# NATIONAL ACADEMY OF SCIENCES

# LOUIS LEON THURSTONE

# 1887—1955

A Biographical Memoir by J. P. GUILFORD

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Biographical Memoir

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O<sup>N</sup> SEPTEMBER 19, 1955, one of the world's greatest psychologists passed from the scene. It is quite appropriate to say that Louis Leon Thurstone was to psychology of the first half of the twentieth century what Gustav Theodore Fechner was to the last half of the nineteenth. Fechner was the father of quantitative psychology; Thurstone was its chief torchbearer in recent years. In addition to his many novel contributions during the past thirty years, we have as memorials to him the Psychometric Society and the journal *Psychometrika*, both of which were founded through his initiative. Their motto was essentially his own motto: The development of psychology as a quantitative, rational science.

Thurstone was born in Chicago, May 19, 1887, to parents of native Swedish stock. The family name was Thunström but was later changed to a form that would better suit the American scene. His father had been an instructor in mathematics in the Swedish Army, and later became, in turn, a Lutheran minister, a newspaper editor, and a publisher. His mother was interested in music and musically talented. Leon and his sister, Adele, two years younger, started piano lessons when quite young. Leon showed a transitory interest in composing, whereas Adele later completed a college degree in music.

Thurstone's elementary education was obtained at several places-Berwyn, Illinois; Centerville, Mississippi; Stockholm, Sweden (both public and private schools); and Jamestown, New York. High school was completed in Jamestown. In high school he won a competition in geometry. With some of the prize money he purchased a Kodak, which marked the beginning of a lifelong hobby of photography, in which he later demonstrated considerable artistic skill. As a sophomore, his first notable literary effort was in the form of a letter on "How to Save Niagara," which appeared in the *Scientific American*. This was an attempt to solve the problem of utilizing large portions of Niagara's waters for power purposes while preserving the beauty of the falls, a lively issue at the time.

His second publication, also in the Scientific American, demonstrated his potentialities for creative thinking. As a high school sophomore he developed a geometric method for trisecting an angle, a solution that went beyond Euclidian geometry. Later, in college, he developed an equation for his solution.

Enrolled in electrical engineering at Cornell, Thurstone took a special interest in experiments in physics of the singing arc. The experiments took the direction of a method by which sounds could be recorded on film. He also worked on the designing of a new type of motion-picture camera and projector that eliminated flicker completely by means of a continuously running film.

His first notable interests in psychology arose during his studies of engineering at Cornell. A course on machine design particularly appealed to him. In this connection he was struck by the fact that among the problems of machine design are some concerned with the properties of the men who are to operate the machines. Today, of course, there is a growing effort and body of information along these lines, sometimes included under the heading of "human engineering." He also became interested in human learning as a scientific problem and attended a few lectures in psychology.

Having constructed a working model of his motion-picture projector, on which he secured a patent, he succeeded in having it demonstrated at the Thomas A. Edison laboratory. Although Edison was reported as being impressed, he did not decide to change over to the production of Thurstone's model. He did, however, offer Thurstone a position in his laboratory, which Thurstone accepted effective upon his graduation from Cornell. Thurstone's observations of the way in which Edison went about his work undoubtedly had much to do with his interest in the psychology of creative thinking, later in life.

His stay in the Edison laboratory was brief, owing to his desire to return to an academic setting. In the fall of 1912. Thurstone became instructor in engineering at the University of Minnesota, where he taught descriptive geometry and drafting. There he took his first course in experimental psychology and started his study of the learning function (performance as a function of practice time). In the summer of 1914 he started graduate work in psychology at the University of Chicago. A fellow student, now rather noted in other fields, was Beardsley Ruml.

In the fall of 1915, Thurstone accepted an assistantship in the new and active Department of Psychology at the Carnegie Institute of Technology, where the emphasis was on research in applied psychology. Earning his doctorate from Chicago in 1917, he was rapidly promoted at Carnegie, until he was Professor and head of the department in 1920, a position that he held until 1923. His wartime service included work in the trade-test division of the Army, where his methods of testing and of test appraising were put to use. In 1923 and 1924 he devoted a time to research in the Institute of Government, research aimed at the improvement of civil service practices. His efforts in this connection, and his later counsel, have had lasting effects upon the civil service.

In the summer of 1924 he was married to Thelma Gwinn whom he had known as a graduate student in psychology. That fall he became Associate Professor of Psychology at the University of Chicago. Subsequent academic assignments, briefly listed, include appointment to full professorship in 1928 and to Charles F. Gray Distinguished Service Professor in 1938. In the meantime, he established and directed the Psychometric Laboratory in the Social Sciences Division, in which capacity he continued until his retirement from Chicago in 1952. He had much to do with the institution of the unique examining system at Chicago and with its policies and practices in the Board of Examinations. During the year 1948-1949 he was visiting professor at the University of Frankfort. In the spring semester of 1954 he was visiting professor at the University of Stockholm and lectured at other Swedish universities as well as at the universities of Helsinki and Oslo. Upon his retirement from Chicago he became Research Professor and Director of the Psychometric Laboratory at the University of North Carolina, which was his affiliation at the time of his death.

Thurstone's contributions to psychological measurement grew out of his dissatisfactions with psychology as he found it. For example, little or no attention had been given to the description of learning curves in terms of mathematical equations. In connection with his doctoral dissertation Thurstone found that a large number of different empirical equations might be applied. In 1930 he published the derivation of the first general, rational equation for a learning curve. He demonstrated that under certain, somewhat standard conditions the learning functions is S-shaped. From his general function he deduced other relationships, which have been supported by learning data. For example, he deduced that learning varies as the 3/2 power of the number of items (beyond the memory span) in a memorized list.

He very early observed that practices of psychological testing were developing apparently without adequate foundations of theory to support them. He proceeded to do something about this from two directions, psychological and statistical. A major contribution to psychological theory was in his monograph on intelligence, which appeared in 1924. He developed and supported the thesis that the degree of intelligence is related to the degree of incompleteness of an act at which it becomes focal in consciousness. Becoming highly aware of an act during its early stages offers much opportunity to bring to bear upon it a wider range of choice or determination. This conception was poorly understood and Thurstone himself did little more to investigate intelligence from this particular point of view, at least explicitly.

From the standpoint of statistically oriented theory, Thurstone's new conceptions of testing were decidedly more notable. One of his chief, early concerns had to do with the development of a rational metric for mental ability. He rejected raw-score scales and mental-age scales because of uncertainty concerning equality of units and location of a meaningful zero point. He developed a method called "absolute scaling," based upon the concept of item difficulty, on which he published a report in 1925. Using measurements based upon the absolute-scaling method, he was able to estimate that the zero point of mental ability, as represented in test performance, should be placed at an age several months before birth. Using the same type of measurements, he concluded that the mental-growth function is typically S-shaped, with the inflection point at about the ten-year level.

Of all the statistical bases for tests that Thurstone developed, that of factor theory and factor analysis is the one for which he will be longest remembered. It is true that factor analysis was not new with Thurstone; Charles Spearman had initiated factor analysis in psychology as much as a quarter century earlier. Even before Spearman, Karl Pearson had proposed the idea of factor analysis as a statistical procedure. Thurstone came to the problem with a fresh approach, derived a more generalized theory, and developed procedures that prevail, in this country at least, today.

Whether it was Thurstone's engineering background or his natural habits of thinking, or both, in being faced with a new problem he usually went to the heart of it, reducing it to its simplest terms. He would, in effect, ask, "What are the variables involved? How are they interrelated?" He also recognized that all too frequently in psychology the readily available variables are not the fundamental ones. Thus, latent in any test-score scale, for example, there are probably one or more significant underlying variables or dimensions. Spearman and his followers had focused most of their attention upon what they believed to be the single intellective factor g, which was believed to be common to all tests involving cognition. While recognizing the existence of group factors (factors of limited generality among tests), they played down the importance of such components. Where only g exists in a group of tests, it alone determines their intercorrelations, and the latter exhibit a pattern of simple proportionality, except for sampling errors. The group factors were regarded by Spearman as primarily disturbers of the picture of simple proportionality and as having little psychological significance.

