr>
<tr>
<td>+P Factor F</td>
<td>In Biology</td>
<td>$-0.31x_3 - 0.03x_4 - 0.07x_5$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor L</td>
<td></td>
<td>$+0.04x_6 + 0.10x_7$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Fluency ($F$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Fluency ($F$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Flexibility ($X$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Originality (O)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
These findings were further supported by the conclusions of factor analysis as Original Factor IV in case of urban sample was identified as a "Factor of General Mental Ability". Variable of intelligence shared positive significant loading of the order of .696 with the criterion measure of achievement in Biology in Factor IV in urban sample.

Model - II:

This model gave the proportion of variance of the criterion measure of achievement in Biology attributable to the conjoint effect of variable of intelligence and SES. The value of $R^2 = .169$ (vide table 7.24) showed that 16.9% of whatever made students differ in achievement in Biology was attributed to the two independent variables of intelligence and SES. It implied that 15% of the variance of the criterion measure of achievement in Biology was attributable to intelligence and 1.9% to SES. Value of multiple correlation i.e. $R = .411$ was slightly higher than the individual correlation between independent and dependent variable.

F-test showed that in the criterion measure of achievement in Biology the prediction of achievement by intelligence in addition to the prediction by SES was significant at .01 level (vide table 7.24).
It may be inferred from the above mentioned results that conjoint effect of intelligence and SES was higher than their separate prediction in the prediction of achievement in Biology. This implied that although SES and intelligence were significantly related to achievement in Biology (vide table 7.1) yet they have their distinctive component which in their own way were positively related to achievement and when put conjointly increased the potentiality of the variables in predicting achievement in Biology.

Passi (1971), Corey (1978) and Yadav (1986) also obtained similar results.

Model - III:

This model was set up by stepping up personality factor F (Sobber vs Happy go lucky) to the variable of intelligence and SES. Values of $R^2$ and $R$ increased from .169 to .182 and .411 to .427 and percentage of variance increased from 16.9% to 18.2%. In the light of significant coefficient of correlation ($r = -.104$) between personality factor F and achievement in Biology and on the basis of F value ($F = 25.05$) significant at .01 level, the factor F of personality (sober vs happy go lucky) was found to be a good predictor of achievement in Biology.
Also results of factor analysis (vide table 7.6) had led to the identification of Original Factor I as a "Group Factor of Personality" wherein personality factor F shared significant loading of the order of .836 and therefore, confirming further, that personality factor F and criterion variable of achievement in Biology are associated with this factor. Thus the variable of personality factor F (sober vs happy go lucky) in a multivariate analysis found to be a good predictor of urban students achievement in Biology.

The above results were supported by Dhaliwal (1971) Hemalatha and Renuka Devi (1987) findings.

Model - IV:

In this model personality factor L (trusting vs suspicious) was added to the model III. By stepping up personality factor L, value of $R^2$, $R$ and percentage variance increased from .182, .427, 18.2% to .187, .433 and 18.7% respectively. F value ($F=19.35$) and coefficient of correlation between personality factor L and criterion variable of achievement in Biology were found to be significant. Therefore, personality factor L was found to be influencing the achievement in Biology.

As from the results of factor analysis (table 7.6) the personality factor L shared significant loading of
the order of .328 with Original Factor I in urban sample, therefore, these results further supports that personality factor L (trusting vs Suspicious) in a multiple correlational analysis was also found to be a good predictor of urban students achievement in Biology.

The findings of the present study resembled with the findings of Abraham (1969) and Hemalatha and Renuka Devi (1987).

Model - V:

In this model with the stepping of creativity measure i.e. fluency (F) to the model IV, there was an increase of $R^2$ from .187 to .191 and also an increase in the value of $R$ from .433 to .437. Percentage variance increased from 18.7% to 19.1% meaning thereby that .4% variance of criterion variable was predicted by variable of fluency (F) and this value was significant at .01 level as it was noticed by F value (F=15.7). Coefficient of correlation between fluency (F) and criterion variable of achievement in Biology was .172 which was also significant at .01 level. The value of multiple correlation ($R = .437$) was higher than the individual correlation ($r = .172$) between independent variable of fluency (F) and dependent variable of achievement in Biology.

The value of $R^2 = .191$ showed that 19.1% of whatever made urban senior secondary students differ in their
achievement in Biology was attributed to the variable of intelligence, SES, personality factor F, L and fluency (F) and that 15% of criterion measures of achievement in Biology was attributable to variable of intelligence, 1.9% to the variable of SES, 1.3% to the variable of personality factor F and .5% to the personality factor L and .4% to fluency (F). The remaining 80.9% of the variance in predicting the achievement in Biology was attributable to the variables not taken up here.

In the light of above results, therefore, measure of creativity i.e. fluency (F) was found to be influencing the achievement in Biology.

The above results were also supported by the results of factor analysis because measure of fluency (F) shared significant loading of the order of .855 with Original Factor III in urban sample and a loading of .955 with Varimax Factor III in urban sample.

The above results were in line with the findings of Nuefeld (1964), Gakhar and Wahi (1979) and Yadav and Saraswat (1989) who obtained similar results concerning the prediction of intelligence and creativity towards academic achievement.
Model - VI:

This model presented the variance accounted for the criterion variable as predicted from the measure of intelligence, SES, personality factor F, L, fluency (F) and flexibility (X). The coefficient of multiple R in this model has been raised from .437 to .439.

It was noticed from table 7.28 that these above mentioned variables predicted 19.2% of the criterion variable which showed an increase of .10% variance from the value predicted by previous model V.

The variable of flexibility (X) had a significant correlation of .163 and factor loading of .833 on Original Factor III and .929 on Varimax Factor III with achievement in Biology in urban sample. When F-test was applied it was observed that addition of flexibility (X) to the variables of intelligence, SES, personality factor F, personality factor L and fluency (F) was significant (F = 13.1) at .01 level and thus the variable of flexibility (X) was a potent predictor of the criterion measure of achievement in Biology.

