

**COWLES COMMISSION  
FOR RESEARCH IN ECONOMICS**

**REPORT FOR THE PERIOD  
FROM 1932 TO 1937**

**COLORADO SPRINGS · COLORADO**

## THE COWLES COMMISSION FOR RESEARCH IN ECONOMICS

**T**HE Cowles Commission for Research in Economics was founded in 1932, and was incorporated under the laws of the State of Colorado as a not-for-profit corporation to conduct investigations into problems of current economic importance with particular reference to the application of statistics and mathematics in the solution of these problems. It is supported by donations from private sources. Any activity which promises ultimately to further the unification of theoretical and factual studies in economics is within the sphere of interest of the Commission.

### AFFILIATION WITH ECONOMETRIC SOCIETY

**T**HE Cowles Commission is affiliated with the Econometric Society, an international society for the advancement of economic theory in its relation to statistics and mathematics, which was founded in 1930. Alfred Cowles 3rd is secretary and treasurer of the Econometric Society and its offices are located at the headquarters of the Cowles Commission in Colorado Springs. The Society's journal, *Econometrica*, has been published there since its first issue, January, 1933. The editor is Ragnar Frisch of the University of Norway, research consultant of the Cowles Commission; the following members of the Commission staff have assisted in the publication: William F.

C. Nelson, assistant editor from 1933 until his death in May, 1936; Dickson H. Leavens, managing editor from October, 1936; Harold T. Davis, associate editor from 1933; Charles F. Roos, member of advisory editorial board from 1933; Alfred Cowles 3rd, business manager from 1933. Five volumes have been published, totaling over 2000 pages. The mailing list of *Econometrica*, during the five years of its existence, has grown to 880, including the 620 members of the Society and 260 subscribers, mostly libraries.

### ADVISORY COUNCIL

THE following Advisory Council of the Cowles Commission has been appointed by the Council of the Econometric Society: Arthur L. Bowley, University of London; Irving Fisher, Yale University; Ragnar Frisch, University of Norway; Wesley C. Mitchell, Columbia University; Carl Snyder, for many years with the Federal Reserve Bank of New York.

### PERSONNEL

THE staff of the Cowles Commission has included the following:

*Alfred Cowles 3rd*, B. A., Yale, 1913. Mr. Cowles was the founder of the Cowles Commission and has been its president since the beginning. For 10 years prior to its foundation he maintained a private organization for statis-

tical research on problems pertaining to investment and finance. He is secretary and treasurer of the Econometric Society, trustee of Colorado College, trustee and treasurer of the Fountain Valley School of Colorado, trustee and vice-president of the Colorado Foundation for Research in Tuberculosis.

*Edward N. Chapman*, B. A., Yale, 1917; M. D., Harvard, 1921. Dr. Chapman has been a research associate of the Cowles Commission since May, 1936. For several years prior to this time he had devoted himself to economic research.

*Forrest Danson*, A. B., Colorado College, 1929. Mr. Danson has been in charge of the computing clerks of the Cowles Commission since its beginning in 1932, and is now a research associate.

*Harold T. Davis*, A. B., Colorado College, 1915; A. M., Harvard 1919; Ph. D., Wisconsin, 1926. Professor Davis has been a research associate of the Cowles Commission since its beginning, spending several months of each year in the Commission's laboratory at Colorado Springs and functioning actively as a consultant by correspondence throughout the balance of the time. From January to August, 1937, he was acting research director. He was professor of mathematics at Indiana University, 1923-1937, and at Northwestern University, 1937-. In addition to his publications listed in this report he is the author of six volumes of *Tables of Higher Mathematical Functions*, two of which have been published to date. Other books of which he is

the author include *General Mathematics*, *The Philosophy of Modern Science*, *The Volterra Integral Equation*, and *The Theory of Linear Operators*. He is also the author of numerous papers in mathematical journals, and is an associate editor of *Econometrica*, *Isis*, and the *Bulletin of the American Mathematical Society*.

