Various types of investigations, particularly those concerned with practise, memory and transfer, demand the use of much alternative material of a homogeneous character. In the type of mental examination represented by the intelligence scales this need has also made itself felt, as a precaution against the vitiation of results through the subject's fore-knowledge, incidental or purposeful, of the test material. In accordance with this situation have been compiled the tables of alternative material to be described. Those dealing with number material include addition, subtraction, multiplication and division, consecutive magnitudes, the reversed clock test, the problem of the enclosed boxes, the "ingenuity" test, a "relational" test with numbers, and memory for digits. Others dealing with language material comprise tables for alphabetical sequence, alternate directions material and vocabulary lists, together with a "cued combination" method for vocabulary and spelling. A simplified form of the Kent-Rosanoff frequency tables in the association test is also included.

As publication of the tables is not now possible, the writer will gladly answer inquiries in regard to experimental material from them. Here is described the present content of the tables, but it is not unlikely that they will be extended to other sorts of experimental material, and suggestions in this regard will be most welcome.

**TABLE I. ADDITION-SUBTRACTION**

Random drawings of the two place numbers from 11 to 99 inclusive, are grouped in series of 10 numbers each, with no number occurring more than once in each series, and in vertical column, thus:

<table>
<thead>
<tr>
<th>34</th>
<th>79</th>
<th>87</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
<td>25</td>
<td>82</td>
</tr>
<tr>
<td>27</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fifty such series have been prepared. They may be used either for adding the columns, or for adding (or subtracting) a fixed amount from each number (Woodworth-Wells constant increment test).
TABLE II. ADDITION-SUBTRACTION

A series of 100 random pairs of six place numbers was prepared. Each pair is given together with its sum. Any pair may be presented as an addition test, in which case the sum checks the correctness of the subject's answer. As a subtraction test, the sum is used as the subtrahend, and either number as the minuend. The other number checks the correctness of the subject's answer. Examples:

1. 683936 859629 1543565
2. 791661 554668 1346329

The table thus provides 100 such examples in addition, and 200 in subtraction.

TABLE III. MULTIPLICATION-DIVISION

A series of 200 random pairs of three place numbers was prepared, in which no digit occurs more than once in the same number. Each pair is given together with its product (after Crelle's tables). If any pair is presented for multiplication, the product checks the correctness of the subject's response. For division, this product is presented to be divided by either of the pair, and the other number checks the correctness of the quotient obtained by the subject. Examples:

1. 384 194 74496
2. 761 257 195577

If, in division, a remainder is desired, its amount is added to the dividend before presenting the problem. The table provides 200 such examples in multiplication and 400 in division.

These tables presenting mathematical problems in the abstract, are of course equally adaptable to any concrete setting in which the examiner may think fit to give them.

TABLE IV. CONSECUTIVE Magnitudes

A series of 1,000 four and five place numbers is presented. The nature of this list safeguards it against duplication except from clerical error. The subject may arrange a small group of the numbers in order of magnitude. The table begins,

8846
8059
10604
10653
10097
The problem is to tell the time indicated if the hands are reversed from that of a given time on the clock. 132 such problems are gathered in 11 columns of 12 each. It is intended that the problems of one experiment shall not be chosen from outside a single column of twelve. The list begins with the times, 3.36, 8.13, 12.41, 10.19.

As both original and reversed times are given in the table, the problem may be given from either one, and the answer checked from the other.

There are given twelve additional problems, based on combinations of 1-4 boxes.

The principle of the problem is preserved, but its statement altered to the following:

A doctor must measure out exactly \((q)\) ounces of medicine for a man who is sick in the woods. He has only an \((m)\) ounce measure and an \((n)\) ounce measure to do it with. Show how he can use these measures to get just the right dose of \((q)\) ounces without any guessing. He pours from one measure to the other, and what he does not want he pours back into his medicine bottle.

In the table, the problems are stated by giving first the smaller measure, then the larger measure, and then the amount to be obtained. Thus, 3-5-7 signifies, "3 and 5 to get 7." This problem, the first of those given by Terman and Yerkes, takes five steps for its complete solution. Their second problem, 5-7-8, takes seven steps. By varying these quantities, alternative problems have been prepared, classed as \(a\) when the larger measure is filled first, and as \(b\) when the smaller measure is filled first. The number of these alternates for differing degrees of complexity is as follows:

<table>
<thead>
<tr>
<th>No. steps in solution</th>
<th>(a)-problems</th>
<th>(b)-problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3)</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>(3)</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>(5)</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>(7)</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>(9)</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>(11)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>(13)</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>(15)</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Also one each of 9, 11, 13 and 15 step problems in which either measure is filled first.