Model - VII:

The present model was based on the cumulative weight-age of the variable i.e. intelligence, SES, personality factor F, personality factor L, fluency (F), flexibility
(X) with the stepping up of a variable Originality (O). With the addition of this variable, the multiple R has been increased a little more from the value of .439 to .442 and in this way percentage variance also increased from 19.2% to 19.6%. In this way this percentage increase in the percentage variance i.e. .40% was due to the variable of measure of Originality(O).

The variable of Originality had shown a significant correlation of .157 with the criterion measure and the factor loading of .818 on Original factor III and .925 on Varimax Factor III in urban sample.

F-test revealed that the stepping up of the variable of Originality (O) to model VI resulted into significant increase in the variance (F = 11.5) in predicting the criterion variable of achievement in Biology.

RURAL SAMPLE

Model - I :

The first model presented the variance accounted for the criterion variable as predicted by the independent variable of intelligence. Values of $R^2$ and R were found to be equal to .378 and .614, which implied 37.8% of variance was contributed due to the variable of intelligence in predicting the achievement of rural senior secondary students in Biology.
The value of coefficient of correlation \((r = .614)\) was significant at .01 level. Factor structure underlying the independent variable also supported the above results because the variable of intelligence shared significant loading of the order of .818 in Varimax Factor III in case of rural sample. Therefore, on the basis of above results, the variable of intelligence may be considered as a potent predictor of achievement of rural senior secondary students in Biology.

**Model - II:**

This model was set up with the combination of variable of intelligence and SES. With the stepping up of independent variable of SES, the values of \(R^2\) and \(R\) have been raised from .378 and .614 to .390 and .625 respectively and percentage variance increased from 37.8% to 39.0%.

The variable of SES had shown a significant correlation \((r = .483)\) with the criterion measure of achievement in Biology at .01 level and factor loading of the order of .398 on Original Factor III in rural sample.

F-test revealed that stepping up of variable of SES to the previous model was significant \((F = 50.3)\) at .01 level and thus variable of SES exercised influence on the achievement of rural senior secondary students.
### Table 7.30

Showing $R$ between independent variable of Intelligence and criterion Variable of Achievement in Biology (Rural Sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>DF</th>
<th>%age Variance</th>
<th>$F$</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence</td>
<td>Achievement in Biology</td>
<td>$Y = 8.56 + .59x$</td>
<td>.378</td>
<td>.614</td>
<td>158</td>
<td>37.8</td>
<td>96.08**</td>
<td>.614</td>
</tr>
</tbody>
</table>

### Table 7.31

Showing $R$ between independent variable of Intelligence and SES and Criterion Variable of Achievement in Biology (Rural Sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>DF</th>
<th>%age Variance</th>
<th>$F$</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence + SES.</td>
<td>Achievement in Biology</td>
<td>$Y = 11.7 + .57x_1 - .44x_2$</td>
<td>.390</td>
<td>.625</td>
<td>157</td>
<td>39.0</td>
<td>50.3**</td>
<td>.483</td>
</tr>
</tbody>
</table>
Table 7.32
Showing R between independent variable of Intelligence, SES and Personality Factor A and Criterion Variable of achievement in Biology (Rural sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Multiple Regression Equation</th>
<th>R</th>
<th>R^2</th>
<th>R^2</th>
<th>R^2</th>
<th>%age Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int. + SES + Personality Factor A</td>
<td>Y = 0.5 + 0.5X1 + 0.5X2 + 0.5X3</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>42.0</td>
</tr>
</tbody>
</table>

Table 7.33
Showing R between independent variable of Intelligence, SES, Personality Factor A and Personality Factor B and criterion variable of achievement in Biology (Rural sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Multiple Regression Equation</th>
<th>R</th>
<th>R^2</th>
<th>R^2</th>
<th>R^2</th>
<th>%age Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int. + SES + Personality Factor A + Personality Factor B</td>
<td>Y = 1.0 + 1.0X1 + 1.0X2 + 1.0X3</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>42.0</td>
</tr>
</tbody>
</table>
Table 7.34

Showing R between independent variable Personality Factor G and Criterion Variable of achievement in Biology (Rural Sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>R²</th>
<th>R</th>
<th>DF</th>
<th>%age Variance</th>
<th>F</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int+SES</td>
<td>Achievement</td>
<td>Y=19.4+.53x₁.445</td>
<td>.667</td>
<td>154</td>
<td>44.5</td>
<td>24.7**</td>
<td>-.265</td>
<td></td>
</tr>
<tr>
<td>+P Factor A</td>
<td>in Biology</td>
<td>-.23x₂-.61x₃</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor B</td>
<td></td>
<td>-.52x₄-.13x₅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor G</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Table 7.35

Showing R between independent variable of Intelligence, SES, Personality Factor A, B, G and Personality Factor I and criterion variable of achievement in Biology (Rural Sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>R²</th>
<th>R</th>
<th>DF</th>
<th>%age Variance</th>
<th>F</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int + SES</td>
<td>Achievement</td>
<td>Y=18.7+.53x₁.446</td>
<td>.668</td>
<td>153</td>
<td>44.6</td>
<td>20.5*</td>
<td>-.169</td>
<td></td>
</tr>
<tr>
<td>+P Factor A</td>
<td>in Biology</td>
<td>-.25x₂-.64x₃</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor B</td>
<td></td>
<td>-.56x₄-.17x₅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Personality Factor I</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
**Table 7.36**