In approaching the factor problem, Thurstone simply asked the question, "How many factors are needed to account for the intercorrelations and how general is each factor?" He regarded a table of intercorrelations among tests as a matrix and applied to it the mathematics of matrix algebra. This called for a number of new conceptions and led to a more general theory in which the Spearman g-factor model is a special case. The number of common factors is represented by the rank of the matrix. The concept of *communality* was introduced by Thurstone to stand for the sum of the proportions of common-factor variance of a test. This concept aroused considerable criticism, but it is now generally recognized that communality cannot be ignored.

In the practice of factor analysis, Thurstone developed his centroid method of extracting factors. A similar summational method has been developed by Cyril Burt in England. But Thurstone differs most from Burt and his followers in insisting that the centroid method gives an arbitrary reference frame that usually makes no psychological sense. The reference frame must be rotated in order to arrive at positions for the axes that are psychologically meaningful. His chief criterion as to where to rotate lies in his concept of *simple structure*. Roughly, simple structure means that with tests represented by vectors extending from the origin of the *n*-dimensional reference frame, there are definite regions of higher and lower density of test vectors. The meaningful axes are located at regions of high density. This procedure results in a *factor pattern* for a group of tests, with each test exhibiting relations to a minimal number of factors and each factor tending to have relations to a minimal number of tests. The principle of simple structure thus provides criteria for a unique solution to the rotation problem.

Very frequently the optimal achievement of simple-structure solutions calls for oblique rotations of factor axes. Oblique rotations have become the rule in the Thurstone procedures of analysis. In terms of theory, this meant to Thurstone that the psychological factors are correlated; they are not statistically independent. The correlation between a pair of factors is estimated from the cosine of the angle of separation between them. The matrix of intercorrelations of the first-order factors can be factor analyzed, giving rise to second-order factors. These are factors among factors, and Thurstone regarded them as having genuine psychological meaning. On this point there is not general agreement among investigators. Noting that Spearman's g factor is not found among the firstorder factors, Thurstone suggested that it could probably be found among the second-order factors. Thurstone's major publications on factor theory and method were The Vectors of Mind (1935) and Multiple Factor Analysis (1947).

Having developed procedures for factor analysis, Thurstone carried out a number of factor-analytic studies, often in collaboration with his wife Thelma. In 1938 he reported his first findings on aptitude factors, which he called "primary mental abilities." This study involved a battery of 57 tests administered to 240 superior university students. Similar studies were made with children in different age groups, even at the kindergarten level, showing essentially the same primary mental abilities at all levels. He subsequently developed and published for general use two different test batteries (for two age groups) for measuring five of the primary mental abilities. These are commonly known as the Thurstone PMA batteries. The obvious implication is that a profile of factor scores should replace the commonly used single IQ score in describing a child. Such a change in assessing the intelligence of individuals has taken place very slowly.

Thurstone also carried out factor analyses in the areas of temperament and interest traits, followed by publication of instruments to assess individuals in the factors indicated. With Mrs. Thurstone he produced for a number of years successive forms of the American Council on Education Examination, a very widely used collegeaptitude test. In his latest years he was very occupied with research on performance tests of non-aptitude traits of personality.

Among Thurstone's most significant contributions were those on psychophysics and psychological-scaling methods. He was very dissatisfied with the classical psychophysics of Fechner, Wundt, and G. E. Müller because of its restriction to the measurement of limens or thresholds and of points or intervals of subjective equality. He saw in the traditional psychophysical methods the possibility for a much broadened use in psychological measurement, including the assessment of social, economic, aesthetic, and moral values, as appreciated by human individuals.

Classical psychophysics, being interested ultimately in the functional relationships between quantified psychological events and quantified physical events, was confined to those areas of experience in which measurable physical variables are obvious. Measurements on psychological scales were actually very infrequently made, for limens and the like were referred back to physical scales. Thurstone put the emphasis upon psychological scaling. Indeed, where corresponding physical variables are not readily available this is a natural step.

Starting with human judgments that have the crudest quantitative properties, the problem, as Thurstone saw it, was to derive scale values of a relatively high order of measurement by combining such information. As an important step in achieving this objective, he developed his well-known *law of comparative judgment*. The rationale for this law involved the introduction of new concepts, such as the *discriminal process* and the *discriminal dispersion*. A specified stimulus or object at any moment arouses a certain discriminal process in a certain individual. Over a population of occasions, or over a population of individuals, there is a variability in quantity of process along some specified psychological continuum. The frequency distribution of those quantities has a mean and a standard deviation, two well-known statistical values. Assuming a normal distribution of the discriminal processes, certain deductions follow concerning the relation between the proportion of the time that one stimulus is judged greater than another and their linear separation on a psychological continuum. It is not necessary to assume independence between discriminal processes from pairs of stimuli, over occasions or over individuals. The possible correlation between processes is taken into account in the law of comparative judgment.

The law of comparative judgment makes possible a wide range of scaling operations, whether the data come from the method of pair comparisons or from other methods from which comparative judgments may be inferred such as the method of rank order. The stimuli being compared may be of almost any kind, such as crimes to be judged for seriousness, nationalities to be judged for desirability or handwriting samples to be judged for excellence. From the standpoint of theory, the law of comparative judgment provided a basis of explanation of why it is that Weber's and Fechner's laws are sometimes not both experimentally verified in the same situation.

In another area of measurement Thurstone adapted the psychophysical method of equal-appearing intervals to the calibration of opinions concerning specified issues, institutions, or other social stimuli. The aim was to arrive at some 20 to 25 statements of opinion, regarding prohibition, for example, that belong at psychologically equal steps along a continuum of attitude, from the most extremely favorable attitude to the most extremely unfavorable attitude. An "attitude scale" was thus developed. The instrument could then be used to evaluate the characteristic position of a person on this continuum or the average position of a specified population. This involves the step of asking each person to say which of the opinions he endorses and noting their scale values. With his students Thurstone developed attitude scales for such matters as treatment of criminals, patriotism, war, the Negro, labor unions, communism, birth control, and censorship.

The availability of scaling methods and of attitude scales made possible some excursions by Thurstone and his students into the study of social-psychological problems. For example, there were studies of the effects of certain motion pictures upon the attitudes of children toward the seriousness of certain crimes, toward the Chinese, and toward the Negro. The summational effect of viewing two or more films was also detected. Thurstone regarded the field of social psychology as being amenable to the isolation of variables and the study of their quantitative interrelationships, an obvious scientific approach that seemed foreign to too many who had selected that field of investigation.

Among Thurstone's last contributions to psychological-measurement theory was an exploration into the logical problems of predicting first choices from knowledge of mean scale positions and dispersions of objects. Some deductions were made that should be of interest in politics and merchandising. He had also developed scaling procedures for judgments that place objects in successive categories. This method, and others, were used in studies of food preferences for the armed services.

Thurstone's breadth of professional interests was shown not only by the variety of fields he chose for investigation but also by the variety of organizations with which he was affiliated and in which he showed leadership. He was a Fellow in the American Psychological Association (President 1932-1933), the American Association for the Advancement of Science, the American Statistical Association (Board of Directors), and the American Academy of Arts and Sciences. He was Honorary Fellow in the British, Spanish, and

Swedish Psychological Associations. He was a member of the Midwestern Psychological Association (President 1930-1931), the Society for the Promotion of Engineering Education (Council member), the American Society for Human Genetics (Advisory Editorial Committee), the American Philosophical Society, the Chicago Psychology Club (President 1928-1929), and the Chaos Club, Chicago. He was elected to the National Academy of Sciences in 1938. He rendered editorial service to several psychological journals. His honorary societies included Phi Delta Kappa, Sigma Xi, and Eta Kappa Nu.