The problems may be arranged in series of increasing complexity, care being used that the solution of a shorter problem is not involved in the solution of a longer one. A table of thirty such series is prepared, one of which is:

<table>
<thead>
<tr>
<th>No. steps</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>7-8-1</td>
</tr>
<tr>
<td>5</td>
<td>7-9-11a</td>
</tr>
<tr>
<td>7</td>
<td>4-5-7b</td>
</tr>
<tr>
<td>9</td>
<td>5-8-12b</td>
</tr>
<tr>
<td>11</td>
<td>4-9-11b</td>
</tr>
<tr>
<td>13</td>
<td>8-9-5b</td>
</tr>
<tr>
<td>15</td>
<td>8-9-4a</td>
</tr>
</tbody>
</table>
In three step problems, the direction to fill a certain measure first may be dispensed with.

**Table VIIIa. Mathematical Relations. (After Yerkes’ Multiple Choice and Relational Tests)**

Tables are prepared adapted to two forms of this test. First, the subject is required to *state* a certain relationship which is thus presented:

<table>
<thead>
<tr>
<th>What must be done to each of these numbers,</th>
<th>To get these numbers,</th>
</tr>
</thead>
<tbody>
<tr>
<td>269</td>
<td>292</td>
</tr>
<tr>
<td>378</td>
<td>381</td>
</tr>
<tr>
<td>276</td>
<td>279</td>
</tr>
</tbody>
</table>

The nature and complexity of the relations to be presented is indefinitely variable, and must be decided by the examiner. To facilitate the construction of such test material, the following tables are prepared:

- 100 random 3-place numbers between 200 and 450
- 15 2-place and 15 3-place numbers which are multiples of 3
- 15 2-place and 15 3-place numbers which are multiples of 4
- 15 2-place and 15 3-place numbers which are multiples of 6
- 10 2-place and 15 3-place numbers which are multiples of 7
- 10 2-place and 15 3-place numbers which are multiples of 8
- 10 2-place and 15 3-place numbers which are multiples of 9
- Three examples in 2-place and three examples in 3-place figures of each of the relationships: multiplication and division by 3, 4, 6, 7, 8, 9.
- Three examples in 2-place figures of each of the relationships: 2/3, 3/2; 3/4, 4/3; 5/6, 6/5; 6/7, 7/6; 7/8, 8/7; 8/9, 9/8.

**Table VIIIb**

Second, the subject may be requested to *apply* the relation, with or without its statement. Then a blank is left in a series presented where he is to insert the proper figure. Thus:

232 235 238 241 ,......

The tables quoted under VIIIa are also adapted to this form of experiment.

**Table IX. Memory for Digits**

108 orders of the nine digits are prepared according to these rules: (1) No order to have a figure differing from the preceding figure by 2, 1 or minus 1. (2) No order to have the same difference occurring twice in succession, as 2, 5, 8; or 9, 5, 1. (3) In the same group of three orders, no successive orders to have the same figure in the same position. (4)
In the same group of three orders, no two orders to begin or end with the same figures.

For convenience, the digits in each order are divided into groups of three. Thus the first group of this table is, (read horizontally),

\[
\begin{array}{ccc}
286 & 153 & 947 \\
749 & 625 & 183 \\
851 & 742 & 639 \\
\end{array}
\]

This table is equally adapted to the "reversed" repetition of digits (Bobertag, Terman), except that then, differences of plus 2 between successive digits will be involved.

If the conditions are not suitable for the usual type of memory test, a partial substitute (after W. D. Scott) may be had in requiring the subject to transcribe portions of this table, printed at one end of the test form, at the other end, thus,

\[
\begin{array}{c}
286153947 \\
749625183 \\
851742639 \\
\end{array}
\]

But in this form of test the rôle of memory is practically absorbed by attention.

**Table X. Alphabetical Sequence**

A list of 1,000 names in random alphabetical sequence is prepared. The constitution of this list does not wholly safeguard it from duplications, but they are practically eliminated. Among the many uses to which such a list may be put, is the arrangement of a small portion of the list in alphabetical order; or better, if responses are written, the indication of this order by prefixing to the names the numbers 1, 2, 3, etc. The table begins,

- Foley, Annie E.
- Gates, Mary M.
- Kennedy, Allan G.
- McDonald, Alice D.
- Robertson, Clara L.