Showing $R$ between independent variable of Intelligence, SES, Personality Factor A, B, G, I, and Fluency(F) and Criterion Variable of Achievement in Biology (Rural Sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>DF</th>
<th>%age Variance</th>
<th>$F$</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int + SES + P Factor A in Biology</td>
<td>$Y = 17.4 + 0.50x_1$</td>
<td>0.451</td>
<td>0.671</td>
<td>0.152</td>
<td>45.1</td>
<td>17.8*</td>
<td>0.243</td>
<td></td>
</tr>
<tr>
<td>+ P Factor B</td>
<td>$-0.29x_2 - 0.62x_3$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P Factor G</td>
<td>$-0.57x_4 - 0.19x_5$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P Factor I</td>
<td>$+0.01x_6 + 0.05x_7$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P Fluency(F)</td>
<td></td>
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</tr>
</tbody>
</table>

**Table 7.37**

Showing $R$ between independent variable of Intelligence, SES, Personality Factor A, B, G, I, Fluency(F) and Flexibility(X) and Criterion Variable of achievement in Biology (Rural Sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>$R^2$</th>
<th>$R$</th>
<th>DF</th>
<th>%age Variance</th>
<th>$F$</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int + SES + Fluency(F) in Biology</td>
<td>$Y = 16.4 + 0.52x_1$</td>
<td>0.459</td>
<td>0.677</td>
<td>0.151</td>
<td>45.9</td>
<td>16.03*</td>
<td>0.192</td>
<td></td>
</tr>
<tr>
<td>+ P Factor A</td>
<td>$-0.24x_2 - 0.66x_3$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P Factor B</td>
<td>$-0.54x_4 - 0.16x_5$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P Factor G</td>
<td>$+0.02x_6 + 0.18x_7$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P Factor I</td>
<td>$-0.15x_8$</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Table 7.38
Showing R between independent variable of Intelligence, SES, Personality Factor A, B, G, I, Fluency (F), Flexibility (X) and Originality (O) and Criterion Variable of Achievement in Biology (Rural Sample)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Criterion Variable</th>
<th>Multiple Regression Equation</th>
<th>R²</th>
<th>R</th>
<th>DF</th>
<th>%age Variance</th>
<th>F</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int. + SES</td>
<td>Achievement in Biology</td>
<td>$Y = 16.7 + 0.53X_1 + 1.462$</td>
<td>0.679</td>
<td>150</td>
<td>46.2</td>
<td>14.3*</td>
<td>0.213</td>
<td></td>
</tr>
<tr>
<td>+P Factor A</td>
<td></td>
<td>$-.25X_2 -.062X_3$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor B</td>
<td></td>
<td>$-.53X_4 -.15X_5$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor G</td>
<td>Achievement in Biology</td>
<td>$+.02X_6 +.24X_7$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor I</td>
<td></td>
<td>$-.15X_8 -.07X_9$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+P Factor F</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Flexibility(X)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Originality(O)</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Model - III:

The model was formed for assessing the influence of personality factor A. The values of $R^2$, $R$ and percentage variance had increased from .390, .625 and 39.0% to .420, .648 and 42.0% respectively.

The variable of personality factor A had a significant negative correlation of -.189 with achievement in Biology and also had a significant loading of the order of .339 on Original Factor I in rural sample.

F-test showed that for the criterion measure of achievement in Biology, the addition to the prediction of achievement in Biology made by predictor personality factor A (reserved vs outgoing) was significant at .01 level ($F = 37.7$).

The above results have been supported by Abraham (1969), Dhaliwal (1971) and Somasundran (1980).

Model - IV:

This model presented the variance accounted for the criterion variable as predicted from the measures of intelligence, SES, personality factor A and personality factor B. The coefficient of multiple 'R' in this model
has been raised from .648 to .666. It was noticed from table 7.33 that these above mentioned variable predicted 44.4% of the criterion variable which showed about 2.40% increase from the value predicted by previous model III.

The variable of personality factor B had a significant correlation of -.269 and factor loading of the order of .288 on Original Factor I in rural sample with the criterion variable of achievement in Biology.

When F-test was applied it was noticed that the addition of personality factor B to the variable of intelligence, SES, and personality factor A (reserved vs outgoing), this personality factor B (less intelligent vs more intelligent) was significant (F = 31.005) at .01 level and thus variable of personality factor B was a good predictor of the criterion measure of achievement in Biology.

Model - V :

The present model based on the cumulative weightage of the variables i.e. intelligence, SES, personality factor A, personality factor B with the stepping up of variable of personality factor G (conscientiousness vs expedience). With the addition of this variable the multiple 'R' has been increased slightly from the value of .666 to .667 and in this way percentage variance has slightly increased from 44.4% to 44.5%. Thus .10% increase
in the percentage variance was due to the variable of personality factor G (conscientiousness vs expedience).

The variable of personality factor G (conscientiousness vs expedience) had shown a significant correlation of -.265 with the criterion variable of achievement in Biology and the factor loading of .546 on the Original Factor I in rural sample.

F-test revealed that the stepping up of the variable of personality factor G (conscientiousness vs expedience) to model V has resulted into significant increase in variance (F = 24.7) in predicting the criterion variable of achievement in Biology.

Model - VI:

In this model the conjoint effect of the variables namely intelligence, SES, personality factor A, Personality factor B, personality factor G and personality factor I (Tough minded vs tender minded) was seen. The value of multiple 'R' predicted by these variable was found to be .668.

The maximum variance predicted by the variables of this model VI was 44.6% (vide table 7.35), which showed an increase of .10% from the previous model V.
The variable of personality factor I (Tough minded vs tender minded) had a significant correlation of the value of -.169 with the criterion measure of achievement in Biology and the factor loading of the order of .463 on Original Factor I in case of rural sample.

F-test showed that the obtained F-value (F = 20.5) was significant at .01 level, which implied that the addition of the variable of personality factor I (Tough minded vs tender minded) to model V contributed significantly towards the prediction of criterion measure of achievement in Biology.

Model - VII :

This model was formed to see the predictive efficiency of rural senior secondary students in Biology. When the variable of fluency (F) was added to the previous model VI with the addition of this model, the value of multiple 'R' was raised from .668 to .671. There was also an increase in the value of percentage variance from 44.6% to 45.10%, inferring that .50% variance was due to the addition of variable of fluency (F).