His social affiliations included the Acacia fraternity, the Quadrangle Club (Chicago), and the Chicago Literary Club. With his family he frequently spent summers at the family residence at Wabigama Club, Elk Lake, Rapid City, Michigan. Special honors included the Award of the American Psychological Association for the best published paper of 1949 and the Centennial Award, Northwestern University, 1951.

A very important component of the heritage left by Thurstone is represented by his former students. He was a stimulating lecturer, always clear and logical. His seminars were regarded as a treat and were attended repeatedly. A number of post-Ph.D. individuals were commonly present. His students generally caught the spirit of the challenge that had dominated Thurstone's career—to make psychology a quantitative, rational science—and many of them have carried on in that same spirit.

The Thurstones had three sons, Robert Leon (born in 1927), Conrad Gwinn (born in 1930), and Frederick Louis (born in 1932), It may be expected that they, too, having chosen the fields of physics, medicine, and engineering, will carry on in the scientific tradition set for them by their illustrious father.

# **KEY TO ABBREVIATIONS**

- Am. J. Human Gen. = American Journal of Human Genetics
- Am. J. Phys. Anthro. = American Journal of Physical Anthropology
- Am. J. Psychol. = American Journal of Psychology
- Am. J. Soc. = American Journal of Sociology
- Am. Polit. Sci. Rev. = American Political Science Review
- Am. Psychol. = American Psychologist
- Am. Stat. Assoc. J. = American Statistical Association Journal
- Ann. Am. Acad. Polit. Soc. Sci. = Annals of the American Academy of Political and Social Science
- Bull. Am. Assoc. Univ. Prof. = Bulletin of the American Association of University Professors
- Bull. Soc. Social Res. = Bulletin of the Society for Social Research
- Educ. Psychol. Meas. = Educational and Psychological Measurement
- Educ. Rec. = Educational Record
- Educ. Rev. = The Educational Review
- Eng. Educ. = Engineering Education
- J. Ab. Soc. Psychol. = Journal of Abnormal and Social Psychology
- J. Appl. Psychol. = Journal of Applied Psychology
- J. Cons. Psychol. = Journal of Consulting Psychology
- J. Educ. Psychol. = Journal of Educational Psychology
- J. Educ. Res. = Journal of Educational Research
- J. Exper. Psychol. = Journal of Experimental Psychology
- J. Gen. Psychol. = Journal of Genetic Psychology
- J. Higher Educ. = Journal of Higher Education
- J. Person. Res. = Journal of Personnel Research
- J. Philos. Psychol. Sci. Meth. = Journal of Philosophy, Psychology, and Scientific Methods
- J. Soc. Psychol. = Journal of Social Psychology
- Mus. Quart. = The Musical Quarterly
- Person. J. = Personnel Journal
- Proc. Am. Phil. Soc. = Proceedings of the American Philosophical Society
- Proc. Nat. Acad. Sci. = Proceedings of the National Academy of Sciences
- Proc. Nat. Conf. Soc. Work = Proceedings of the National Conference of Social Work
- Proc. Soc. Prom. Eng. Educ. = Proceedings of the Society for the Promotion of Engineering Education
- Psychol. Bull. = Psychological Bulletin
- Psychol. Rev. = Psychological Review
- Pub. Person. Rev. = Public Personnel Review
- Rep. Cir. Ser. Nat. Res. Council = Reprint and Circular Series of the National Research Council

School Rev. = The School Review Sci. Amer. = Scientific American Sci. Mo. = Scientific Monthly Sibley J. Eng. = Sibley Journal of Engineering Vis. Educ. = Visual Education

### BIBLIOGRAPHY

#### BOOKS AND MONOGRAPHS

#### 1908

Schemes and Precautions for a Course in Qualitative Analysis, and the "Double-Oxide" and "Multiple-Equation" Methods of Balancing Equations. Ithaca. 20 pp.

## 1915

Freehand Lettering. A course of exercises in single-stroke freehand lettering adapted for classes in mechanical drawing. Chicago: B. D. Berry Company.

### 1919

- The Learning Curve Equation. Princeton, New Jersey: Psychological Review Company. Also: Psychological Monographs, Vol. 26, No. 114, 51 pp.
- A Course in Telegraphy. Bulletin No. 16. Federal Board of Vocational Education.

### 1923

A Handbook of Clerical Tests. Johns Hopkins Press.

#### 1924

- The Nature of Intelligence. London: Kegan Paul, Trench, Trubner and Co., Ltd.: New York: Harcourt, Brace and Company, Inc. xvi + 167 pp.
- Purpose of Psychological Tests. Scranton, Pennsylvania: International Textbook Company. 22 pp.

### 1925

The Fundamentals of Statistics. New York: The Macmillan Company. 237 pp.

# 1929

With E. J. Chave. The Measurement of Attitude. Chicago: The University of Chicago Press. xii + 97 pp.

With Richard L. Jenkins. Order of Birth, Parent-Age, and Intelligence. Chicago: The University of Chicago Press, 1931. xiii + 135 pp.

# 1933

- A Simplified Multiple Factor Method and an Outline of the Computations. Chicago: The University of Chicago Bookstore. 25 pp. Supplement to The Theory of Multiple Factors, Microfilm No. 1648.
- With Leone Chesire and Milton Saffir. Computing Diagrams for the Tetrachoric Correlation Coefficient. Chicago: Distributed by The University of Chicago Bookstore. 57 pp.

### 1935

The Vectors of Mind. Chicago: The University of Chicago Press. xv + 266 pp.

### 1937

With J. R. Hamilton. Safe Driving. New York: Doubleday, Doran and Company.

### 1938

Primary Mental Abilities. Psychometric Monographs, No. 1, Chicago: The University of Chicago Press. ix + 121 pp. Also: Psychological Test Supplement to Psychometric Monograph No. 1, Document 1317, American Documentation Institute, Washington, D. C.

### 1941

With Thelma Gwinn Thurstone. Factorial Studies of Intelligence. Psychometric Monographs, No. 2. Chicago: The University of Chicago Press. 94 pp. Also: Document 1434, American Documentation Institute, Washington, D. C.

#### 1944

- Code Aptitude Test. Chicago: The University of Chicago Press. Includes reports on the use of the test 1943-44, at the Naval Training School, University of Chicago.
- A Factorial Study of Perception. Psychometric Monographs, No. 4. Chicago: The University of Chicago Press. vi + 148 pp. Also: Microfilm No. 1774, The University of Chicago Library Department of Photographic Reproduction.

#### 1947

Multiple-Factor Analysis; A Development and Expansion of The Vectors of Mind. Chicago: The University of Chicago Press. xix + 535 pp.

#### ARTICLES

#### 1905

How to Save Niagara. Sci. Amer. 93:27.

#### 1912

Curve Which Trisects Any Angle. Sci. Amer. 73:259-261. The Efficiency Propaganda. Sibley J. Eng., pp. 262-268.

#### 1916

Character and Temperament. Psychol. Bull., 13:384-387.

#### 1917

- A Statistical Method for the Treatment of School-Survey Data. School Rev. 25:322-330.
- A Method of Calculating the Pearson Correlation Coefficient without the Use of Deviations. Psychol. Bull., 14:28-32.

#### 1918

A Notebook: Aid for Interviewers. (Issued by the Adjutant General of the Army for the use of personnel officers.) Orange, New Jersey: Trade Test Division of the Committee of Classification of Personnel.

Variability in Learning. Psychol. Bull. 15:210-212.

- Mental Tests for Engineering Students. Proc. Soc. Prom. Eng. Educ., 27:113-119.
- A Course of Training for Radio Operators. Part II of Emergency War Training for Radio Mechanics and Radio Operators, Bulletin No. 16, 35-63. Issued by the Federal Board for Vocational Education; Washington, D. C.: Government Printing Office.

- Three Methods of Teaching Radio Telegraphy. J. Educ. Psychol. 9:467-470.
- AA Standardized Test for Office Clerks. J. Appl. Psychol., 3:248-251.
- Mental Tests for College Entrance. J. Educ. Psychol., 10:129-142.
- Mental Tests for Prospective Telegraphers; a Study of the Diagnostic Value of Mental Tests for Predicting Ability to Learn Telegraphy. J. Appl. Psychol., 3:110-117.
- A Scoring Method for Mental Tests. Psychol. Bull., 16:235-240.
- The Anticipatory Aspect of Consciousness. J. Philos., Psychol. Sci. Meth., 16:561-568.