**Table XI. Directions**

The text of the Woodworth-Wells hard directions test is so varied as to alter each of the responses called for. The number of alternative responses thus provided varies from 10 to 25 among the 15 directions of the test. The order of their presentation is also varied. In preparing a test form, the choice of each direction, and its place of sequence in the form, is governed by chance, giving an indefinite variety of test forms from the same foundation. Two sample forms are,
Put the number 736 before this name of a boy ....... John. # Write any letter except g just after this comma, ....... # If people believe Lincoln was president in the Civil War, cross out what you last wrote; but if it was someone else, put in the number to complete this sentence, "A dog has ... feet." # Notice the numbers 2, 9. # If iron is heavier than water, write the larger number here ; but if iron is lighter, write the smaller number here. ....... # Write no, no matter whether California is in Asia or not. ....... # Write again what you last wrote, here ....... # Write the first letter of your first name and the second letter of your last name at the beginning of the dotted line. ...........
# Write yes if 3 x 3 are 10 ......... ; if not, make a cross here .......
# Make a figure 3 under any one of these letters: F G H I J.
# If coal is black, make a figure 8 here ......... ; but if not, tell where the sun sets ....... # Make a dash after the longest of these three words, sand cow cattle. # If Thursday comes after Wednesday, make a square here ......... ; but if not, make a circle here ....... or two crosses here ....... 
# Give a wrong answer to this question, "How many days are there in the year?" ....... # Show by an exclamation point when the days are longer: In summer? ....... In winter? ....... # Give the correct answer, yes or no to this question, "Do turtles have shells?"

If a square is round, make a figure 3 here ....... ; but if not, tell where the sun sets ....... # Write no if 3 x 3 are 9 ......... ; if not, make a cross here ....... 
# Write again what you last wrote, here ....... # Show by a circle when the nights are shorter: In summer? ....... In winter? ....... 
# Write any letter except e just after this comma, ....... 
# Write yes, no matter whether Egypt is in Africa or not ....... # Make a comma after the shortest of these three words, pocket pole gun 
# Give the right answer to this question, "How many months are there in a year?" ....... # If you believe Paris is in Asia, cross out what you last wrote, but if it is somewhere else, put in the number to complete this sentence, "A chicken has ....... legs." # Notice the numbers 6, 9. If iron is lighter than water write the smaller number here ....... ; but if it is heavier, write the larger number here ....... # Make a dot to the right of any one of these letters: F G H I J. # Put the number 681 between these names of boys, John Alfred
# If Wednesday comes after Tuesday, make a circle here ....... ; but if not, make a square here ....... or two crosses here ....... # Give the correct answer, yes or no, to this question, "Are tigers fierce animals?" ....... 
# Write the first letter of your first name and the second letter of your last name at the end of the dotted line. 

Table XII. Vocabulary. (After Terman, The Measurement of Intelligence, 1916, pp. 224-231)

Two thousand words not in Terman’s standard list of 100 are similarly selected, at random according to their positions in Webster’s Primary Dictionary. Random drawings from these 2,000 are grouped in 20 series of 100 words each. The words in each series are presented roughly in order of their difficulty, beginning with the easiest.

Table XIII. The Method of Cued Combination

Its purpose is (1) to make the Vocabulary test of Table XII practicable as a group experiment, (2) to serve also as
a test of spelling without the examiner's pronouncing the word to be spelled.

In tests of word-combination, the word to be combined is usually left an entire blank. Here the word is not left wholly blank, but a determining cue is given. The extent of this cue should be such that (1) if the word forms a part of the subject's effective vocabulary, he can hardly fail to combine it properly; (2) if he does not know the word, he cannot supply it by guessing. This cueing must be done carefully, and its extent depends somewhat on whether the test is meant primarily for vocabulary or for spelling. In the latter case, only those portions of the word need be omitted where errors in spelling are most apt to occur.

In representing omitted portions of the word, it is sometimes desirable to represent the number of letters omitted, and sometimes not so. In the former case, each letter omitted is represented by a period, thus:

The boy was sucking a big ripe or...e

In the latter case, the omitted portion, of whatever length, is represented by a dash, as is usual in combination tests:

A cent is made of co——

Similar brief sentences, with appropriate cues for the word to be supplied in each, are prepared for

(1) The 100 words of Terman's Vocabulary Test. The same methods is now being extended to the 2,000 alternative words of Table XII.

(2) The "100 commonly misspelled words" of Hammond and Herzberg's "Style-Book of Business English," 1916, pp. 113-4. These are cued especially for spelling. Such methods of spelling test relieve the examiner from speaking the words, and the test from errors traceable to this cause. The subject simply fills out the test-form given him. One at the same time tests the ability to use the word correctly, as in testing for vocabulary.

(3) For spelling alone, a mixture of misspelled and correctly spelled words is efficient. Such misspellings as are given by Hammond and Herzberg are listed with other correctly spelled words selected from Table XII. The subject corrects the misspellings he notes.