Variable of Fluency (F) had a significant positive correlation of the order of .243 with the criterion measure of achievement in Biology and the factor loading of the
order of .915 and .957 on original Factor II and Varimax Factor II respectively in rural sample.

With the addition of the variable of fluency (F) the F-value (F = 17.8) was found to be significant at .01 level which showed that variable of fluency (F) was also a potent predictor of criterion variable of achievement in Biology.

Model - VIII :

Model VIII was made to see the predictive efficiency of variable of flexibility (X) in predicting the criterion variable of achievement in Biology while stepping it up in the previous model VII. By doing this, the value of multiple 'R' was raised from .671 to .677. This showed that there was an increase in the percentage variance from 45.1% to 45.9% and hence an increase of .80%. The value of coefficient of correlation between the variable of flexibility (X) and the criterion variable of achievement in Biology was of the order of .192 which was significant at .01 level and factor loading of the order of .894 and .919 on Original Factor II and Varimax Factor II respectively in rural sample.

Statistical value of F was observed to be significant at .01 level (F = 16.03), whereby showing that the variable of flexibility was also a good predictor of achievement.
The last model i.e. model number IX was designed to show how much variance towards the criterion variable of achievement in Biology in case of rural senior secondary students was accounted for by the addition of the variable of Originality (O) to the previous model VIII. The values of $R^2$, multiple 'R' and percentage variance increased from .459, .677, 45.9% to .462, .679 and 46.2% respectively.

The value of 'r' between Originality (O) and the achievement in Biology as entered in table 7.38 was equal to .213 which was significant at .01 level. Further, variable of Originality (O) shared significant loading of the Order of .875 and .909 on Original Factor II and Varimax Factor II with the achievement in Biology in rural sample.

F-value was also found to be significant at .01 level ($F = 14.3$). Also the Varimax Factor II was identified as "Group Factor of Creativity". Thus, in the light of the above results the measures of Originality (O) was also found to be influencing the achievement of rural senior secondary students in Biology.
On the basis of above results of regression equation, therefore, following inferences were drawn:

1) Variable of intelligence was a good predictor of achievement in Biology of both urban as well as rural senior secondary students.

2) Variables of SES also emerged as a good predictor of achievement in Biology in both the urban as well as rural samples.

3) Out of sixteen measures of personality, only two measures i.e. personality factor F (sober vs happy go lucky) and personality factor L (trusting vs Suspicious) emerged as a good predictors of achievement in Biology in urban sample.

4) Four measures of personality i.e., Personality Factor A (Reserved vs outgoing), personality factor B (Less intelligent vs More intelligent), personality factor G (Conscientiousness vs Expedience) and personality factor I (Tough minded vs Tender minded) out of sixteen measures, emerged as good predictors of achievement in Biology in rural sample.

5) None of the personality factors which was common in both the samples emerged as a predictor of achievement in Biology in both the samples.

6) Remaining fourteen personality factors i.e. personality factors A, B, C, E, G, H, I, M, N, O, Q.
Q_2, Q_3 and Q_4 were not significantly correlated with achievement in Biology and hence were not predictors of achievement in Biology in urban sample. Similarly remaining twelve personality factors i.e. C, E, F, H, L, M, N, O, Q_1, Q_2, Q_3 and Q_4 were not found to be the good predictors of achievement in Biology in rural sample. Delition of these personality factors did not reduce the predictive efficiency as based upon the remaining personality factors in urban as well as rural sample.

7) Measures of creativity i.e. fluency (F), Flexibility (X) and Originality (O) were influencing the achievement of the urban as well as rural students in Biology and hence measures of creativity also emerged as strong predictor of urban and rural senior secondary students achievement in Biology.

In the light of the above findings, therefore, hypothesis 6(a) that Intelligence, SES, Creativity and personality factors are differential predictors of achievement in Biology in case of urban senior secondary students; hypothesis 6(b) that Intelligence, SES, Creativity and personality factors are differential predictors of achievement in Biology in case of rural senior secondary students; hypothesis 6(c) that conjoint effect of the variables of intelligence, SES, creativity and personality is higher as compared to their separate prediction in predicting the achievement of urban senior students in Biology and
hypothesis 6(d) that conjoint effect of the variables of intelligence, SES, creativity and personality is higher as compared to their separate prediction in predicting the achievement of rural senior secondary students in Biology were accepted.
In this Section, effect of different levels of independent variables i.e. Intelligence, SES, Personality, Creativity and Sex on the achievement (in Biology) of urban and rural senior secondary students were examined by way of t-ratios in order to test the hypotheses No. 7a, 7b, 7c, 7d, 7e, 7f, 8a, 8b, 8c, 8d, 8e, 8f, 9 and 10 which are given below for ready reference.

7a) There are significant differences in the achievement (in Biology) of urban senior secondary students at different levels of intelligence.

7b) There are significant differences in the achievement (in Biology) of urban senior secondary students at different levels of SES.

7c) Extraversion ($E^+$) and introversion ($E^-$) accounts for significant difference in the achievement (in Biology) of urban senior secondary students.

7d) The levels of anxiety namely high and low contribute to significant differences in the achievement (in Biology) of urban senior secondary students.

7e) There are significant differences in the achievement (in Biology) of urban senior secondary students at different levels of creativity.
7f) There are significant differences in the achievement (in Biology) of urban senior secondary students at different levels of sex.

8a) There are significant differences in the achievement (in Biology) of rural senior secondary students at different levels of intelligence.

8b) There are significant differences in the achievement (in Biology) of rural senior secondary students at different levels of SES.

8c) Extraversion ($E^+$) and introversion ($E^-$) accounts for significant differences in the achievement (in Biology) of rural senior secondary students.

8d) The levels of anxiety namely high and low contribute to significant differences in the achievement (in Biology) of rural senior secondary students.