*Herbert E. Jones*, A.B., Stanford University, 1926; Degree in Engineering, 1928. Mr. Jones was a research fellow of the Cowles Commission from April, 1936 to September, 1937, and since then has been a research associate. He worked for four years as a hydraulic engineer for the Federal Water Service Corporation in San Francisco and New York.

*Dickson H. Leavens*, B.A., Yale, 1909; M.A., 1915. Mr. Leavens has been a research associate of the Cowles Commission since September, 1936 and has also served as managing editor of *Econometrica*. He taught mathematics and other subjects at the College of Yale in China, Changsha from 1909 to 1928 and was treasurer from 1916 to 1928. From 1929 to 1933 he was on the research staff of the Harvard Graduate School of Business Administration. In 1934 he served in China and India as a special agent of the United States Treasury Department to investigate the silver situation.

*Francis McIntyre*, A.B., Stanford, 1931. Professor McIntyre has been a research associate of the Cowles Commission since September, 1937. He was research assistant, Social Science Research Committee, University of

Chicago, 1931-1932; university fellow in economics, University of Chicago, 1932-1934; and instructor in statistics and economics, Stanford University, 1934-1937. He has been associate professor of economics at Colorado College since September, 1937.

*William F. C. Nelson*, A.B., University of Toronto, 1921. Mr. Nelson from 1932 until his death in May, 1936, was a research associate of the Cowles Commission. He also served as assistant editor of *Econometrica*, and was a lecturer in statistics at Colorado College.

*Charles F. Roos*, B.A., Rice Institute, 1921; M.A., 1924; Ph.D., 1926. Dr. Roos was director of research of the Cowles Commission from September, 1934 to February, 1937. He was National Research Council fellow in mathematics 1926-1928; assistant professor of mathematics at Cornell University, 1928-31; secretary of Section K (Economics, Sociology, and Statistics) American Association for the Advancement of Science, 1928-1931, and permanent secretary and member of the executive committee of this organization, 1931-1933; fellow of the John Simon Guggenheim Memorial Foundation, 1933; principal economist and director of research, National Recovery Administration, 1933-1934; professor of econometrics, Colorado College, 1934-37. He was a founder of the Econometric Society; secretary-treasurer, 1931-32; secretary, 1932-36. He is chairman of the program committee and a fellow and member of the council of the Society. He has received research grants from the Social Science Research Council and the

American Association for the Advancement of Science. He is now director of research of the Mercer-Allied Corporation.

*Gerhard Tintner*, Ph.D., Vienna, 1928. Professor Tintner was a research fellow of the Cowles Commission from November, 1936 to September, 1937. He studied at the University of Vienna and the Universities of London, Cambridge, and Harvard. During 1934 and 1935 he held a Rockefeller fellowship. He is the author of *Prices in the Trade Cycle*, published in Vienna in 1935 by the London School of Economics and the Austrian Institute for Trade Cycle Research, with which he was formerly connected. He has also written a number of articles on economic and statistical topics. He is now assistant professor of economics and mathematics at Iowa State College.

In addition to the foregoing, the Commission regularly employs a librarian and two computing clerks, as well as necessary stenographic and bookkeeping help. During the past two years, through the affiliation with Colorado College, have been secured the services of 12 or more student computers each year. Some of these have worked in the laboratory of the Commission under the supervision of staff members and others in the laboratory of Colorado College under the direction of a faculty member retained by the Commission for that purpose.

## RESEARCH FELLOWSHIPS

THE COMMISSION in 1936 established two Research Fellowships of \$1,000 a year each. These are awarded to promising young men, with the doctor's degree or equivalent experience, who have demonstrated ability to do constructive research in the fields of economics and statistics. The purpose of the Fellowships is not so much to give the formal theoretical training, which is best obtained at a large university, as to supply a familiarity with the problems which arise in connection with actual statistical investigations. The Research Fellows are expected to acquire familiarity with various types of computing machinery and techniques, and in other ways to fit themselves for the supervision of extensive research projects. During 1936-37 the Fellowships were held by Herbert E. Jones and Gerhard Tintner.

