CHAPTER III

REVIEW OF TEST-LITERATURE

Review of past researches prepare a background for work to be followed up. The first step in the review of literature was to study the 'classics' and 'readings' on psychometrics. The books listed in the bibliography were found to be of great use in formulating the design of the present work.

INDIAN TEST-LITERATURE

Indian publications, one edited by Adaval and the other by Long, were the standard works through which primary sources were traced for further scrutiny. When the list of Indian researches, relevant to the present works, was ready, the author visited the university libraries at Ahmedabad, Baroda, Bombay, Delhi and Vallabh Vidyanagar to refer to the unpublished dissertations on related areas. The lists of such dissertations and tests are given in the bibliography.

The tests developed at other centres were not traced, hence they were studied from the reviews and abstracts edited by Long in the First Mental Measurement Handbook for India. Only the abstracts and reviews concerning Numerical Ability were studied closely. The tests are referred to here by their index numbers in the Handbook.
Tests covered by the Handbook

The test-abstracts of Numerical ability, under any name, with index numbers 6404, 6406, 6501, 6502, 6503, 6604 and 7303 were studied to know the rational, operational and empirical basis of works carried out by their authors.

Item-contents. - Out of seven tests, five seem to have items of Numerical facility. Test number 6502 and 6503 have items requiring verbal components also. In the adaptation of D.A.T. Numerical, test number 6501, four items have been dropped from the original test.

Both the Selection Batteries, number 6404 and 6406, have items on number series.

The Educational Counseling Test Battery, number 7303, has six parts of Numerical Test along with seven parts of verbal and four parts of spatial Test. The parts of the Numerical Test are as follows:-

- Number checking
- Number series
- Number classification
- Number problems
- Number memory and
- Number computation

Data on differential prediction of the above tests could not be traced even through correspondence with the test developing agency at Calcutta.
Validity. - Test number 6503 was reported to correlate 0.45 with marks in science. Sample-size is not reported. Test number 6504 was reported to correlate 0.47 with marks in mathematics for standard eleventh and 0.32 with marks in mathematics for standard tenth. Nature and size of the sample are not reported. The Arithmetic test from number 6406 was reported to be correlated with average weekly marks obtained by trainees as follows:

- .19 Draftsmen Civil  (N = 38)
- .06 Draftsmen Mech.  (N = 35)
- .26 Surveyor        (N = 18)
- .18 Machinist       (N = 36)
- .17 Radio Mech.     (N = 30)
- .06 Refrigerator Mech. (N = 13)
- .07 Tailoring and cutting   (N = 70)

Availability. - Out of these seven tests only one, number 6504, is applicable to students in Gujarat, for the purpose of guidance in secondary schools. But the test is not available for general use. Its use is restricted to the Institute of Vocational Guidance, Bombay. The others are not adapted on samples from Gujarat. Not only that, but their reliabilities and validities are not yet studied and reported adequately.
Gujarat Adaptation of D.A.T. - Numerical Ability

The Numerical Ability Test (form A) was adapted by Pujara, for his M.Ed. dissertation in 1964 for High School Students in Gujarat. Adapted norms and instructions are not published. The items and instructions seem to be faithfully translated from the original English version. The average scores of eleventh standard are found to be higher than the corresponding U.S.A. norms. They are reported as follows:-

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>Md</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>68</td>
<td>20.25</td>
<td>20.03</td>
<td>6.90</td>
</tr>
<tr>
<td>Boys</td>
<td>257</td>
<td>22.75</td>
<td>22.77</td>
<td>8.50</td>
</tr>
</tbody>
</table>

(Pujara, p. 37)

Corresponding average scores on samples of U.S.A. are reported as follows:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>Md</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>2850</td>
<td>18.3</td>
<td>18</td>
<td>9.0</td>
</tr>
<tr>
<td>Boys</td>
<td>2700</td>
<td>20.6</td>
<td>20-21</td>
<td>10.1</td>
</tr>
</tbody>
</table>

(D.A.T. Manual (3rd Ed.), p. 28)

The retest reliability on a sample of 51 students (standards not specified), after a lapse of five months is reported to be 0.86, while split-half reliability on a sample of 201 (standard/s not specified) is reported to be 0.78. (Pujara, p. 66)
The higher norms on eleventh standard samples is indicative of higher ratios of selection and segregation at the respective grade level. The present author took a hint to evolve separate norms for sub-groups of tenth and eleventh standards. The consistent higher scores of boys on samples of Gujarat for Adapted D.A.T. prompted the present author to expect similar trend in the present work and separate norms as a natural corollary.

The adaptation was reported to be correlated 0.60 with marks in mathematics on a sample of sixty students of ninth standard. The differential validities are not reported.

Tests and studies by N.C.E.R.T.

The National Council of Educational Research and Training (New Delhi) conducts Science Talent Search Examinations for the last several years.