8e) There are significant differences in the achievement (in Biology) of rural senior secondary students at different levels of creativity.

8f) There are significant differences in the achievement (in Biology) of rural senior secondary students at different levels of sex.

9) Significant difference exists in the achievement (in Biology) of urban and rural senior secondary students at different levels of intelligence, SES, creativity, personality characteristics and sex.
10) Significant difference exists in the achievement (in Biology) of urban and rural senior secondary students.

The overall picture of the achievement of urban and rural senior secondary students was obtained separately by evaluating the effect of different independent variables i.e. intelligence, SES, personality characteristics, creativity and sex.

Independent variables i.e. variable 1 (intelligence) was varied in three-ways low intelligence, average intelligence and high intelligence; variable 2 (SES) was varied in three ways - low SES, average and high SES; variable 3 (personality traits i.e. extraversion) was varied in two ways - extrovert and introvert and similarly anxiety was varied in two ways - low anxiety and high anxiety; variable 4 (total creativity) was varied in three ways - low creative group, average creative group and high creative group - but in case of creativity total scores were first changed into T-scores and then grouping were made. Variable 5 (sex) was varied in two ways - male and female.

All the urban and rural senior secondary students were involved in each of the conditions representing categories of different independent variables.
### Table 7.39

Showing t-ratios to locate groups which differed in achievement on the basis of different levels of Intelligence and SES (Urban sample = N=340)

<table>
<thead>
<tr>
<th>Variable No.</th>
<th>Name of Variable</th>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>Between Groups</th>
<th>df</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Intelligence</td>
<td>I</td>
<td>35.717</td>
<td>7.999</td>
<td>I &amp; II</td>
<td>224</td>
<td>1.982*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>38.144</td>
<td>7.838</td>
<td>I &amp; III</td>
<td>151</td>
<td>6.306**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>44.131</td>
<td>6.899</td>
<td>II &amp; III</td>
<td>299</td>
<td>6.720**</td>
</tr>
<tr>
<td>II</td>
<td>Socio-Economic Status</td>
<td>I</td>
<td>33.409</td>
<td>7.320</td>
<td>I &amp; II</td>
<td>136</td>
<td>2.972**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>38.722</td>
<td>8.089</td>
<td>I &amp; III</td>
<td>222</td>
<td>4.378**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>41.123</td>
<td>7.900</td>
<td>II &amp; III</td>
<td>316</td>
<td>2.370*</td>
</tr>
</tbody>
</table>

* Indicates significant level at .05 level.
** Indicates significant level at .01 level.
Table 7.40
Showing t-ratios to locate groups which differed in achievement in Biology on the basis of different levels of personality, creativity and sex (urban sample N=340)

<table>
<thead>
<tr>
<th>Variable No.</th>
<th>Name of Variable</th>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>Between Groups</th>
<th>df</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Personality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extraversion</td>
<td>I Extrovert</td>
<td>44.370</td>
<td>6.32</td>
<td>I &amp; II</td>
<td>136</td>
<td>11.73**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II Introvert</td>
<td>33.841</td>
<td>8.24</td>
<td>131</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anxiety</td>
<td>I High Anxiety</td>
<td>34.440</td>
<td>6.37</td>
<td>146</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>II Low Anxiety</td>
<td>44.720</td>
<td>8.68</td>
<td>I &amp; II</td>
<td>119</td>
<td>10.82**</td>
</tr>
<tr>
<td></td>
<td>Extraversion</td>
<td>I</td>
<td>38.272</td>
<td>9.328</td>
<td>I &amp; II</td>
<td>285</td>
<td>1.462</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>40.064</td>
<td>7.877</td>
<td>I &amp; III</td>
<td>106</td>
<td>1.448</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>40.698</td>
<td>7.989</td>
<td>II &amp; III</td>
<td>283</td>
<td>0.526</td>
</tr>
<tr>
<td></td>
<td>Sex</td>
<td>Male I</td>
<td>39.852</td>
<td>9.061</td>
<td>148</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female II</td>
<td>40.162</td>
<td>7.880</td>
<td>190</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indicates significant level at .05 level.
** Indicates significant level at .01 level.
The values of t-ratio along with values of mean and SD for different groups have been entered in tables, 7.39, 7.40, 7.41, 7.42 and 7.43.

**Urban Sample:**

From the result of table 7.39 it was found that there exist significant differences between the three groups of urban senior secondary students divided on the basis of their intelligence scores (subject scoring 51 and above were considered to be falling under high intelligence level, subjects having their intelligence scores between 31 and 50 were included under the average level, subjects scoring 30 and below 30 were considered to be falling under low level) as the values of t-ratios between group I & II, between I & III and between II & III were found significant at .05 level or above (t between group I & II = 1.982, between I & III = 6.306, between II & III = 6.720). In other words students of low, average and high intellectual ability differed with each other in their achievement in Biology and that too significantly from each other. It was also observed that mean score of high intelligence group (group III, mean = 44.131) was higher as compared to average intelligence group (group II, mean = 38.144) and low intelligence group (group III, mean = 35.717) on the achievement test in Biology. This showed that high intelligence accounts for higher achievement in the learning of biological concepts. Thus the empirical validity in obtaining higher
score on achievement test in Biology for high intelligence group was established. This phenomenon can be understood if intelligence is thought of broadly speaking in terms of reasoning, ability to learn, perceptual and motor speed, speed in organising thoughts and ideas, ability of making quick association characterized by enriched amount of knowledge—longitudinally as well as vertically and the like. Beyond doubts these factors seem to be equally present in a situation requiring new learning such as learning of biological concepts. Another explanation accounting for higher score of high intelligence group on the achievement test may be looked into the nature of intelligence test used in the present study. Tondon’s (1971) Group test of General Mental Ability consists of nine sub-sets namely—number series, mathematical instructions, following instructions, vocabulary similar, vocabulary opposites, classification, analogies, best answers and reasoning. These abilities clearly are involved in learning of biological concepts.

