Celebrating Irving Fisher: The Legacy of a Great Economist

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Introduction[1]

Irving Fisher made seminal contributions across an astonishing spectrum of economic science: monetary policy rules, the neoclassical theory of capital and interest, expected inflation as the difference between real and nominal interest, the Fisher "ideal" index number, indexed bonds, correlation analysis, distributed lags, the "Phillips curve," the debt-deflation process, taxing consumption rather than income, the value of human capital and improvement in health, even the computation of general equilibrium. On May 8 and 9, 1998, economists gathered at Fisher's university, Yale, to celebrate his contributions and to examine themes in economics suggested by his work. The publication of William Barber's 14-volume edition of *The Works of Irving Fisher* in 1997, the 50th anniversary of Fisher's death, provided a suitable occasion for reflecting on Fisher's legacy and inspiration for economics. This volume contains revised versions of the papers and comments presented on that occasion, together with other writings on Fisher by James Tobin.

No other American economist working before World War II has had anything close to the influence that Irving Fisher has on modern economics. James Tobin (1985: 29–30) reports that Fisher led his contemporaries Wesley Clair Mitchell, John Bates Clark, and Frank W. Taussig in column inches in the *Social Sciences Citation Index* for 1976–1980 by the ratio 9:3:1:1 (with Fisher's lead growing over time), "[m]uch more than the others, moreover, Fisher is cited for substance rather than for history of thought."

In the early 20th century, Fisher was the most cited economist in

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the world. George Stigler and Claire Friedland (1979) have calculated that Fisher was the economist cited most often in journal articles published in English in all fields of economics in the period 1886 to 1924, but Jeff Biddle (1996: 150–151), who eliminates self-citations, places Alfred Marshall first (and Fisher fourth) for 1904–1924.

In the money and fluctuations literature, Fisher was the most-cited economist in the 1920s (with Mitchell second, and the young Keynes tenth). By the 1940s, Fisher vanished completely from citation lists as John Maynard Keynes captured the profession's attention (Deutscher 1990). Yet contemporary macroeconomics builds largely upon Fisher's foundations. Once remembered primarily for his spectacular misprediction of stock prices in October 1929 and for eccentric crusades (reform of the calendar, a new world map projection, Prohibition, the use of mathematics in economics), Fisher emerges in retrospect as a major figure in the development of economics—not least for those innovations his contemporaries found most ludicrous, such as building a hydraulic model to simulate the determination of prices in a general equilibrium system.

What Were Fisher's Contributions?

FISHER'S CONTRIBUTIONS TO THE MODERN THEORY of capital, income, interest, and saving, discussed by John Geanakoplos and James Tobin in this volume, have proved of central importance. The two-period consumption diagram of Fisher's *The Rate of Interest* ([1907] 1997, Vol. 3: 409) put intertemporal choice on the same footing as contemporaneous choice among goods (and was promptly extended to international exchange by Enrico Barone in 1908). Fisher's diagram brought together impatience (the marginal rate of time preference, represented by the slope of the indifference curve) and expected rate of return on investment (reflected in the slope of the budget constraint). Like Marshall's supply and demand diagram, Fisher's diagram brought together key concepts of economics and made their interaction conveniently and memorably visible for analysis and teaching. Fisher's diagram is the basis for permanent-income and life-cycle consumption theories, with the simple Keynesian absolute-income hypothesis restricted to cashflow-constrained consumers in imperfect

credit markets. Fisher's rate of return over costs, developed in *The Rate of Interest* and *The Theory of Interest* ([1930] 1997, Vol. 9), was recognized by John Maynard Keynes as equivalent to his marginal efficiency of capital (Keynes 1937; Kregel 1988; Dimand 1995), so modern theories of investment, saving, and consumption all have roots in Fisher's analysis of impatience and opportunity to invest.