What Is an Educational Motion Picture? Vis. Educ., pp. 3-7. The Problem of Melody. Mus. Quart., pp. 1-4.

### 1921

Report of Committee Number 22 on Intelligence Tests. Proc. Soc. Prom. Eng. Educ., 28:349-356.

Intelligence and Its Measurement. J. Educ. Psychol., 12:201-207.

A Cycle-Omnibus Intelligence Test for College Students. J. Educ. Res. 4:265-278.

## 1922

The Course Schedules in a Professional Curriculum. Eng. Educ., 12:293-297.

The Predictive Value of Mental Tests. Educ. Rev., 63:11-22.

A Data Sheet for the Pearson Correlation Coefficient. J. Educ. Res. 6:49-56. The Intelligence of Policemen. J. Person. Res., 1:64-74.

The Calculation and Interpretation of Percentile Ranks. J. Educ. Res., pp. 1-11.

#### 1923

A Comparative Study of Clerical Tests. (Public Personnel Studies), Washington: Bureau of Public Personnel Administration, 1. Part I, Arithmetic and Spelling; Part II, Classifying and Tabulating; Part III, Tests of Business Information; Part IV, Grammar, Reading, Letter Writing, Oral English; Part V, Proof Reading, Alphabetizing, Filing. Intelligence Tests for Engineering Student. Eng. Educ., 13:263-318.

Intempence resis for Engineering Student. Eng. Educ., 13:203-31

Personnel Research. Pro. Nat. Conf. Soc. Work, pp. 126-127.

The Seventh International Congress of Psychology. Psychol. Bull., 20: 558-561.

The Stimulus-Response Fallacy in Psychology. Psychol. Rev., 30:354-369.

What Do We Measure by the Intelligence Test? Hygeia, 1:349-353; 453-455.

Intelligence Tests in the Civil Service: A Discussion of Fundamental Principles in the Development and Application of Intelligence Tests. (Public Personnel Studies), Washington: Bureau of Public Personnel Administration, Institute for Government Research, 1:4-24.

Arithmetic and Spelling. Public Personnel Studies, 1:5-28.

Psychology in the Civil Service. In *Psychology in Business*. Ann. Amer. Acad. Polit. Soc. Sci., 110:194-199.

The Civil Service Tests for Patrolmen in Philadelphia. (Public Personnel Studies), Washington: Bureau of Public Personnel Administration, Institute for Government Research, 2:1-5.

The Nature of General Intelligence and Ability, III. British Journal of Psychology (General Section), 14:243-247. This paper was read at the Seventh International Congress of Psychology at Oxford, July, 1923. Intelligence Tests in the Civil Service. J. Person. Res., 2:431-441.

The Deteriol of Versional Cuidence (III) Detect Lournal of Dev

- The Principles of Vocational Guidance (III). British Journal of Psychology (General Section), 14:353-361. This paper was read at the Seventh International Congress of Psychology at Oxford, July, 1923.
- Influence of Freudism on Theoretical Psychology. Psychol. Rev., 31:175-183.

What Is Personnel Research? J. Person. Res., 3:52-56.

#### 1925

- The Significance of Psychology for the Study of Government and Certain Specific Problems Involving Both Psychology and Politics. Amer. Polit. Sci. Rev., 19:7-19. Round Table on Politics and Psychology, National Conference on the Science of Politics held at Chicago, Illinois, September 8-12, 1924.
- Vocational Guidance for College Students. J. Person. Res., 3:421-448.
- A Method of Scaling Psychological and Educational Tests. J. Educ. Psychol., 16:433-451.
- With C. R. Mann. Vocational Guidance for College Students. (Rep. Cir. Ser.), National Research Council, 3:421-448.

#### 1926

Aspects of Public Opinion. Am. Polit. Sci. Rev., 20: 126-127. (Report of the Third National Conference on the Science of Politics, held September 7-11, 1925, at New York City.)

The Mental Age Concept. Psychol. Rev., 33:268-278.

The Scoring of Individual Performance. J. Educ. Psychol., 17:446-457.

### 1927

The Method of Paired Comparisons for Social Values. J. Ab. Soc. Psychol., 4:384-400.

Equally Often Noticed Differences. J. Educ. Psychol., 18:289-293.

A Law of Comparative Judgment. Psychol. Rev., 34:273-286.

Psychophysical Analysis. Am. J. Psychol., 38:368-389.

- The Unit of Measurement in Educational Scales. J. Educ. Psychol., 18:505-524.
- A Mental Unit of Measurement. Psychol. Rev., 34:415-423.
- Three Psychophysical Laws. Psychol. Rev., 34:424-432.
- Note on the Calculation of Percentile Ranks. J. Educ. Psychol., 18:617-620.

- A Note on the Spearman-Brown Formula. J. Exper. Psychol., 11:62-63. Attitudes Can Be Measured. Am. J. Soc., 33:529-554.
- Reply to K. J. Holzinger's "Some Comments on Professor Thurstone's Method of Determining the Scale Values of Test Items." J. Educ. Psychol., 19:117-124.
- The Measurement of Opinion. J. Ab. Soc. Psychol., 22:415-430.
- The Absolute Zero in Intelligence Measurement. Psychol. Rev., 35:175-197.
- An Experimental Study of Nationality Preferences. J. Gen. Psychol., 1:405-425.

The Phi-Gamma Hypothesis. J. Exper. Psychol., 11:293-305.

Scale Construction with Weighted Observations. J. Educ. Psychol., 19:441-453.

### 1929

- The Measurement of Psychological Value. In *Essays in Philosophy;* ed. T. V. Smith and W. K. Wright. Chicago: Open Court Publishing Company, pp. 157-174.
- Theory of Attitude Measurement. Psychol. Rev., 36:222-241.
- Fechner's Law and the Method of Equal-Appearing Intervals. J. Exper. Psychol., 12:214-224.
- With Luton Ackerson. The Mental Growth Curve for the Binet Tests. J. Educ. Psychol., 20:569-583.
- With Richard L. Jenkins. Birth Order and Intelligence. J. Educ. Psychol., 20:641-651.

### 1930

- Commentary. In *Statistics in Social Studies;* ed. S. A. Rice. Philadelphia: University of Pennsylvania Press. xii + 222 pp.
- The Learning Function. J. Gen. Psychol., 3:469-493.
- The Relation between Learning Time and Length of Task. Psychol. Rev., 37:44-53.
- With Percy Bordwell, John H. Gray, and A. J. Carlson. University of Missouri: Report on the Dismissal of Professor DeGraff and the Suspension of Professor Meyer. Bull. Am. Asso. Univ. Prof., 16:3-35.

- Academic Freedom. A practical plan to achieve the right of unhampered thinking and research for the teacher. J. Higher Educ., 1:136-140.
- A Scale for Measuring Attitude toward the Movies. J. Educ. Res., 22:89-94.
- With Thelma Gwinn Thurstone. A Neurotic Inventory. J. Soc. Psychol., 1:3-30.

- Development of Personality Traits as an Object of College Instruction. Annual Proceedings of The American Association of Collegiate Schools of Business. This paper was read at the New Orleans meeting of the American Association of Collegiate Schools of Business, March 31, 1931.
- Experimental Determination by Floyd H. Allport of Group Influence Upon Mental Activity. In *Methods in Social Science*, ed. S. A. Rice, Chicago: University of Chicago Press, pp. 694-696.

The Measurement of Change in Social Attitude. J. Soc. Psychol., 2:230-235. The Indifference Function. J. Soc. Psychol. 2:139-167.

Rank Order as a Psychophysical Method. J. Exper. Psychol., 14:187-201. Influence of Motion Pictures on Children's Attitudes. J. Soc. Psychol., 2:201-305.