In the light of the above discussion, the hypothesis 7(a) that there are significant differences in the achievement (in Biology) of urban senior secondary students at different levels of intelligence was accepted.

The results obtained in the present study were in agreement with the findings of Freeman (1942), Shukla (1958), Rastogi (1964), Rao (1965), Sinha (1967), Sinha (1970), Phatak (1972), Dhaliwal & Saini (1976), Mishra
(1978) and Yadav & Srivastva (1989) wherein intelligence and concept learning in general and intelligence and scientific concepts in particular were found to be positively correlated thereby accounting for better concept learning on the basis of higher intelligence.

From the results as entered in table 7.39 mean difference on achievement in Biology among three groups of students on the variable of SES, it was found that group III (high SES group) scored higher on Achievement Test (mean = 41.123) while the group I (low SES group) scored lower (mean = 33.409), whereas the group II (average SES group) scored the average marks (mean = 38.722). Mean difference between group I & II (t = 2.972), I & III (t = 4.378) and II & III (t = 2.370) were found to be statistically significant at .01 level or above.

Results showed that students with high socio-economic status did better on achievement test as compared to their counterparts whose SES was lower or average. In other words socio-economic status of the students played a very important role in enhancing the ability of learning biological concepts, and that students scoring high on socio-economic status scale were having high scores on Achievement Test and vice versa. The reason for the higher achievement on the Achievement Test in Biology among the higher socio-economic status urban group may be due to the fact that in urban areas members of families with higher socio-economic status are generally literates.
and thus parents due to their education can look after the education of their children. Also elder brothers and sisters in the families help their youngesters and take interests in their study. Secondly parents with high socio-economic status by virtue of their education, nature of job, outwardly outlook, friendly relations with the children, spend more time with their children, take more interest in their day to day activities and studies, provide good books and environment which enhance the ability of the students and help them to get good marks. Therefore, the hypothesis 7(b) that there are significant differences in the achievement (in Biology) of urban senior secondary students at different levels of SES was also accepted.

The results of present study were in line with the findings of Burt (1937), Davis (1947), Mathur (1963), Jain (1965), Chopra (1967), Patil (1972), Patel (1977), Vijay Lakshmi (1980), Gakhar (1983, 1987) and Jagnandhan (1986).

Upon the variable of extraversion, introverts and extraverts were isolated by including all subjects of urban sample scoring 47 and above (mean + .5 SD) under extraversion ($E^+$) and the subjects scoring 41 and below (mean - .5 SD) were included under the category of introversion ($E^-$). The subjects having scores between 41 and 47 were ignored. For classifying introverts and extroverts the manual for 16 PF was consulted.
It was observed from table 7.40 that t-ratio of 11.73 related to extraversion was significant at .01 level. Extrovert scored 10.53 scores higher than the introverts on the Achievement test in Biology. Therefore, the hypothesis 7(c) that extraversion (E+) and introversion (E-) accounts for significant differences in the achievement (in Biology) of urban senior secondary students stood accepted.

The results were in agreement with the empirical evidence based on Eysenckian Theory that extrovert perform better on task because they have a tendency to excel slowly, accumulate, reactive, inhibition quickly and dissipate it slowly, Eysenck (1960), but in disagreement with the results of Eber and Cattell (1967) that extrovert can do very favourable in situation that call for temperament for salesmanship etc. but it should not be considered necessarily favourable as a general predictor e.g. of scholastic achievement. There is another explanation for this. Kelinsmith and Kaplan (1963) have explained that introverts are characterised by high arousal and extroverts by poor arousal and while consolidation is taking place, the highly aroused organisation is at disadvantage because it interferes with recall.

Classification of urban subjects under high and low anxiety groups was done with the help of the methods given in the manual of 16 PF by Eber and Cattell (1967).
The variable of anxiety was also found to be significantly influencing the achievement of urban senior secondary students in Biology, as the t-ratio was found to be significant at .01 level ($t = 10.824$ vide table 7.40). It was also noticed that the mean achievement score of high anxiety group was lower than the mean of low anxiety group (mean of high anxiety group on achievement test = 34.440 and mean of low anxiety group = 44.720). In this way the hypothesis 7(d) that the levels of anxiety namely high and low contribute to significant differences in the achievement (in Biology) of urban senior secondary students was accepted.

According to the results of the study variable of anxiety have an important implication in the achievement of biological concepts and drive inductive property of anxiety has shown its motivation effect in the present study. The explanation of high performance of low anxiety group over the high anxiety group may be sought in accordance with Sarason (1958) report that the nature of the taks is an important variable in evaluating the effect of anxiety. His study showed that very difficult task might lead to greater decrement in performance for high anxiety subject than for low anxiety subject because the more difficult task might arouse a much more anxiety than very simple task would do. The task given in the present study that is the achievement test in Biology, can be considered very difficult task. Another explanation
may be that the stable individuals (low anxiety group) require more of the external motivation to come to their best and hence perform better on more complex tasks which provide a challenge to their ability.

From the results of table 7.40 it was clearly observed that t-ratio between high and average creative, average and low creative and low and high creative were insignificant. In other words on the basis of these results there was no significant differences between the high creatives and average creatives, average creatives and low creatives and low creatives and high creatives. That is, high creatives, average creatives and low creatives did not differ from each other on the Achievement test in Biology, however, the high creatives did better on the achievement test than did the average and low creatives (Means of low creative group I = 38.272, average creative group II = 40.064 and high creative group III = 40.698 vide table 7.40).

The above results were suggestive of the fact that urban senior secondary students who prefer greater number of relevant ideas, whether of the same (fluency) or of different type (flexibility) or original responses (originality) did not influence the achievement of the students in Biology in any way. The reason for the no difference in the creativity level of the urban senior secondary students may be due to the fact that lack in urban school
teachers creative awareness of creativity which is responsible for unexposure of the students to appropriate experiences in learning biological concepts.