The elements of Fisher's analysis were brilliantly anticipated in 1834 by John Rae (to whom Fisher dedicated *The Rate of Interest* and, jointly with Eugen von Böhm-Bawerk, *The Theory of Interest*) and developed by Böhm-Bawerk. Fisher was the first to draw them together, using his two-period diagram, and the first to show how they interacted to determine equilibrium. Fisher (1907) even anticipated the Cambridge capital controversies over reswitching of techniques, with a numerical example of multiple solutions for Böhm-Bawerk's average period of production (without noticing that his own rate of return over costs could be similarly subject to multiple roots).

An implication of Fisher's two-period consumption diagram was that, given the possibility of borrowing or saving, the relevant budget constraint for consumption decisions is the discounted present value of expected lifetime after-tax income. Fisher expounded his view of the stock of wealth or capital as the capitalized value of a stream of expected receipts (so that the flow of income rather than the stock of capital is the fundamental concept) in *The Nature of Capital and Income* ([1906] 1997, Vol. 2), discussed by James Tobin in this volume. Tobin brings out the importance of Fisher's insistence upon the then-unfamiliar concepts of discounting and net present value.

Since the market value of the assets acquired with savings is the discounted present value of the expected receipts to be received from owning the assets, Fisher held that it would be double-counting to include as income both the savings and the subsequent stream of earnings from the assets. As John Shoven and John Whalley discuss in this volume, Fisher redefined income to exclude net savings, so as to avoid double taxation and a tax-induced bias against saving. Instead of the income tax, Fisher proposed an expenditure tax. In recent years, Fisher's concern about a tax bias against capital accumulation has again come to the fore in public finance.

Fisher emphasized that human capital, the discounted present value of the stream of income from human skills and abilities, far exceeds the value of physical capital. He cited an estimate stating that human capital in the United States was worth five times as much as physical capital. Accordingly, he advocated investment in improving health, co-authored a best seller on *How to Live* (1915), and devoted his two presidential addresses to the American Association for Labor Legislation to proposals for a national department of health and for health insurance. Fisher's guide to a healthy life sold 400,000 copies in 21 editions in his lifetime, far more than any of his other books, while insurance companies distributed 12 to 15 million copies of an abridgement. Papers by William Nordhaus and Victor Fuchs in this volume, with comments by Robert Dimand, the late Alvan Feinstein, T. N. Srinivasan, and Richard Zeckhauser, follow Fisher in their concern with the economic value of the health of nations.

Fisher's American Economic Association monograph *Appreciation and Interest* ([1896] 1997, Vol. 1) was the first substantial study of expected inflation as the difference between nominal interest and real interest, a distinction whose recognition Fisher credited to earlier writers, especially Alfred Marshall. This relationship has become known as the Fisher equation. Considering rates of interest in different monetary standards, Fisher (1896) pioneered the uncovered interest parity theorem that nominal interest rates in two countries will differ by the expected rate of change of the exchange rate between the currencies of the countries. Attributing differences among money rates of interest for different terms to expectations about the future course of prices, Fisher offered an expectations theory of the term structure. He is often misremembered as asserting that real interest is independent of inflation and monetary shocks. This was true only for comparison of equilibria; his theory of economic fluctuations stressed the effect of monetary shocks on real interest during transition periods (see Dimand 1999a, 1999b). In *The Theory of Interest* (1930), Fisher used a distributed lag of past price level changes to represent expected inflation in correlations between nominal interest and expected inflation, an anticipation of the adaptive expectations hypothesis. Given Fisher's role as a pioneer of distributed lags and correlation analysis and as the founding president of the

Econometric Society, it is highly appropriate that Peter C. B. Phillips applies new methods of data description for nonstationary time series to an "Econometric Analysis of Fisher's Equation" in this volume.

Fisher's compensated-dollar proposal for stabilizing the cost of a basket of commodities, advanced in *The Purchasing Power of Money* ([1911] 1997, Vol. 4) and *Stabilizing the Dollar* ([1920] 1997, Vol. 5), advocated a policy rule (varying the dollar price of gold to target a commodity price index, not a monetary aggregate) instead of discretion. Advocacy of monetary policy rules (other than the gold standard) was unusual in Fisher's day (see Robert Hall in this volume), as was Fisher's preference for internal stabilization over exchange stability.