## EQUIPMENT

THE Cowles Commission occupies approximately 2400 square feet of floor space in the Mining Exchange Building of Colorado Springs. Its equipment includes one Marchant and three Monroe calculating machines and two adding machines. Leased equipment includes Hollerith electric duplicating card punch, sorter, tabulator, summary punch, and multiplying punch. In addition to the above the statistical laboratory of Colorado College, with five



Monroe calculating machines and one adding machine is available for special purposes.

## LIBRARY

THE library of Colorado College, available to members of the Cowles Commission staff, includes 140,000 volumes. It has several thousand volumes in economics, mathematics, and statistics. To supplement this the Cowles Commission has built up a working library in these fields, containing a total of about 1400 volumes, of which about 850 are books and 550 are bound volumes of journals; there are also several hundred pamphlets and reprints of articles. About 200 volumes are being added to the library each year. Over 60 journals are received currently. The Commission also subscribes to 12 services which provide in convenient form statistical material of various sorts.

## TEACHING ACTIVITIES OF STAFF MEMBERS

DURING the past five years the following courses in economics and statistics, chiefly for graduate students, have been conducted at Colorado College by members of the staff of the Cowles Commission:

William F. C. Nelson: *Statistics Applied to Business and Economic Problems*, both semesters, 1932-33.

Charles F. Roos: *Business and the National Recovery Administration*, first semester, 1934-35; *Economic Statistics*, second semester, 1934-35; *Econometrics*, first semester, 1935-36; *Industry and Trade and Economics Reading Course*, both semesters, 1935-36; *Econometrics, Contemporary Economic Experiments*, and *Advanced Mathematical Statistics*, first semester, 1936-37.

Harold T. Davis: *Advanced Mathematical Statistics*, second semester, 1936-37.

Gerhard Tintner: *Econometrics*, second semester, 1936-37.

Francis McIntyre: *Econometrics*, first semester, 1937-38.

In addition to the foregoing, weekly seminars have been conducted at the offices of the Cowles Commission. The subjects discussed were: John Maynard Keynes' *The General Theory of Employment, Interest and Money*, second semester, 1935-36; *Socialism*, second semester, 1936-37; *Business-cycle Theory*, first semester, 1937-38. These sessions were attended by members of the Cowles Commission staff and of the Colorado College faculty, as well as by other residents of Colorado Springs interested in economic theory.

## RESEARCH CONFERENCES

IN the summers of 1935, 1936, and 1937 research conferences on economics and statistics were conducted at Colorado College in Colorado Springs by the Cowles Commission. These conferences have lasted for approximately the whole month of July each year and have been attended by over 100 out-of-town visitors who hold academic or research positions in various institutions throughout the United States and Europe. In 1937 the program called for two lectures a day of approximately one hour each, for five days a week, each lecture being followed by a discussion period of about half an hour. The sessions were from 9.30 A. M. to 12.30 P. M. Saturdays and Sundays were left free and were used by many of those in attendance for expeditions to various points of interest in the region such as Pike's Peak, the Royal Gorge, Cripple Creek gold camp, Estes Park, Mesa Verde cliff dwellings, Taos Indian pueblos, Santa Fe, and Cheyenne roundup. Nationally or internationally known economists and statisticians among the lecturers at the conferences have included the following: Louis H. Bean, Harold T. Davis, Edward L. Dodd, Griffith C. Evans, Irving Fisher, R. A. Fisher, Ragnar Frisch, Thornton C. Fry, Corrado Gini, Harold Hotelling, Edward V. Huntington, Alfred J. Lotka, Jakob Marschak, Karl Menger, James Harvey Rogers, Charles F. Roos, Walter A. Shewhart, Carl Snyder, O. C. Stine, S. S. Wilks, Elmer J. Working, Holbrook Working, and Theodore O. Yntema.

The Commission has published reports of the 1936 and 1937 conferences containing abstracts of papers presented.