Therefore, the above results led to the rejection of the hypothesis 7(e) that there are significant differences in the achievement (in Biology) of urban senior secondary students at different levels of creativity.

These results were in agreement with the findings of Kogan (1965) and Bagga (1973) and correlational results of the present study given in section one where in total, verbal creativity was not correlated with the achievement of the urban senior secondary students in Biology.

On the variable of sex although the value of mean score (in Biology) of female was slightly high as compared to male, yet no significant difference existed between their means as was depicted in table 7.40 (mean score of female on achievement test in Biology = 40.162 and mean score of male in achievement test in Biology = 39.852). It implied therefore, that all the urban senior secondary students of the present sample were found to have nearly same achievement level in Biology irrespective of their sex. In other words the variable of sex was found to have less variation on achievement test in Biology. This may be due to the effect of educational institutions from where the sample of present study was drawn.
provide a similar type of environment to all the students and hence no difference in achievement in Biology.

Therefore, the hypothesis 7(f) that there are significant differences in the achievement in Biology of urban senior secondary students at different levels of sex was rejected.

Sharma (1977), Aggarwal and Saraswat (1981) and Dutta (1989) have also found that sex did not contribute towards achievement.

(B) **Rural Sample** :

To see the significant differences between three groups of students divided on the basis of their intelligence, t-values were calculated (t between group I & II = 5.675, between I & III = 7.054, between II & III = 4.484 vide table 7.41) which were found significant at .01 level. The results showed that significant differences occurred between low, average and high intelligence groups of rural students. The results also showed that significant differences were obtained between mean scores of low intelligence, average intelligence and high intelligence group (mean of low intelligence group, group I = 24.333 mean of average intelligence group, group II = 32.388, and mean of high intelligence group, group III = 44.600) on the achievement in Biology and the differences were in favour of high intelligence group. In other words,
Table 7.41

Showing t-ratios to locate groups which differed in achievement in Biology on the basis of different levels of Intelligence and SES (Rural Sample N = 16)

<table>
<thead>
<tr>
<th>Variable No.</th>
<th>Name of Variable</th>
<th>Groups Mean SD</th>
<th>Between Groups</th>
<th>df</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intelligence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
<td>24.333 6.118</td>
<td>I &amp; II</td>
<td>153</td>
<td>5.675**</td>
</tr>
<tr>
<td>II</td>
<td></td>
<td>32.388 6.036</td>
<td>I &amp; III</td>
<td>24</td>
<td>7.054**</td>
</tr>
<tr>
<td>III</td>
<td></td>
<td>44.600 3.577</td>
<td>II &amp; III</td>
<td>137</td>
<td>4.484**</td>
</tr>
<tr>
<td>2</td>
<td>Socio-Economic Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
<td>27.260 6.224</td>
<td>I &amp; II</td>
<td>120</td>
<td>2.942**</td>
</tr>
<tr>
<td>II</td>
<td></td>
<td>31.666 6.523</td>
<td>I &amp; III</td>
<td>59</td>
<td>4.025**</td>
</tr>
<tr>
<td>III</td>
<td></td>
<td>34.526 7.168</td>
<td>II &amp; III</td>
<td>135</td>
<td>2.234*</td>
</tr>
</tbody>
</table>

* Indicates significant level at .05 level.

** Indicates significant level at .01 level.
Showing t-ratios to locate groups which differed in achievement in Biology on the basis of different levels of Personality, Creativity and Sex (Rural Sample, N=160)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Name of Variable</th>
<th>Group</th>
<th>Means</th>
<th>SD</th>
<th>df</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Extraversion</td>
<td>I</td>
<td>36.720</td>
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</tr>
<tr>
<td></td>
<td>II Introvert</td>
<td></td>
<td>26.751</td>
<td>6.240</td>
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</tr>
<tr>
<td>Anxiety</td>
<td>I High Anxiety</td>
<td></td>
<td>34.064</td>
<td>6.550</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II Low Anxiety</td>
<td></td>
<td>26.240</td>
<td>6.512</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creativity</td>
<td>I &amp; III</td>
<td></td>
<td>31.650</td>
<td>6.210</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II &amp; III</td>
<td></td>
<td>26.153</td>
<td>6.152</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Male I</td>
<td></td>
<td>31.422</td>
<td>7.66</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Female II</td>
<td></td>
<td>31.977</td>
<td>7.13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indicates significant level at .05 level.
** Indicates significant level at .01 level.
Showing the significance of difference between means of achievement in Biology of urban and rural senior secondary students

<table>
<thead>
<tr>
<th>Variable Code</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference</td>
<td>Rural</td>
<td>160</td>
<td>31.712</td>
<td>6.950</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Indicates significant level at .01 level.

** Indicates significant level at .01 level.
according to the results of the study, the biological achievement of those rural students who were having high intellectual level, was certainly better than those students who were having average and low intellectual level. Thus intelligence was found to be a strong factor in determining the achievement of the rural students in Biology.

The reason for high achievement of higher intellectual group as compared to other two groups may be the same as already explained while discussing the independent variable of intelligence under urban sample.

Thus the hypothesis 8(a) that there are significant differences in the achievement (in Biology) of rural senior secondary students at different levels of intelligence was retained here.

t-ratios for the variable of SES were found to be significant between group I & II (low & average SES group) at .01 level; between group I & III (low SES & High SES groups) at .01 level; between group II & III (average & high SES groups) at .05 level (t between group I & II = 2.942, between group I & III = 4.025, between group II & III = 2.234 vide table 7.41). This indicated that socio-economic status of the students significantly affect their achievement in Biology. t-ratio indicated that significant differences exist between the mean scores of the student in Biology who were having low socio-economic
status (mean = 27.260), average socio-economic status (mean = 31.666) and high socio-economic status (mean = 34.526).