Multiple Factor Analysis. Psychol. Rev., 38:406-427.

A Multiple Factor Study of Vocational Interests. Person. J., 10:198-205.

The Measurement of Social Attitudes. J. Ab. Soc. Psychol., 26:249-269. Presidential address for Midwestern Psychological Association, May 9, 1931.

#### **1**93**2**

- With Ruth C. Peterson. The Effect of a Motion Picture Film on Children's Attitudes toward the Germans. J. Educ. Psychol., 23:241-246.
- Stimulus Dispersion in the Method of Constant Stimuli. Exper. Psychol., 15:284-297.
- Isolation of Blocs in a Legislative Body by the Voting Records of Its Members. J. Soc. Psychol., 3:425-433.

#### 1933

The Error Function in Maze Learning. J. Gen. Psychol., 9:288-301.

With Ruth C. Peterson. Motion Pictures and the Social Attitudes of Children. In *Motion Pictures and Youth*, New York: The Macmillan Company. 75 pp. A preliminary edition was issued in 1932 under the title: The Effect of Motion Pictures on the Social Attitudes of High School Children.

- The Vectors of Mind. Psychol. Rev., 41:1-32. Presidential Address, American Psychological Association, 1933.
- Unitary Abilities. J. Gen. Psychol., 11:126-132.
- With J. E. Anderson, M. A. May, G. Murphy, R. S. Woodworth, and C. C. Brigham. Report of the Committee on Research in the Social Sciences. Psychol. Bull., 31:660-662.

#### 1935

A Vocational Interest Schedule. Psychol. Bull., 32:719.

## 1936

The Isolation of Seven Primary Abilities. Psychol. Bull., 33:780-781.

The Bounding Hyperplanes of a Configuration of Traits. Psychometrika, 1:61-68.

A New Conception of Intelligence. Educ. Rec., 17:441-450.

- The Factorial Isolation of Primary Abilities. Psychometrika, 1:175-182.
- A New Concept of Intelligence and a New Method of Measuring Primary Mental Abilities. Educ. Rec., 17:124-138.

#### 1937

Elements in Intelligence. Proceedings of the Annual Congress on Medical Education and Licensure, American Medical Association, pp. 31-33.

- Psychology as a Quantitative Rational Science. Science, 85:228-232. Presidential address, Psychometric Society, 1936.
- Current Misuse of the Factorial Methods. Psychometrika, 2:73-76.
- Ability, Motivation, and Speed. Psychometrika, 2:249-254. Also: Abstract in Psychol. Bull., 34:735-736.

#### 1938

Shifty and Mathematical Components: A Critique of Anastasi's Monograph on the Influence of Specific Experience upon Mental Organization. Psychol. Bull., 35:223-236.

The Perceptual Factor. Psychometrika, 3:1-17.

- Research and Psychology. Bull. Soc. Social Res., pp. 3-6.
- A New Rotational Method in Factor Analysis. Psychometrika, 3:199-218.

#### 1940

Factor Analysis as a Scientific Method with Special Reference to the Analysis of Human Traits. In Louis Wirth, *Eleven Twenty-six; a Decade of Social Science Research*, Chicago: The University of Chicago Press, pp. 78-112.

- A Factorial Study of Visual Gestalt Effects. Abstract—Psychol. Bull., 37:456.
- Current Issues in Factor Analysis. Psychol. Bull., 37:189-236.

Experimental Study of Simple Structure. Psychometrika, 5:153-168.

### 1941

A Micro-film Projector Method for Psychological Tests. Psychometrika, 6:235-248.

## 1942

Experimental and Factorial Study of Perceptual Dynamics. Abstract-Psychol. Bull., 39:452-453.

### 1944

Research Note: In Search of New Tests. Psychometrika, 9:69.

Graphical Method of Factoring the Correlation Matrix. Proc. Nat. Acad. Sci., 30:129-134.

Second-order Factors. Psychometrika, 9:71-100.

### 1945

Testing Intelligence and Aptitudes. Hygeia, 23:32-36; 50; 52; 54.

Testing Intelligence and Aptitudes. Pub. Person. Rev., 6:22-27.

A Multiple Group Method of Factoring the Correlation Matrix. Psychometrika, 10:73-78.

The Effects of Selection in Factor Analysis. Psychometrika, 10:165-198. The Prediction of Choice. Psychometrika, 10:237-253.

## 1946

- Primary Abilities. In P. L. Harriman, *Encyclopedia of Psychology*, New York, Philosophical Library, pp. 544-546.
- Psychophysics. In P. L. Harriman, *Encyclopedia of Psychology*, New York, Philosophical Library, pp. 640-644.

A Note on the Experimental Study of English Style. Am. Psycho. 1:62.

Theories of Intelligence. Sci. Mo., 62, Supplement 5:101-112. This Paper was presented to the Chicago Literary Club, February 12, 1945.

Factor Analysis and Body Types. Psychometrika, 11:15-21.

A Single Plane Method of Rotation. Psychometrika, 11:71-79.

Comment on Elizabeth Havely and Gwynne Nettler's Paper "Known-Group Validation in the Measurement of Attitudes toward the Japanese in America." Am. J. Soc., 52:39-40.

Note of a Reanalysis of Davis' Reading Tests. Psychometrika, 11:185-188.

The Calibration of Test Items. Am. Psychol., 2:103-104.

Factorial Analysis of Body Measurements. Am. J. Phys. Anthro., 5:15-28.

### 1948

- Psychophysical Methods. Chapter V in *Methods of Psychology;* ed. T. G. Andrews. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 716 pp.
- Tests for Primary Mental Abilities. Encyclopedia of Vocational Guidance, New York: Philosophical Library, pp. 1099-1102.

The Improvement of Examinations. Am. Assoc. Univ. Profs. Bull., 34:394-397.

Psychological Implications of Factor Analysis. Am. Psychol., 3:402-408. Also: Implicaciones psicológicos del análisis factorial, Rev. Psicol. Gen. Apl., Madrid, 5 (1950), 19-35. Presidential address, American Psychological Association, Division of Evaluation and Measurement, Detroit, Michigan, September 9, 1947.

The Rorschach in Psychological Science. J. Ab. Soc. Psychol., 43:471-475. This paper was presented to the Illinois Association for Applied Psychology in Chicago, November 18, 1947.

- The Edge-Marking Method of Analyzing Data. Am. Sta. Assoc. J., pp. 451-462.
- Primary Mental Abilities. Abstract—Science, 108 (November 26, 1948), 585. Read at the Symposium of Human Individuality, American Association for the Advancement of Science meeting, September 14, 1948, in Washington, D. C.

### 1949

Analysis of Human Abilities. In: Armed Forces Familiarization Course in Military Psychology. Washington: American Psychological Association, v.p.

Note about the Multiple Group Method. Psychometrika, 14:43-45.

Primary Abilities. Occupations, 27:527-529.

### 1950

Methods of Food Tasting Experiments. In *Proceedings of the Second* Conference on Research, American Meat Institute (March 1950), pp. 85-91.

The Factorial Description of Temperament. Abstract—Science, 3:453-463. Read at NAS Annual Meeting, April 24-26, 1950, Washington, D. C.

- Primary Mental Abilities. In: American Association for the Advancement of Science, Centennial, pp. 61-66.
- L'Analyse Factorielle Méthode Scientifique. L'Année Psychologique, 50: 61-75. Translated by Jean Cardinet. Read at a common meeting of the American Psychological Association, the American Association, and the Psychometric Society on December 29, 1950.
- The Dimensions of Temperament. Psychometrika, 16:11-20.
- Experimental Methods in Food Tasting. J. Appl. Psychol, 35:141-145. With James W. Degan. A Factorial Study of the Supreme Court. Proc. Nat. Acad. Sci., 37:628-635. Also: Abstract—Science, 113:478.
- Experimental Tests of Temperament. In *Essays in Psychology. . . David Katz*, ed. Ekman, *et al.*, Uppsala: Almquist & Wiksells. x + 283 pp.