The Fourth Annual Research Conference will be held at Colorado College, July 5-29, 1938. The aim of the Conference is to provide an opportunity for leaders in economics and statistics to discuss their problems in a more leisurely manner than is possible in the crowded sessions of the national meetings of the various learned societies. All serious scholars, including teachers, research workers, and graduate students, will be welcome at the Conference. There is no charge for attendance. Board and lodging for participants will be available in the dormitories of Colorado College at the rate of about \$40 for the four-week session, or \$11 a week for those attending less than the full period. Further information may be obtained on application to the Cowles Commission.

## COWLES COMMISSION MONOGRAPHS

**A** FUNCTION of the Commission is to issue, from time to time, various monographs of an economic-statistical or econometric nature without, however, assuming responsibility for theories or opinions expressed therein.

Monograph No. 1, *Dynamic Economics, Theoretical and Statistical Studies of Demand, Production and Prices*, 275 pp., by Charles F. Roos, was published in September, 1934 by the Principia Press. This book is one of few that

apply mathematical analysis in the investigation of economic theory. It goes further than most previous studies by differentiating between the old theories of static economics and the new developments of dynamic economics. The author was one of the pioneers in this field. A series of separate studies is presented, the theoretical parts being chiefly concerned with the modification and extension of classical theories by the introduction of various dynamic elements. A theoretical investigation is made of certain problems concerning joint demand and loss leaders. Other studies include the demand for consumers' goods and capital goods, growth and decline of industry, production incentives, and the behavior of free and restrained prices. The book also contains two statistical analyses, one of the automotive demand for gasoline, which is an example of the demand for a consumers' good, the other a study of the factors influencing residential building, as an instance of demand for a capital goods. As a whole, the book undertakes to outline a basis for the dynamic analysis of various economic problems.

Monograph No. 2, *NRA Economic Planning*, 596 pp., by Charles F. Roos, was published in February, 1937, by the Principia Press. The author served as principal economist and director of research on policy matters of the National Recovery Administration from July, 1933 to September 1934. His intimate experience with the organization and personnel, combined with his theoretical training in the fields of economics, statistics, accounting, and engineer-

ing, fitted him in an exceptional way to write on the NRA with a critical, scientific attitude, aided by familiarity with actual conditions. The book first traces the factors which had their part in the development of NIRA, the drafting and passage of the Act, and the personnel and organization of the National Recovery Administration. Later chapters discuss the background of issues involving hours of work, wages, collective bargaining, costs, prices, fair trade practices, effects on small business men, and the whole problem of economic planning. Solutions attempted by the NRA are described, the reasons for adopting them given, and the degree of their success appraised; Many fundamental policy memoranda are reproduced in part or in full. In each chapter an attempt is made to outline the rapidly changing decisions and the reasons therefor. A further aim is to provide more complete statistical data as an aid in the analysis of the general economic and social objectives and accomplishments of the NRA. Finally, an endeavor is made to appraise constructively this great undertaking and to throw light on the important question: What can we expect from economic planning?

Monograph No. 3, *Common Stock Indexes, 1871-1937*, by Alfred Cowles 3rd and associates, will be published early in 1938 by the Principia Press. This will present the results of a major project on which the staff of the Cowles Commission has been engaged for several years, the construction of new monthly common stock indexes from 1871 to date. These include all industrial and utility common

stocks, and more than 90 per cent in market value of all rail stocks, quoted on the New York Stock Exchange from 1871 to 1917. Thereafter are included more than 75 per cent in the market value of stocks quoted on all United States exchanges. The volume will include monthly indexes of (1) stock prices, (2) stock prices adjusted for reinvestment of cash dividends, (3) yields, and (4) dividend payments; and annual indexes of (5) earnings and (6) earnings-price ratios. Each of these indexes has been computed for 69 industry groups or combinations of groups. All necessary corrections have been made for changes in capital structure. From 1918 (in some cases 1926 or later) the index (1) of stock prices is the monthly average of Standard Statistics weekly averages and for this period the other five indexes are composed of the same group of stocks. From 1871 to 1917 the index of railroad stock prices is one constructed by Frederick R. Macaulay of the National Bureau of Economic Research and for this period the other five railroad stock indexes are based on the list of stocks which he included. The volume will contain over 400 pages of tables, with introduction and appendixes. Some idea of the magnitude of the project may be gained from the fact that it required over 1,500,000 work-sheet entries.