Fisher's monetary theory of economic fluctuations, first presented in Chapter IV of *The Purchasing Power of Money* (1911), anticipated later developments such as the Phillips curve and adaptive expectations. Indeed, Fisher's "A Statistical Relation Between Unemployment and Price Changes" (1926) was reprinted in 1973 as "Lost and Found: I Discovered the Phillips Curve—Irving Fisher," a title devised by George Stigler, then editing the *Journal of Political Economy* (although the direction of causality in Fisher's article ran from price changes to unemployment, while that of A. W. H. Phillips ran from unemployment to wage changes). Fisher's rejection of the belief of W. Stanley Jevons, Wesley Mitchell, William Beveridge, Henry L. Moore, and Nikolai Kondratieff that economic fluctuations reflect the summation of truly periodic cycles has carried the field so completely that "business cycles" as the name of a field no longer implies that fluctuations are cyclical—even though David Hendry and Mary Morgan (1995: 45–48) find that Fisher erred in claiming that his own monthly data for U.S. trade for 1915–1923 showed no cyclical tendencies (Fisher 1997, Vol. 8). Like Milton Friedman and Anna Schwartz (1963), Fisher attributed the onset and severity of the Great Depression to a contraction of the money supply that the Federal Reserve could have prevented (Cargill 1992). Going beyond a monetary theory of fluctuations, Fisher ([1933] 1997, Vol. 10) developed a debt-deflation theory of depressions, stressing the consequences for stability of changes in the real value of nominal-valued inside debt that had not been anticipated when the debts were incurred. This

analysis, which influenced Hyman Minsky's theory of financial-system fragility, is only now being absorbed by the mainstream (see Tobin 1980, Ch. 2; Minsky 1982; King 1994; Robert Dimand in this volume). Fisher (1935) assembled a 27-country data set to study the role of the gold standard in the international transmission of the Depression, anticipating a post-1980 wave of similar studies (see Dimand 2003).

Fisher took the equation of exchange from the work of Simon Newcomb, to whom he dedicated *The Purchasing Power of Money*, and expressed it as $MV = PT$, where M is the stock of money, V the velocity of circulation, P the price level, and T an index of transactions. Fisher then expanded the equation of exchange to $MV + M'V' = PT$, to take account of demand deposits M' as well as currency M, and attempted an independent measurement of the velocities of circulation of currency and deposits, drawing on a survey of cash-holding and spending by his Yale students and on David Kinley's (1897, 1910) studies of bank clearings. Although Fisher expounded the quantity theory of money in terms of the velocity of circulation of money rather than of a stable money demand function, Bennett McCallum and Marvin Goodfriend (1987) credit Fisher's *Theory of Interest* (1930: 216) with the first correct and unambiguous account of the marginal opportunity cost of holding money.

Fisher's 1891 Yale doctoral dissertation, published the following year as *Mathematical Investigations in the Theory of Value and Prices* ([1892] 1997, Vol. 1), introduced general-equilibrium analysis into American economics (with some unnecessary originality, as he wrote much of the thesis before discovering the writings of Léon Walras and Francis Ysidro Edgeworth). In his dissertation, Fisher presented his hydraulic model to simulate price determination (see William Brainard and Herbert Scarf in this volume, and the comments by Donald Brown and Felix Kubler and by K. R. Sreenivasan). Though that machine was destroyed in transit to the Columbian Exhibition in Chicago, it and a later version by Fisher were ancestors of A. W. H. Phillips's hydraulic macro-model (Leeson 2000) and forerunners of today's computable general equilibrium modeling.

Fisher's commitment to making his theory empirically meaningful led to *The Purchasing Power of Money*'s attempted statistical

verification of the quantity theory of money, to annual articles in the *American Economic Review* (1911–1919) on the equation of exchange, to his massive *The Making of Index Numbers* ([1922] 1997, Vol. 7) and the Fisher "ideal index" (the geometric mean of the Paasche and Laspeyres indexes), and to Fisher's Index Number Institute, whose *weekly* commodity price index was accompanied by weekly articles by him. Fisher's exhaustive test approach to index numbers, searching for the formula that best satisfied a set of statistical tests (see W. Erwin Diewert in this volume), has borne belated fruit: in 1995, the U.S. Department of Commerce's Bureau of Economic Analysis switched to a chain-weighted index approximating Fisher's ideal index. A reliable price index was crucial for Fisher's proposed monetary-policy rule (the compensated dollar plan), for his campaign to educate the public against what he termed *The Money Illusion* ([1928] 1997, Vol. 8), and for his proposal to index transactions against monetary instability (see John Geanakoplos in this volume). Fisher persuaded Rand Kardex (later Remington Rand) to issue the first indexed bonds in the 1920s: the U.S. government followed only in 1996.