- Autobiography. In A History of Psychology in Autobiography, Vol. IV, Langfeld, Boring, et al., Worcester, Massachusetts: Clark University Press. xii + 356 pp.
- Applications of Psychology. L. L. Thurstone, editor, New York: Harper & Brothers. x + 209 pp.
- Creative Talent. Chapter 2, in Applications of Psychology: Essays to Honor Walter V. Bingham; L. L. Thurstone, (ed.), New York: Harper & Brothers. x + 209 pp. Also: Proceedings of the 1950 Conference on Testing Problems, Educational Testing Service, (1951), pp. 55-69.
- An Experiment in the Prediction of Food Preference and the Prediction of Choice. In *Proceedings of the Fourth Research Conference*, pp. 58-66. Sponsored by The Council on Research, American Meat Institute, March 20-21, 1952, at The University of Chicago.
- A Psychologist Discusses the Mechanism of Thinking. In *The Nature of Creative Thinking*. A Monograph sponsored by Industrial Research Institute, Inc., pp. 35-43. This paper was read at a symposium presented May 5-7, 1952, at Skytop Lodge.
- With Allen L. Edwards. An Internal Consistency Check for Scale Values Determined by the Method of Successive Intervals. Psychometrika, 17: 169-180.

The Measurement of Values. Psychol. Rev. 61:47-58.

- Criteria of Scientific Success and the Selection of Scientific Talent. Office of Scientific Personnel, National Academy of Sciences—National Research Council, Technical Report No. 4 (April 15, 1954), pp. 29-36. This paper was read at a Meeting on November 14, 1953, of the Research Advisory Committee, Office of Scientific Personnel.
- An Analytical Method for Simple Structure. Psychometrika, 19:173-182.
- A Method of Factoring without Communalities. In *Proceedings of the* 1954 Invitational Conference on Testing Problems, Educational Testing Service, Princeton, New Jersey, October 30, 1954, 59-62.
- Some New Psychophysical Methods. In *A Symposium on Food Acceptance Testing Methodology*, sponsored by the Quartermaster Food and Container Institute. National Academy of Sciences—National Research Council (October 1954), pp. 100-104.
- With Lyle V. Jones. Psychophysics and the Normality Assumption: An Experimental Report. In *A Symposium on Food Acceptance Testing Methodology*, sponsored by the Quartermaster Food and Container Institute. National Academy of Sciences-National Research Council (October 1954), pp. 105-111.

#### 1955

- With Lyle V. Jones. The Psychophysics of Semantics: An Experimental Investigation. J. Appl. Psychol., 39:31-36.
- The Criterion Problem in Personality Research. Educ. Psychol. Meas., 15(4):353-61.
- With Thelma Gwinn Thurstone and Herluf Strandskov. A Psychological Study of Twins: 2. Scores of One Hundred and Twenty-five Pairs of Twins on Fifty-Nine Tests. Am. J. Human Gen. (In a forthcoming issue.)

#### AMERICAN COUNCIL ON EDUCATION

- Psychological Tests for College Freshman. Educ. Rec., 6:(April, 1925), 69-83, 282-294.
- The Psychological Test Program. 7: (April, 1926), 114-126.
- Psychological Examinations for College Freshman. Educ. Rec., 1:(April, 1927), 27.
- 1927 Norms, Psychological Examination. Educ. Rec., 9:(April, 1928). Psychological Examination for 1928. Educ. Rec., 10:(April, 1929).

- With Thelma Gwinn Thurstone. The 1929 Psychological Examination. Educ. Rec. (April, 1930), pp. 101-128.
- The 1930 Psychological Examination. Educ. Rec. (April, 1931).
- The 1931 Psychological Examination. Educ. Rec. (April, 1932).
- The 1932 Psychological Examination. Educ. Rec. (April, 1933).
- With Thelma Gwinn Thurstone. The 1933 Psychological Examination. Educ. Rec., 15:(April, 1934), 161-175.
- The 1934 Psychological Examination. Educ. Rec. (April, 1935).
- With Thelma Gwinn Thurstone. The 1935 Psychological Examination. Educ. Rec. (April, 1936). 24 pp.
- With Thelma Gwinn Thurstone. The 1936 Psychological Examination for College Freshmen. Educ. Rec. (April, 1937).
- With Thelma Gwinn Thurstone. The 1937 Psychological Examination for College Freshmen. Educ. Rec. (April, 1938).
- With Thelma Gwinn Thurstone. The American Council on Education Psychological Examination, 1939 Edition. Psychological Examinations, 1939; American Council on Education Studies, Series V, Volume IV, No. 2 (May, 1940), 37 pp.
- With Thelma Gwinn Thurstone and Dorothy C. Adkins. The 1938 Psychological Examination. Educ. Rec. (April, 1939).
- With Thelma Gwinn Thurstone. Psychological Examination, 1940 Norms. (American Council on Education Studies), Series V, Council Staff Reports, No. 3, Vol. 5 (May, 1941).
- With Thelma Gwinn Thurstone. Psychological Examinations, 1941 Norms. (American Council on Education Studies), Series V, Council Staff Reports, No. 4, Vol. 6 (May, 1942).
- With Thelma Gwinn Thurstone. Psychological Examination for College Freshmen, 1942 Norms. (American Council on Education Studies), Series V, Council Staff Reports, No. 6, Vol. 7 (May, 1943).
- With Thelma Gwinn Thurstone. Psychological Examination for College Freshmen, 1943 Norms. (American Council on Education Studies), Series V, Council Staff Reports, No. 8, Vol. 8 (June, 1944).
- With Thelma Gwinn Thurstone. Psychological Examination for College Freshmen. (American Council on Education Studies), Series V, Council Staff Reports, No. 9, Vol. 9 (May, 1945).
- With Thelma Gwinn Thurstone. Psychological Examination for College Freshmen, 1945 Norms. (American Council on Education Studies), Series V, Council Staff Reports, No. 10, Vol. 10 (May, 1946).

- With Thelma Gwinn Thurstone. Psychological Examination for College Freshmen, 1946 Norms. (American Council on Education Studies), Series V, Council Staff Reports, No. 11, Vol. 11 (June, 1947).
- With Thelma Gwinn Thurstone. Psychological Examination for College Freshmen, 1947 Norms. The American Council on Education, 1948.

### TESTS

- Examination in Clerical Proficiency, Form 1. Also: Form 2, Form E, Form F.
- Oral Trade Tests. Committee on Classification of Personnel in the Army, Trade Test Divisions, 1918.
- Thursone's Hand Test. Chicago, Illinois: C. H. Stoelting Company, 1918.
- Thurstone's Miscellaneous Intelligence Test. Chicago, Illinois: C. H. Stoelting Company, 1918.
- Thurstone's Spatial Relations Test, A and B. Chicago, Illinois: C. H. Stoelting Company, 1918.
- Wheels Tests. Chicago: C. H. Stoelting Company, 1918. This was the first form of the mechanical movements test.
- Intelligence Tests for College Students. Pittsburgh: Carnegie Institute of Technology, Form 1481, 1919.
- Thurstone Cycle-omnibus Intelligence Test for College Students. Range: high school seniors and college freshmen. Bloomington, Illinois: Public School Publishing Company, 1919. See: J. Educ. Res., 1921, 4:265-278.
- Thurstone's Intelligence Test (IV). Also: Supplement to Test IV. Chicago, Illinois: C. H. Stoelting Company, 1919.
- Thurstone's test of Engineering Aptitude for College Freshmen and High School Seniors. Pittsburgh: Carnegie Institute of Technology, 1919. There are five tests in the engineering series, published by World Book Company.
- Thurstone's Vocational Guidance Tests. Algebra, Arithmetic, Geometry, Physics and Technical Information. Range: high school seniors and college freshmen. Yonkers: World Book Company, 1919.
- Thurstone Proficiency Test for Typists. Yonkers: World Book Company, 1920.
- Thurstone Employment Tests. Examination in clerical work and examination in typing. Yonkers: World Book Company, 1922.
- Thurstone's Psychological Examination. Chicago, Illinois: C. H. Stoelting Company, 1922, 1923, 1924.