Monograph No. 4, *Silver Money*, by Dickson H. Leavens, will be published in 1938 by the Principia Press. This book will sketch the nineteenth-century background of the use of silver as money, the reasons for the abandon-

ment of bimetallism or the silver standard by the principal nations, the special position of the white metal in India and China, and the effects of the World War on the price and monetary use of silver. More detailed consideration will be given to the silver agitation during the world depression, to American legislation on the subject and its effect on world monetary use of silver, and in particular to the abandonment of the silver standard by China.

Monograph No. 5, *The Analysis of Economic Time Series*, by Harold T. Davis, is in preparation. The object of this volume is to set forth in some detail the present status of the problem of analyzing and interpreting that very extensive set of data known as economic time series. This perplexing problem has engaged the attention of economists and statisticians for many years, but the extraordinary intensity with which it has been attacked during the past decade attests the importance which it has for modern economic development. The need for a comprehensive survey of this field has become evident in the course of the studies made by the Cowles Commission.

Monograph No. 6, *The Action of Stock Prices*, by Alfred Cowles and associates, is in preparation. In this volume the movements of stock prices, as shown by the new Cowles Commission indexes, will be analyzed. Differences in yields for various groups will be considered. Trends will be investigated and an attempt made to determine the factors which influence them. Relative variability for prices in different groups and the evidence as to cyclical and sea-



sonal variation will be thoroughly considered by means of a variety of techniques. Finally, an attempt will be made, in the light of statistical evidence, to appraise various theories of stock-price action.

## OTHER STAFF PUBLICATIONS AND PAPERS

THE Commission, in addition to its own monographs, assisted in the publication of a textbook, *Elements of Statistics*, 424 pp., by Harold T. Davis and William F. C. Nelson, published in July, 1935, by the Principia Press. This has been adopted as a text by a number of colleges and universities in the United States and abroad. A revised and enlarged second edition (434 pp.) was published in March, 1937.

Since the organization of the Commission members of its staff have published 26 papers in scientific periodicals and have presented 55 papers at meetings of scientific societies. These are listed below:

EDWARD N. CHAPMAN

(With Alfred Cowles 3rd), "A Statistical Study of Climate in Relation to Pulmonary Tuberculosis." *Journal of the American Statistical Association*, Vol. 30, Sept., 1935, pp. 517-536.

ALFRED COWLES 3RD

"Can Stock Market Forecasters Forecast?" presented at Cincinnati, Dec. 31, 1932, before the Econometric Society and the American Statistical Association.

"The Meeting of the Econometric Society in Cincinnati, Ohio, December, 1932," *Econometrica*, Vol. 1, Apr., 1933, pp. 209-217.

"Can Stock Market Forecasters Forecast?" *Econometrica*, Vol. 1, July, 1933, pp. 309-324.

"The Meeting of the Econometric Society in Chicago, June, 1933," *Econometrica*, Vol. 1, Oct., 1933, pp. 431-444.

"The Meetings of the Econometric Society in Philadelphia and Boston, December, 1933," *Econometrica*, Vol. 2, Apr., 1934, pp. 204-220.

"The Effect of Climate on Pulmonary Tuberculosis: A Statistical Study," presented at Pittsburgh, Dec. 28, 1934, before Sections K and N of the American Association for the Advancement of Science.

"Practical Problems in the Methodology of Multiple Correlation Analysis," presented at Colorado Springs, June 24, 1935, before the Econometric Society.

"Multiple Correlation Analysis of Intercorrelated Variates," presented at Colorado Springs, July, 1935, before the Cowles Commission Research Conference.

(With Edward N. Chapman), "A Statistical Study of Climate in Relation to Pulmonary Tuberculosis," *Journal of the American Statistical Association*, Vol. 30, Sept., 1935, pp. 517-536.

"Effects of Building Activity and Other Factors on Security Prices," presented at St. Louis, Jan. 3, 1936, before the Econometric Society and the American Association for the Advancement of Science.

"Evidence of Structure in Common Stock Prices," presented at Colorado Springs, Aug. 7, 1936, before the Cowles Commission Research Conference.