Talent search. - The 1965 test booklet contained twentyfive factual items and fifteen thought-type items in the section on mathematics. Even the factual items are application-type items to serve as useful models to coin new items for the present work. Most of the items, however, looked beyond the comprehension level of eighth standard pupils. This was natural because the examination was meant for selecting Talented students at the college level.
Achievement survey. - The Mathematics Achievement Survey, conducted by the National Institute of Education (New Delhi), under N.C.E.R.T., developed tests for an all India survey. The tests were administered in regional languages, including Gujarati, to the Primary, Middle and High school pupils. There are separate tests for each standard. The items are multiple choice, without separate answer-sheets. Most of the items are highly loaded with verbal component. Hence only a few of them could be of use as model items for the present work. The tests are, however, at present, very good models for achievement testing in any State of India.

Syllabi-study. - In absence of blue-prints for these tests the present author tried to study the contents covered by syllabi of mathematics in the various States of India. Position of Mathematics in India, an N.C.E.R.T. publication was found to be useful in knowing the range of the topics and the order of their frequencies of inclusion in the syllabi of States. The topics for high school Arithmetic and Algebra considered as relevant to the present work are listed below:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arithmetic</strong></td>
<td></td>
</tr>
<tr>
<td>Simple and compound interest</td>
<td>16</td>
</tr>
<tr>
<td>Percentage</td>
<td>14</td>
</tr>
<tr>
<td>Profit and Loss</td>
<td>13</td>
</tr>
<tr>
<td>Vulgar and decimal fractions</td>
<td>12</td>
</tr>
</tbody>
</table>
Some of the well-known tests developed in U.S.A. were referred to in the previous chapter on construct of Numerical Ability. There it was discussed how test-constructors differ in naming the variable, as well as its factorial composition judged from the mental operations covered by the test items.

Iowa tests

Itemwise content analysis of those tests are not known to have been published. Hence to avoid taxonomical misinterpretations, the list of concepts published for Iowa Tests of Basic Skills is adopted to indicate concepts.

(N.C.E.R.T., p.39-41)
considered relevant to the present work. The code-symbols are maintained as per the Iowa tests. They are as follows:

N - Concepts involving knowledge of Number system
   N-2 Relative value of numbers
   N-5 Positive and negative numbers
   N.10 Place value and zero as a place-holder

W - Concepts involving whole numbers
   W.3. b Relationships among number facts

F - Concepts involving fractions
   F.2 Part of a whole and part of a group
   F.3 Relative sizes
   F.6 a Ways to perform fundamental operations

D - Concepts involving Decimals
   D.3 Relative sizes
   D.4 a Ways to perform fundamental operations.

P - Concepts involving per cents
   P-1 Meaning and use
   P-2 Fractions, decimal and per cent equivalents

M - Concepts involving standard measures
   M-1 Telling time and time zones
   M-5 Changing from one unit to another

R - Concepts involving ratio and proportion
   R-1 Ratio and proportion
   R-3 Equations

( Lindquist, 3, pp. 36-37)
In terms of the concepts referred to above, the content analysis of the D.A.T. Numerical Ability Test AA can be expressed briefly as follows:

<table>
<thead>
<tr>
<th></th>
<th>Whole numbers</th>
<th>Decimal Vulgar fractions</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental operations</td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Square root and cube root</td>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Percentage</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ratio</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>11</td>
<td>9</td>
</tr>
</tbody>
</table>

In a review on the Differential Aptitude Tests, Keats has made some observations. A few of them are summarised below:

- In the new edition of D.A.T. there is a change from a score "corrected" for guessing to score equal to the number of correct responses for all tests.
- Data regarding homogeneity, item characteristics and criteria are necessary for test evaluation.
- Despite the extensive predictive validity coefficients for separate D.A.T. subtests, the Differential validity of the tests in predicting various criteria is still without substantiation.
- Adequate occupational validity and normative data are lacking.

- Students and parents being involved emotionally run a high probability of making unjustified decisions on the basis of the material included in the six page student report folder.

(Buros (Ed.) 2, pp. 1003-1007)

A.P.T.

Regarding the items of its Numerical test, the Manual of the Academic Promise Tests reports as follows:

The Numerical test is composed of a variety of item types, in order to sample several quantitative abilities. For the most part, the items require an understanding of concepts rather than extensive figuring. Arithmetic computation is involved in solving the problems, but reasoning rather than computation is intended focus of the test. Few words are used: reading is at a minimum.

(Academic Promise Test, Manual, p.6)

In a review of Academic Promise Tests, Stanley has stressed the need for explicit content validity and equal distribution of keyed options. (Buros (Ed.), 2, p. 999)

HINTS FOR THE PRESENT WORK

Review of the tests and test-literature gave some hints regarding the following points:

- The keyed options should be equal in number as far as possible.
- Correction for chance may be necessary in item analysis procedure, but it may not be of much use when responses are more than four and "none of these" being one of them.
- Data regarding homogeneity of test and item indices are necessary for evaluating the test.
- Multitrait Multimethod synthetic matrix of validity or Factor matrix should be aimed at, when the test is designed to function as a 'cell' of a multi-factor battery.
- Validity data and comparative norms should be provided on occupation or at least training groups, relevant to the measurement variable, before the test is placed in the market.

The measurement variable is now adequately defined and described through the first three chapters. The construction of the test involves developing operations by means of which the individual differences on the measurement variable are meaningfully described.