- With Thelma Gwinn Thurstone. Ingenuity Test. Chicago, Illinois: C. H. Stoelting Company, 1923.
- Psychological Examination for High School Graduates and College Freshmen, 1924, 1925, 1926, 1927 editions. American Council on Education, Washington, D. C.
- Thurstone Lettering Test. See: H. Smith and W. W. Wright (second revision of the bibliography of educational measurement), Bull Sch. of Educ., Indiana University, 4, No. 2, 1927.
- Thurstone's Proverbs Test. Supplement to Test IV. Chicago, Illinois: C. H. Stoelting Company. See: A. F. Bronner, W. Healy, G. M. Lowe, and M. E. Shimberg, *A Manual of Individual Mental Tests and Testing*. Boston: Little, Brown and Company, 1927.
- Thurstone's Reasoning Test A and B. Chicago, Illinois: C. H. Stoelting Company. See: A. F. Bronner, W. Healy, et al., A Manual of Individual Mental Tests and Testing. Boston: Little, Brown and Company, 1927.
- With Thelma Gwinn Thurstone. Psychological Examination for High School Graduates and College Freshmen, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935 editions. American Council on Education, Washington, D. C.
- With Thelma Gwinn Thurstone. Personality Schedule. Range: high school, college, and adult. University of Chicago Press, 1929. Pp. 4-23. (Form A, 1928; Form B (alternate), 1929). Also published by the Cambridge University Press, 1930. See: A Neurotic Inventory, J. Soc. Psychol., 1930, 1:3-30.
- With Thelma Gwinn Thurstone. Psychological Examination for Grades Nine to Twelve, 1933, 1934, 1935 editions. American Council on Education, Washington, D. C.
- Psychological Examination for College Freshmen, Experimental Machinescoring edition, 1937. American Council on Education, Washington, D. C.
- Psychological Examination for Grades 9 to 12, Machine-scoring, 1938 edition, American Council on Education, Washington, D. C.
- Tests for the Primary Mental Abilities, Experimental edition. American Council on Education, Washington, D. C., 1938.
- Psychological Examination for College Freshmen, 1936, 1937, 1938, 1939, 1940, 1941 editions. American Council on Education, Washington, D. C.
- Psychological Examination for College Freshmen, Machine-scoring, 1938, 1939, 1940 editions. American Council on Education, Washington, D. C.

- Psychological Examination for High School Students, 1936, 1937, 1938, 1939, 1940, 1941 editions. American Council on Education, Washington, D. C.
- Psychological Examination for High School Students, Machine-scoring, 1939, 1940, editions. American Council on Education, Washington, D. C.
- Chicago Primary Mental Abilities Tests, Experimental edition. 1940.
- With Thelma Gwinn Thurstone. Chicago Tests for Primary Mental Abilities. Washington, D. C., American Council on Education, 1942.
- With Thelma Gwinn Thurstone. The Chicago Tests of Primary Mental Abilities. Single booklet edition. Chicago, Illinois: Science Research Associates, 1943.
- With Thelma Gwinn Thurstone. Thurstone Test of Mental Alertness. Form AH, Form AM. Chicago, Illinois: Science Research Associates, 1943 and 1949.
- With Thelma Gwinn Thurstone. United States Coast Guard Academy Scholastic Examination. Washington, D. C.: American Council on Education, 1945.
- With Thelma Gwinn Thurstone. Tests of Primary Mental Abilities, for ages 5 and 6. Chicago, Illinois: Science Research Associates, 1946. See: J. Con. Psychol., 1947, 11:341.
- SRA Verbal Form. Form AH, Form AM. High school-college. Chicago, Illinois: Science Research Associates, 1947. See: J. Con. Psychol., 1947, 11:341.
- Thurstone Interest Schedule. Revision of the Vocational Interest Schedule. New York: Psychological Corporation, 1947. High school-adult. See: J. Con. Psychol., 1948, 12:63.
- With Thelma Gwinn Thurstone. SRA Primary Mental Abilities, for ages 11 to 17. Form AH and Form AM. Chicago, Illinois: Science Research Associates, 1947. See: J. Con. Psychol., 1947, 11:340.
- With Thelma Gwinn Thurstone. SRA Primary Mental Abilities, Elementary, for ages 7 to 11. Form AH. Chicago, Illinois: Science Research Associates, 1948.
- With Thelma Gwinn Thurstone. SRA Primary Mental Abilities, Intermediate, for ages 11 to 17. Form AM, Form AH. Chicago, Illinois: Science Research Associates, 1948.
- Thurstone Temperament Schedule. Chicago: Science Research Associates, 1949, 1950.
- Color-Form Film Test.

# LABORATORY REPORTS

- Note about Factor Analysis of Reading Tests.
- A Code Aptitude Test. January, 1944.
- The Centroid Method of Factoring. Chap. VIII in Multiple Factor Analysis.
- Alternative Methods of Rotation. Chap. XVII in Multiple Factor Analysis.
- Data for Company 19 at the Naval Training School after Six Weeks of Instruction. January, 1944.

Supplementary Report on Code Aptitude Test. March, 1944.

- With Ledyard Tucker and Virginia Brown. Definitions of Terms in Factor Analysis. General comments on definitions in factor analysis. March 15, 1944.
- The Psychometric Laboratory. January, 1944.
- Frequency Distributions for Code Aptitude Test (by Virginia Brown). March, 1944.
- Code Aptitude Test Scores for Company 31 at the Naval Training School (by Virginia Brown). April, 1944.
- The Determination of Successive Principal Components without Computation of Tables of Residual Correlation Coefficients (by Ledyard R. Tucker). May 2, 1944.
- Progress Report on Code Aptitude Tests (by Virginia Brown). May, 1944.
- Final Progress Report on Code Aptitude Tests (by Virginia Brown). July, 1944.
- Factor Analysis of the Allergies (by T. Gaylord Andrews). December, 1944.
- Tests For Primary Mental Abilities. *Encyclopedia of Vocational Guidance*, pp. 1099-1102. June, 1945.
- Intelligence Quotients for Superior Adults. June, 1945.
- Note on the Prediction of Choice with Correlated Ratings. October, 1945. The Selection of Talent. March, 1946.
- Mechanical Aptitude. No. 1. Research Plan for the Project. October, 1946.
- Navy Mechanical Aptitude Project. No. 2. Progress Report. January, 1947.
- The Objective Study of Temperament. January, 1947.
- Report for Dr. John G. Lynn. April, 1947.
- An Interest Schedule. June, 1947.
- The Dimensions of Temperament. June, 1947.

- The MacQuarrie Test of Mechanical Ability (by Robert L. Chapmen). August, 1947.
- A Note on the Effects of Selection in Factor Analysis (by James W. Degan). November, 1947.
- With Thelma G. Thurstone. Mechanical Aptitude. Report of the First Year of the Study. October, 1947.
- Application of the Concept of Simple Structure to Alexander's Data (by Mariano Yela). July, 1948.
- Psychological Assumptions in Factor Analysis. Paper given at Twelfth International Congress of Psychology. Edinburgh, July 24, 1948.
- Experimental Methods in Food Tasting. Paper given at Research Conference, Council on Research, American Meat Institute, March 24, 1950.
- The Factorial Description of Temperament. Paper Given at National Academy of Sciences, Washington, D. C., April 24, 1950.
- With Thelma G. Thurstone. Mechanical Aptitude II. Description of Group Tests. March, 1949.
- Mechanical Aptitude III. Analysis of Group Tests. May, 1949.
- With Thelma G. Thurstone. Mechanical Aptitude IV. Description of Individual Tests. May, 1949.
- Mechanical Aptitude V. Individual and Group Tests of Mechanical Aptitude. May, 1949.
- Mechanical Aptitude VI. A Re-analysis of the Army Air Force Battery of Mechanical Tests (James W. Degan). September, 1950.
- Apparatus for Studying Continuous Apparent Movement. September, 1950.
- An Analysis of Mechanical Aptitude. Summary of previous reports, Carol Pemberton and L. L. Thurstone. January, 1951.
- A Factorial Study of Temperament (by Melany E. Baehr). February, 1951.
- With James W. Degan. A Factorial Study of the Supreme Court. Paper given at National Academy of Sciences, Washington, D. C., April 23, 1951.
- Factor Analysis as a Scientific Method. Paper given at a joint meeting of APA, American Statistical Association, and Psychometric Society, December 29, 1950.
- Incidental Memory and Problem Solving (by Per Saugstad). March, 1951.
- An Experiment in the Prediction of Choice. April, 1951.