(With Herbert E. Jones), "Some a Posteriori Probability Considerations of Stock Market Action," presented at Chicago, Dec. 29, 1936, before the Econometric Society.

(With Herbert E. Jones), "Some a Posteriori Probabilities in Stock Market Action," *Econometrica*, Vol. 5, July, 1937, pp. 280-294.

#### HAROLD T. DAVIS

"New Technique in the Analysis of Trend Lines," presented at Indianapolis, May 7, 1932, before the Indiana Section of the Mathematical Association of America.

"The Perturbation Problem for Economic Series," presented at Syracuse, June, 1932, before the Econometric Society.

"A Technique for the Study of the Interaction of Economic

Series," presented by title at Ames, Iowa, Nov. 26, 1932, before the American Mathematical Society.

"Harmonic Interaction of Economic Series," presented at Atlantic City, Dec. 26, 1932, before the Econometric Society and Section K of the American Association for the Advancement of Science.

"The Predictable Elements in Economic Series," presented at Columbus, Ohio, Apr. 6, 1933, before the Ohio Section of the Mathematical Association of America.

"Contributions to the Theory of Harmonic Analysis of Economic Series," presented at Chicago, June 29, 1933, before the Econometric Society and Section K of the American Association for the Advancement of Science.

"Polynomial Approximations by the Method of Least Squares," *Annals of Mathematical Statistics*, Vol. 4, Aug., 1933, pp. 155-195.

"Some Statistical Aspects of Random Series," presented at Philadelphia, Dec. 28, 1933, before the Econometric Society and the American Statistical Association.

"Properties of the Polygamma Function," presented at Lafayette, Indiana, May 12, 1934, before the Indiana Section of the Mathematical Association of America.

"Can Man's Group Activity be Measured?" presented at Indianapolis, Nov. 30, 1934, before the Central Association of Science and Mathematics Teachers.

"How Periodic Elements are Discovered in Statistical Series," presented at Indianapolis, Nov. 30, 1934, before the Mathematics Section of the Central Association of Science and Mathematics Teachers.

"Statistical Proofs of Periodicity in Economic Series," presented at Pittsburgh, Dec. 28, 1934, before the Econometric Society, the American Mathematical Society, the Mathematical Association of America, and Sections A and K of the American Association for the Advancement of Science.

"An Extension to Polygamma Functions of a Theorem of Gauss," *Bulletin of the American Mathematical Society*, Vol. 41, Apr., 1935, pp. 243-247.

"Some Periodic Aspects of the Stock Market," presented at Colorado Springs, June 24, 1935, before the Econometric Society.

"The Statistical Validity of Harmonic Analysis," presented at Colorado Springs, July, 1935, before the Cowles Commission Research Conference.

"Report of the Meeting of the Econometric Society, Colorado Springs, June 22-24, 1935," *Econometrica*, Vol. 3, Oct., 1935, pp. 473-476.

"Statistical Validity of the Forty-Month Cycle in Stock Prices," presented at St. Louis, Jan. 2, 1936, before the Econometric Society and the American Association for the Advancement of Science.

"Mathematics and Social Phenomena," presented at North Manchester, Indiana, May 1, 1936, before the Indiana Section of the Mathematical Association of America.

"Significance of Analysis of Variance of Time Series," presented at Colorado Springs, Aug. 7, 1936, before the Cowles Commission Research Conference.

"Significance Tests for Periodogram Analysis with Application to Prices of Common Stocks," presented at Colorado Springs, Aug. 8, 1936, before the Cowles Commission Research Conference.

"The Application of Functionals in Economics," presented at Denver, June 24, 1937, before the Econometric Society and Sections A and K of the American Association for the Advancement of Science.

"The Econometric Problem," presented at Colorado Springs, June 28, 1937, before the Cowles Commission Research Conference.

"The *Fonctionelle* Nature of Utility," presented at Colorado Springs, July 16, 1937, before the Cowles Commission Research Conference.