Fisher was notorious for an empirical failure: his excessive optimism about stock prices in October 1929. While he could not have been expected to predict when a stock price bubble would burst, he was overly sanguine in denying any such bubble and insisting that soaring stock prices reflected the sound fundamentals of a "New Economy" based on new technologies. Fisher's public reputation and personal finances were devastated by the Wall Street crash. However, Kathryn Dominguez, Ray Fair, and Matthew Shapiro (1988) argue that the severity and duration of the Depression could not have been forecast even with modern statistical techniques and data sets because unpredictable policy mistakes were responsible. In addition, Fisher's claims for a high rate of return on owning common stocks over the long term may be viewed as an early discovery of what is now known as "the equity premium puzzle."

These varied contributions in the many publications listed in Irving Norton Fisher's vast bibliography of his father's writings (I. N. Fisher 1961–1972) have a breadth unmatched by Fisher's contemporaries. John Bates Clark, paired with Fisher in James Tobin's article on the

American Economic Association's centenary (Tobin 1985), is remembered primarily as a favorite straw man of the Cambridge capital controversies. Fisher's contributions closely parallel much of modern macroeconomics, yet his role was long neglected. References to him vanished from macroeconomics in the 1940s. The "Mark I" monetarism of Milton Friedman and his Chicago students had many Fisherian features: the quantity theory of money, a monetary-policy rule, domestic price stability rather than fixed exchange rates, adaptive expectations, the permanent-income consumption function (based on Fisher's two-period consumption diagram), and Federal Reserve responsibility for the Great Depression. Friedman often placed less emphasis on links with Fisher than with Chicago oral tradition. However, Friedman (1972: 12) paid a handsome tribute to Fisher when, addressing the American Economic Association on the question "Have Monetary Policies Failed?," he quoted at length from Fisher's exchange with J. Laurence Laughlin on the quantity theory of money at the 1910 AEA meetings and then stated: "And now I must cease quoting from Fisher, with whom I am in full agreement, and proceed instead to plagiarize him—albeit with modifications to bring him down to date."

James Tobin (1985: 36–37) concluded that Fisher's "insights contain the making of a theory of the determination of economic activity, prices, and interest rates in short and medium runs. Moreover, in his neo-classical writings on capital and interest Fisher had laid the basis for the investment and savings equations central to modern macroeconomic models. Had Fisher pulled these strands together into a coherent theory, he could have been an American Keynes." Fisher never pulled the strands of his economics together in a grand synthesis. His monetary economics, from the equation of exchange through index numbers to the compensated dollar, was united by a concern with the consequences of imperfectly expected monetary shocks but was not set in the context of either the general equilibrium analysis of his dissertation or his capital theory.

This failure to draw his monetary theory of fluctuations, his general equilibrium analysis, and his theory of interest and capital together into a coherent synthesis was one of three reasons for Fisher's inability to hold the attention of his audience in the 1930s and 1940s. The second reason was that Fisher did not deal with the macroeconomic

coordination problem that Keynes and Friedrich von Hayek tackled in very different ways in the 1930s. Fisher offered no explanation of how a drop in nominal income and spending led to mass unemployment in that decade. He did go beyond his monetary theory of economic fluctuations to investigate the debt-deflation process, but he presented no explicit theory of unemployment and the labor market. Fisher correlated output and unemployment with distributed lags of past price level changes, but in the Great Depression of the 1930s, the public and the economics profession demanded an explanation of mass unemployment that focused on what had gone wrong with adjustment in the labor market.