- Psychological Scaling by Means of Successive Intervals (by Allen L. Edwards). May, 1951.
- A Response Timer (by Thomas Jeffrey and Jonathan Wegener). May, 1951.
- Primary Mental Abilities in the Stanford-Binet, Age 13 (by Lyle V. Jones). June, 1951.
- Objective Tests of Temperament. Tests of Verbal Associations. July, 1951.
- A Factorial Analysis of the Wechsler-Bellevue Scale Given to an Elderly Population (by James E. Birren). October, 1951.
- Growth of a Social Group. Cancelled.
- Second Order Factor in Tests (by Lyle V. Jones). March, 1952.
- Speed, Accuracy, and Difficulty (by James E. Birren, William R. Allen, and H. G. Landau). May, 1952.
- The Measurement of Values. Read at the Southern Society of Philosophy and Psychology in Knoxville, Tennessee, April 11, 1952.
- The Criterion Problem in Personality Research. Read in a symposium of the Illinois Psychological Association at Northwestern University, April 5, 1952.
- Word Association with Homonyms. July, 1952.
- Progress Report on a Color-Form Test. Research Project on Objective Tests of Temperament. July, 1952.
- The Scientific Study of Inventive Talent. Read at a meeting of the Industrial Research Institute, Skytop, Pennsylvania, May 6, 1952.
- The Development of Objective Measures of Temperament. Paper given at the American Psychological Association, Washington, September 4, 1952.
- With Thelma G. Thurstone. Classification Test. May, 1953.
- The Stroop Test (by J. J. Mellinger). May, 1953.
- With Thelma Gwinn Thurstone and Herluf H. Strandskov, the University of Chicago. A Psychological Study of Twins.
  - 1. Distributions of Absolute Twin Differences for Identical and Fraternal Twins.
- A Nine-fold Point Correlation (by J. J. Mellinger). A Measure of Association between Questionnaire Item Responses and Quantitative Test Scores. July, 1953.
- Analytical Method for Simple Structure. July, 1953.
- Some New Psychophysical Methods. This paper was prepared for a symposium sponsored by the National Research Council Advisory Board on Quartermaster Research and Development at the Palmer House, Chicago, October 9, 1953.

- The Simple Structure of the American Psychological Association (by Dorothy C. Adkins). Address of the retiring President of the Division on Evaluation and Measurement of the American Psychological Association at Cleveland, Ohio, on September 7, 1953, presented at a dinner meeting held jointly with the Psychometric Society.
- Criteria of Scientific Success and the Selection of Scientific Talent. This paper was prepared for a conference called by the Advisory Committee on Fellowship Selection of the National Research Council in Washington, D. C., on November 14, 1953.
- Simultaneous Absolute Scaling for Several Groups (by W. A. Gibson). March, 1954.
- An Exploratory Study on the Selection of Creative Talent (by J. J. Mellinger). September, 1954.
- With Thelma Gwinn Thurstone and Herluf Strandskov. A Psychological Study of Twins.
  - 2. Scores of One Hundred and Twenty-five Pairs of Twins on Fiftynine Tests. January, 1955.
- The Rational Origin for Measuring Subjective Values. January, 1955.
- The Differential Growth of Mental Abilities. This paper was prepared for the spring meeting of the National Academy of Sciences in Washington, D. C., April 25-27, 1955.

# MICROFILMS

- The following microfilms may be obtained from The University of Chicago Library, Department of Photographic Reproduction.
  - No. 1647 Reliability and Validity of Tests, by L. L. Thurstone, Ann Arbor, Michigan: Edwards Brothers, 1939, 124 pp. Positive copy, \$1.05.
  - No. 1648 Theory of Multiple Factors, by L. L. Thurstone, Ann Arbor, Michigan: Edwards Brothers, 1934, 78 pp. Positive copy, \$1.05.
  - No. 1696 The Effect of Motion Pictures on the Social Attitudes of High School Children, by Ruth Peterson and L. L. Thurstone. Ann Arbor, Michigan: Edwards Brothers, 1932. Positive copy, \$0.85.

No. 1767	Mechanical Aptitude II—Description of Group Tests with Sample Items, by Thelma Gwinn Thurstone and L. L. Thurstone. Report No. 54, The Psychometric Laboratory, The University of Chicago, March, 1949. Positive copy, \$1.30.
No. 1768	Mechanical Aptitude—Complete Set of Group Tests, by Thelma Gwinn Thurstone and L. L. Thurstone. Posi- tive copy, \$1.30.
No. 1771	Measurement of Social Attitudes (Collection of attitude scales), edited by L. L. Thurstone. Positive copy, \$1.80, includes postage.
No. 1772	Psychometric Laboratory Reports (inc. 3, 15, 16, 17, 18, 22, 23, 24, 25, 29, 30, 32, 34, 39, 40, 41, 42, 43, 44, 45, 46, 47), by L. L. Thurstone. Positive copy, \$2.55.
No. 1774	Factorial Study of Perception, by L. L. Thurstone, Chi- cago: University of Chicago Press, 1944, 148 pp. Positive copy, \$1.25.
No. 1844	Mechanical Aptitude III—Analysis of Group Tests, by L. L. Thurstone. Report No. 55, The Psychometric Lab- oratory, The University of Chicago, May, 1949. Positive copy, \$1.30.
No. 1845	Mechanical Aptitude IV—Description of Individual Tests, by Thelma Gwinn Thurstone and L. L. Thurstone, Re- port No. 56, The Psychometric Laboratory, The Univer- sity of Chicago, May, 1949. Positive copy, \$1.30.
No. 1979	Manual of Examination Methods, by M. W. Richardson, J. T. Russell, J. M. Stalnaker, and L. L. Thurstone. Chicago: University of Chicago Bookstore, 1933, 177 pp. Positive copy, \$1.50.
No. T 1136	Word Reactions and Temperament, by Mrs. Frances Smith. 1951. \$1.50.
No. T 1279	The Speed and Flexibility of Closure Factors, by Mrs. Carol Pemberton. 1951. Positive copy, \$2.15, including postage. Library catalogue no.: BF 1999.

The following microfilms and photocopies may be obtained from the American Documentation Institute, 1719 N Street, N. W., Washington 6, D. C.

#### BIOGRAPHICAL MEMOIRS

- Document 1317 Psychological Tests Used in a Study of Mental Abilities, Psych. Tests Supp. To Psych. Mon. No. 1, P.M.A.'s. by L. L. Thurstone. Psychometrika, March, 1940, 304 pp. Microfilm—\$3.24. Photocopy—\$30.60.
- Document 1329 Psychological Tests Used in a Factorial Study at the Hyde Park High School, Chicago, Illinois, 1937, by L. L. Thurstone. Psychometrika, March, 1940, 140 pp. Microfilm—\$1.60. Photocopy—\$14.20.
- Document 1337 Psychological Tests Used in a Factorial Study at the Lane Technical High School in Chicago, Illinois, 1936, by L. L. Thurstone. Psychometrika, June, 1940, Vol. 3, No. 1, 178 pp. Microfilm—\$1.98. Photocopy—\$18.00.
- Document 1434 Psychological Tests Used in a Factorial Study of Eighth-Grade Children, by L. L. Thurstone. 188 pp. Psychometric Society. Microfilm—\$2.08. Photocopy— \$19.00.