"Mathematical Adventures in Social Science," presented at State College, Pennsylvania, Sept. 7, 1937, before the Mathematical Association of America (to be published in the *American Mathematical Monthly*).

"The Pareto Distribution of Income," presented at Atlantic City, Dec. 28, 1937, before the Econometric Society.

(With Herbert E. Jones), "Some Results of the Theory of Random Series," presented at Indianapolis, Dec. 30, 1937, before the American Mathematical Society and the Institute of Mathematical Statistics.

"The Centennial of Cournot's *Theory of Riches*," presented at Indianapolis, Dec. 30, 1937, before the History of Science Society and Section L of the American Association for the Advancement of Science.

#### HERBERT E. JONES

"The Economics of Overhead Costs with Application to Pumping," presented at Colorado Springs, July, 1935, before the Cowles Commission Research Conference.

"Meetings of the Econometric Society in New York City, December, 1935 and St. Louis, January, 1936," *Econometrica*, Vol. 4, Apr., 1936, pp. 184-192.

"The Nature of Regression Functions in the Correlation Analysis of Time Series," presented in preliminary form at Colorado Springs, July 21, 1936, before the Cowles Commission Research Conference, and in final form at Chicago, Dec. 28, 1936, before the American Statistical Association and the Institute of Mathematical Statistics.

(With Alfred Cowles 3rd), "Some a Posteriori Probability Considerations of Stock Market Action," presented at Chicago, Dec. 29, 1936, before the Econometric Society.

"Some Geometrical Considerations in the General Theory of Fitting Lines and Planes," *Metron*, Vol. 13, 1937, pp. 21-30.

(With Alfred Cowles 3rd), "Some a Posteriori Probabilities in Stock Market Action," *Econometrica*, Vol. 5, July, 1937, pp. 280-294.

"The Theory of Runs as Applied to Time Series," presented at Colorado Springs, July 2, 1937, before the Cowles Commission Research Conference.

"The Nature of Regression Functions in the Correlation Analysis of Time Series," *Econometrica*, Vol. 5, Oct., 1937, pp. 305-325.

(With Harold T. Davis), "Some Results of the Theory of Random Series," presented at Indianapolis, Dec. 30, 1937, before the American Mathematical Society and the Institute of Mathematical Statistics.

#### DICKSON H. LEAVENS

"The Accumulation of the Precious Metals in India and China," presented at Colorado Springs, July 15, 1936, before the Cowles Commission Research Conference.

"Silver at the Second Session of the Seventy-fourth Congress," *Finance and Commerce*, Shanghai, Vol. 28, July 29, 1936, pp. 125-127.

"The Silver Clause in China," *American Economic Review*, Vol. 26, Dec., 1936, pp. 650-659.

"Silver [Review of 1936]," *Engineering and Mining Journal*, Vol. 138, Feb., 1937, pp. 55-56.

"Report of the Chicago Meeting [of the Econometric Society]," Dec. 28-30, 1936," *Econometrica*, Vol. 5, Apr., 1937, pp. 184-197.

"Drawings from Rectangular Distributions," presented at Colorado Springs, July 2, 1937, before the Cowles Commission Research Conference.

"Report of the Denver Meeting [of the Econometric Society]," June 24-26, 1937," *Econometrica*, Vol. 5, Oct., 1937, pp. 384-392.

"Silver at the First Session of the Seventy-fifth Congress," *Financial News*, Bombay, Vol. 5, No. 42, Oct. 23, 1937, p. 14; also published in *Finance and Commerce*, Shanghai, Vol. 30, Nov. 3, 1937, p. 345.

"Five Years of American Silver Policy," presented at Atlantic City, Dec. 27, 1937, before the Econometric Society.

#### FRANCIS McINTYRE

"Monopolistic Elements in Pricing: The Domestic-Export Spread," presented at Colorado Springs, July 7, 1937, before the Cowles Commission Research Conference.

"The Cowles Commission Stock Indexes, 1871-1937," presented at Boulder, Colorado, Nov. 26, 1937, before the Colorado-Wyoming Social Science Association.

"Price Discrimination between Two Markets under Imperfect Competition and Monopoly," presented at Atlantic City, December 27, 1937, before the Econometric Society.