The third reason for Fisher's eclipse was the wreckage of his public reputation and personal finances by his misjudgment of stock prices, compounded by his misfortune in providing in October 1929 a memorable and quotable remark about stock prices reaching a permanently high plateau. Fisher could not have predicted the subsequent monetary, fiscal, and tariff policies that turned the slump into a deep depression, and although the equity premium literature suggests that he was right about common stocks as an investment for the long term, his reputation was shattered.

For these three reasons, Fisher found no contemporary audience for his debt-deflation theory of depressions, his explanation of the spending collapse. Even his monetary theory of economic fluctuations was forgotten as introductory textbooks attached his name to a constant-velocity, constant-output version of the quantity theory of money. With historical perspective, however, Fisher can now be recognized as among the most fruitful builders of modern economics. It is not at all unusual for a once-renowned scholar to fade in the collective memory of his or her discipline. There are also numerous instances of unnoticed precursors such as Gossen being belatedly discovered. What is remarkable is that Fisher, having achieved eminence and then been ignored by his professional peers, is once again seen as a crucial figure in the development of economics.

Overview of the Volume

JAMES TOBIN'S *NEW PALGRAVE* ARTICLE on Fisher has become a classic, an evaluation of a great Yale monetary economist by another great

Yale monetary economist. Tobin, the 1981 Nobel laureate in Economic Science, was consulting editor for William Barber's edition of *The Works of Irving Fisher* and has long recognized Fisher as America's outstanding scientific economist of the first half of the 20th century.

William J. Barber, the editor of the 14-volume edition of *The Works of Irving Fisher*, draws on his unrivaled knowledge of Fisher's writings and papers to reflect on Fisher's life and career, and especially on Fisher's often-troubled relationship with Yale University, where Fisher was an undergraduate and graduate student and spent his entire teaching career.

The modern study of computation of general economic equilibrium begins with the fixed-point algorithm from Herbert E. Scarf's "On the Computation of Equilibrium Prices," appropriately in *Ten Economic Studies in the Tradition of Irving Fisher* (Fellner et al. 1967), published to celebrate the centenary of Fisher's birth. Now, William C. Brainard and Herbert E. Scarf examine "How to Compute Equilibrium Prices in 1891," sorting out how the hydraulic machine outlined in Fisher's 1891 dissertation (published as Fisher 1892) actually worked. Brainard and Scarf use Matlab to simulate the path of adjustment in Fisher's hydraulic model for a variety of preferences, endowments, and initial conditions. Donald Brown and Felix Kubler apply a different method of solving nonlinear systems of equilibrium equations, the homotopy method suggested by Eaves, to the adjustment path of Brainard and Scarf's digital version of Fisher's hydraulic machine. The physicist and mechanical engineer K. R. Sreenivasan looks to the mathematical tools available in 1891 to understand why Fisher turned to a hydraulic simulation of general equilibria rather than attempting a mathematical solution of his system of equations describing general competitive equilibrium.

A group of three papers and three comments considers Fisherian themes in monetary economics and macroeconomics. Robert E. Hall examines Chile's experiment with the Unidad de Fomento as an implementation of Fisher's compensated-dollar plan, under which the resource content of the unit of account is varied to stabilize the cost of a bundle of commodities. James Tobin argues that the present multiplicity of available stores of values reduces the importance of

stabilizing the real value of currency, and concludes: "At the end of the century, monetary and economic stability does not seem to be as daunting a challenge as it appeared to Fisher. Fisher himself deserves considerable credit for this happy result." Martin Shubik raises several questions that need to be answered before Hall's proposed indexed unit of account can be a practical policy rather than a theoretical possibility. He draws attention to ongoing work on stochastic strategic game process models as a source of insights into the microeconomics of money, financial institutions, efficiency, and inflation.