The reasons for such results may be that in the present set up due to the impact of scientific and technological advancement in rural areas, majority of the parents who are interested in the higher study of their children are themselves have education at least upto matric or above matric level. Such parents although living in rural areas but by virtue of their education, income and high socio-economic status provide such an environment and facilities in the home which can influence the achievement of their children. Similarly, parents with average socio-economic status though ignorant and not much educated but are very anxious about the education and progress of their children because such parents realise the importance of education for the well adjustment of their children in the present set up of the society. Group I (low socio-economic status group) who get lowest score on the Achievement test in Biology might be the children of labour force living in the villages dominated by zamindars and always busy in earning their livelihoods and thus hardly find any time to know what is happening around them and have least interest in the activities of their children. These findings, thus led to the acceptance of hypothesis 8(b) that there are significant differences in the achievement (in Biology) of rural senior secondary students at different levels of SES.
Rural extroverts and introverts senior secondary students were classified in the same way as urban senior secondary students.

It was noticed from table 7.42 that t-ratio of 9.605 related to extraversion was significant at .01 level. Mean score of extroverts was higher as compared to introverts (mean of $E^+ = 36.720$ and mean of $E^- = 26.751$). In other words achievement of the extroverts was better than the achievement of the introverts on the achievement test in Biology. Thus the hypothesis 8(c) that extroversion ($E^+$) and introversion ($E^-$) account for significant differences in the achievement (in Biology) of rural senior secondary students was accepted.

The reasons for the superiority of extroverts over introverts may be the same as has already been discussed under urban sample.

The classification of rural senior secondary students into high anxious and low anxious group was also done in accordance with the direction as given in the manual of 16PF by Eber and Cattel (1967). Due to significant t-ratio ($t = 6.142$) at .01 level significant differences were exists between high and low anxiety groups. Mean achievement of the high anxious rural students in Biology was lower than the low anxious rural students (mean of high anxiety group on achievement test = 27.754 and mean of low anxiety group on achievement test = 35.064). The
reason for the low achievement of high anxiety group may be that very high anxiety is generally disruptive of performance and productive of physical disturbances. In the light of these results hypothesis 8(d) that the level of anxiety namely high and low contribute to significant differences in the achievement (in Biology) of rural senior secondary students was accepted.

From the summary of the results of t-ratio as presented in table 7.42, no significant t-ratios were obtained between the low and average creative, average and high creative and high and low creative rural senior secondary students. Although high creative rural senior secondary students scored higher than the average and low creative group yet the difference were not statistically significant (mean of low creative group on achievement test = 32.600, average creative group = 31.163, and high creative group = 33.240)

The results of present study suggested that achievement of the rural senior secondary students did not differ regardless of their creativity level. The reasons for statistically insignificant t-ratios between low and average creative, between average and high creative and between high and low creative rural senior secondary students may be that neither the teachers in the rural setting take care of the creative potentiality of students nor the rural students find such an environment in which their creative ability can be enhanced.
Therefore, the hypothesis 8(e) that there are significant differences in the achievement (in Biology) of rural senior secondary students at different levels of creativity was rejected.

t-ratio for the significance of difference between male and female on the mean scores on achievement test in Biology was also entered in table 7.42. The results revealed no significant differences between means of male (mean 31.422) and female (mean 31.977). In other words sex differences had not influenced the achievement of the males and females in Biology. The reasons for no difference in achievement of boys and girls may be the same as have already been discussed in urban sample. Thus the hypothesis 8(f) that there are significant differences in the achievement (in Biology) of rural senior secondary students at different levels of sex was rejected.

The above results of t-ratios related to the independent variables of intelligences, SES, personality, creativity and sex with the dependent variables of achievement in Biology led to the following conclusions:

1) Significant difference exist in the achievement (in Biology) of urban as well as rural senior secondary students at different levels of intelligence.
2) Significant differences exist in the achievement (in Biology) of urban as well as rural senior secondary students at different levels of SES.

3) Significant differences exist in the achievement (in Biology) of urban as well as rural senior secondary students at different levels of personality (extraversion and anxiety).

4) No significant differences exist in the achievement (in Biology) of urban as well as rural senior secondary students at different levels of creativity.

5) No significant differences exist in the achievement (in Biology) of urban and rural senior sec. students at different levels of sex.

Therefore, on the basis of the inferences drawn from the above results hypothesis 9 that significant differences exist in the achievement (in Biology) of urban and rural senior secondary students at different levels of intelligence, SES, creativity, personality characteristics and sex was retained here except in case of creativity and sex.

Results of table 7.43 showed that for the students of urban setting the mean score of achievement in Biology was higher as compared to their counterparts in rural setting (mean score of urban students on Achievement Test in Biology = 39.873 while mean score of rural students on Achievement Test in Biology = 31.712). Mean difference of these groups was statistically quite significant (t
=11.65) at .01 level. In other words according to the results of present study the achievement of the urban senior secondary students was certainly better than the students of rural setting.

The phenomena of higher score of the urban students on Achievement test in Biology as compared to the achievement of the students of rural setting maybe explained that the students in urban setting have greater educational opportunities and get more potential from the teachers. In urban areas there are well furnished Biological laboratories with adequate equipment, students get more opportunities for experimentation. Students of urban setting can take private coaching from teachers. Well equipped libraries are available for up to date knowledge of scientific facts and phenomenon. On the other hand students of rural setting due to their poor family background cannot have adequate educational opportunities. Laboratories and libraries are not well equipped in rural areas. Teachers generally do not take interest in teaching in rural areas and they do not guide the students properly because most of the teachers are coming daily from cities and they are always in hurry in going back to their homes. Other reasons for the low ability of achievement in Biology among the rural students may be that in rural areas, generally there are government institutions where there are no provision for adequate physical facilities. Teachers are also indifferent towards their students.
In the light of the above findings the hypothesis that significant difference exists in the achievement (in Biology) of urban and rural senior secondary students was also retained.

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