#### WILLIAM F. C. NELSON

"A New Index of Investment Experience in American Industrial and Public Utility Common Stocks, 1872-1906," by W. F. C. Nelson, presented at Berkeley, June 22, 1934, before the Econometric Society, the American Statistical Association, and Section K of the American Association for the Advancement of Science.

"Painting and Prices," by W. F. C. Nelson, presented at Colorado Springs, June 24, 1935, before the Cowles Commission Research Conference.

#### CHARLES F. ROOS

"Economic Theory of the Shorter Work Week," presented at Pittsburgh, Dec. 28, 1934, before the Econometric Society.

"What Do Time-Series Correlation Coefficients Show?" presented at Pittsburgh, Dec. 28, 1934, before the Econometric Society, the American Mathematical Society, the Mathematical Association of America, and Sections A and K of the American Association for the Advancement of Science.

"Labor vs. Machine Cost: Some Theoretical and Statistical Studies of Replacement of Men by Machines," presented at Pittsburgh, Dec. 29, 1934, before the Econometric Society and Sections K and M of the American Association for the Advancement of Science.

"Economic Theory of the Shorter Work Week," *Econometrica*, Vol. 3, No. 1, Jan., 1935, pp. 21-39.

"Cost Experiments of the NRA," presented at Colorado Springs, June 24, 1935, before the Econometric Society.

"Meetings of the Econometric Society in Chicago and Pittsburgh, December, 1934," *Econometrica*, Vol. 3, July, 1935, pp. 345-352.

"Lag Analysis with Special Reference to the Building Industry," presented at Colorado Springs, July, 1935, before the Cowles Commission Research Conference.

"Annual Survey of Statistical Information: Capital Formation and the Flow of National Income in the United States," *Econometrica*, Vol. 3, Oct., 1935, pp. 366-375.

"Effects of Credit, Building Costs, and Rent on Building Activity," presented at St. Louis, Jan. 3, 1936, before the Econometric Society.

"Some Economic Effects of Wage Regulation on Interstate Trade," presented at Colorado Springs, July 25, 1936, before the Cowles Commission Research Conference.

"A General Invariant Criterion of Fit for Lines, Planes, and Functions Expandable in Series, Where All Variates Are Subject to Error," presented in preliminary form at Colorado Springs, Aug. 5, 1936, before the Cowles Commission Research Conference, and in final form at Chicago, Dec. 28, 1936, before the American Statistical Association and the Institute of Mathematical Statistics.

"Annual Survey of Statistical Techniques: The Correlation and Analysis of Time Series — Part II," *Econometrica*, Vol. 4, Oct., 1936, pp. 368-381.

"New Indexes of Stock Prices and Yields and their Relation to Some Theories of Capital and Saving," presented at Chicago, Dec. 28, 1936, before the Econometric Society, the American Statistical Association, and the Institute of Mathematical Statistics.

"A General Invariant Criterion of Fit for Lines and Planes Where All Variables Are Subject to Error," *Metron*, Vol. 13, 1937, pp. 3-20.

#### GERHARD TINTNER

"A Note on Distribution of Income over Time," *Econometrica*, Vol. 4, Jan., 1936, pp. 60-66.

"Internationale Konjunkturforschung," *Der Oesterreichische Volkswirt*, Vol. 28, July 4, 1936, pp. 783-784.

"Expectations and the Statistical Theory of Errors," presented at

Chicago, Dec. 29, 1936, before the Econometric Society.

"Monopoly over Time," *Econometrica*, Vol. 5, Apr., 1937, pp. 160-170.

"The Economic Meaning of Functionals," presented at Denver, June 24, 1937, before the Econometric Society and Sections A and K of the American Association for the Advancement of Science.

"The Maximization of Utility over Time," presented at Colorado Springs, July 21, 1937, before the Cowles Commission Research Conference (to be published in *Econometrica*).

"The Dynamic Theory of Duopoly: A Problem in Econometrics," presented at Iowa City, November 26, 1937, before the American Mathematical Society.