---

Since the "median of community"\(^2\) in associative response is not affected by the responses of less frequency than 1%, the original tables of Kent and Rosanoff are reduced to a small fraction of their bulk by eliminating these, and the process of evaluation is also simplified. For the stimulus-word *Dark* the 114 items of the original Kent-Rosanoff table become 7, as follows:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark</td>
<td>7</td>
</tr>
<tr>
<td>black</td>
<td>76</td>
</tr>
<tr>
<td>bright</td>
<td>15</td>
</tr>
<tr>
<td>color</td>
<td>28</td>
</tr>
<tr>
<td>gloomy</td>
<td>11</td>
</tr>
<tr>
<td>light</td>
<td>427</td>
</tr>
<tr>
<td>night</td>
<td>22</td>
</tr>
<tr>
<td>room</td>
<td>22</td>
</tr>
</tbody>
</table>

The precision of the method is unaffected.

**Table XV. Towns and States**

A list of 400 leading towns and cities of the United States is prepared, containing the two largest towns in each State, and other towns over 15,000 population (together with Lakewood, N. J., and Portsmouth, N. H.), according to census of 1910. The towns included in this list are presented in random order. Any selection of these, preferably not less than 30, is given to the subject, who indicates the State in which the town is situated. When a town is specified for more than one State, (e. g. Jackson), the States specified for it in the table are to be named; (e. g. Mich., Miss., Tenn.). Credit is not given for States not specified in this table, though they may contain a smaller town of the name called for, (e. g. Jackson, N. H.). The table begins,

- Muskegon, Mich.
- Ansonia, Conn.
- Walla Walla, Wash.
- Hagerstown, Md.
- Leominster, Mass.

This table may be combined with Table X for a convenient associative memory method. Names taken from Table X are attached at random to addresses from the present table, and thus presented to the subject. After a given interval, it is seen if the subject, on being given the names alone, can recollect the address belonging to each.

---

TABLE XVI. LETTER-SQUARE

This table consists of 375 random drawings of one of twenty letters, paired with a random drawing of one of ten numbers, thus B 3, Q 8, T 5. There is presented to the subject a figure with 200 squares, designated vertically by letters and horizontally by numbers. The subject (1) gives the letter and number corresponding to five designated squares, (2) marks in a specified way five other squares whose letter and number are given. The table designates combinations of letter and number to be employed. No letter occurs more than once in any line of 15 combinations. In each line of 15, no number occurs more than once in the first 5 combinations or in the second 10 combinations.

A sample test form is,

|   | A | B | C | D | E | F | G | H | J | K | L | M | N | P | Q | R | S | T | U | W |
| 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 3 | x |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 5 |   | c |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | g |
| 7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | t |
| 8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 10|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

6. Each of the squares in the diagram above is named according to the letter under which it stands and the number on the same line with it. Thus the square with an x in it is named B3.

   Give the letter and number to name the squares which have in them the small letters c........; f........; t........; g........; n........

   Put a figure 6 in square W2.
   Put a figure 8 in square N4.
   Put a figure 2 in square F3.
   Put a figure 7 in square G4.
   Put a figure 4 in square J7.

Printed forms have been standardized for this experimental material. Each piece of test material, with its written instructions, is not more than 3 inches in height. The width is 7½ inches, or half or quarter thereof, according to space required. Test-forms from the different tables occupy the following portions of a type page 7½ x 9'':

Table I, Addition-Subtraction, 1/12
Table II, Addition-Subtraction, 1/12
Table III, Multiplication-Division, 1/6
Complete test-forms from Tables I-X, also XV, may be presented, recorded and filed on the standard 5 x 3 card; with the remaining tables, results alone are so filable. Slips of fairly heavy paper cut to 5 x 3 size are more convenient in use than cards, and occupy less space when filed.

Forms like those described are conveniently left blank except for the instructions to the subject, and any variation of the test-material entered upon it, from the tables, in printing, multigraph, typewriting or manuscript. The content of the tests is thus changed whenever desired. For individual examinations it is, in most of the tests, efficient to have the instructions (when not verbal) typewritten on a 5 x 3 slip a, and the test material on a second slip b. A third slip c is then clipped adjacent to the experimental material on slip b and on the slip c the subject records his response. This slip is then filed as his record in the test, while the slips a and b are available for repeated similar use. This is most convenient in practice and transfer experiments. Where a number of tests are made in this way with a single subject, the record slips may be filed upon larger master-cards (standard sizes up to 14¾ x 9½) or one behind the other in the regular 5 x 3 cabinet, suitably indexed.

(1) Words 38-70 inclusive, of Terman or alternate Vocabulary Lists.
(2) Seventeen random selections from Hammond and Herzberg's List.
(3) Different composition for 5 x 3 filing.