Peter C. B. Phillips's "Econometric Analysis of Fisher's Equation" applies new econometric techniques to "Fisher's equation," which equates the nominal interest rate to the sum of real interest and expected inflation. Phillips's new methods of data description for nonstationary time series provide a nonparametric mechanism for modeling the spatial densities of a time series that displays random wandering characteristics (like interest rates and inflation) and an estimation procedure called modified log periodogram regression to obtain semiparametric estimates of long range dependence in U.S. real interest rates. John Rust summarizes Phillips's key theoretical results "for the benefit of readers who may not be familiar with advanced stochastic processes," identifies empirical puzzles that remain unresolved, and doubts whether some of the empirical questions are well posed. Fisher was a pioneer in the use of distributed lags and correlation analysis and was a crucial figure in the creation of both the Econometric Society and the Cowles Commission (now the Cowles Foundation), so the application of novel econometric techniques to the Fisher equation is particularly apt as part of a celebration of Fisher's legacy.

Robert Dimand suggests that the debt-deflation process of Fisher (1933), which was also briefly mentioned independently by Keynes, provides a way of introducing a corridor of stability into macroeconomic models, so that the models would be self-adjusting for small shocks but not for shocks large enough to push the economy beyond the threshold of stability. Such models could explain why the classical adjustment mechanism would usually work but occasionally break down, as in the Great Depression.

Two papers by James Tobin discuss Fisher's innovative *Elementary*

Principles of Economics (1912) and *Nature of Capital and Income* (1906). Tobin describes Fisher's elementary textbook, which has been almost entirely forgotten, as a brilliant attempt to make advanced economic theory accessible to students in introductory classes. Tobin's essay on *The Nature of Capital and Income* was first published in German, in a collection of essays accompanying a facsimile reprint of Fisher's book, and was reprinted as an introduction to the reprint in *The Works of Irving Fisher.* Tobin emphasizes the simplicity and comprehensiveness of Fisher's concept of capital and praises Fisher's book for its careful attention to the distinction between stocks and flows and to the dimensionality of concepts used in economic discourses. However, Tobin finds that Fisher's concept of income (equated to current consumption) remains controversial and suggests that some notion of sustainable consumption (such as the hypothetical intact-capital rate of consumption that Fisher termed "standard income") would be preferable.

John B. Shoven and John Whalley, and their discussants Alan J. Auerbach and Michael J. Graetz, offer a modern perspective on Fisher as a founding father of public finance and on Fisher's proposal to substitute a consumption tax for an income tax, which was most fully expounded by Fisher in the 1930s and 1940s (Fisher 1997, Vol. 12) but derived from the distinctive concept of income presented in *The Nature of Capital and Income.* Rounding out the group of papers on Fisher's theories of capital, interest, and public finance is John Geanakoplos's paper on "The Ideal Indexed Bond and Irving Fisher's Impatience Theory of Interest with Overlapping Generations," with a comment by Robert J. Shiller. Fisher long advocated inflation indexed bonds. Geanakoplos shows that, in the context of a multicommodity Capital Asset Pricing Model (CAPM) world, the best welfare-improving bond pays the minimum money needed to achieve the same utility, rather than the minimum needed to buy the same commodity bundle. Geanakoplos also shows that in stationary overlapping generations (OLG) economies with land, the real interest rate at the stationary state depends on impatience (as in Fisher's impatience theory of interest).

Consideration of Fisher's innovation in indexed bonds leads naturally to Fisher's test approach to index theory in *The Making of Index*

Numbers (1922). W. Erwin Diewert develops an alternative branch of index number theory, using differences rather than ratios, that had its origins around the time that Fisher developed his test approach. In his comment, Matthew D. Shapiro reflects on Fisher's contribution to index number theory.

The last group of papers and comments follows from Fisher's concern with the economic value of improving public health. William D. Nordhaus examines "Irving Fisher and the Contribution of Improved Longevity to Living Standards" (with comments by Robert Dimand and T. N. Srinivasan), and Victor R. Fuchs writes on "Health, Government, and Irving Fisher" (with comments by the late Alvan R. Feinstein and by Richard Zeckhauser). As these papers show, this subject was of central importance to Fisher, a lifelong crusader for health reform.

These papers celebrate the life, contributions, and legacy of Irving Fisher, a great scientific economist and outspoken social crusader, a man of brilliance, integrity, and eccentricity who did much to advance theoretical and empirical economics.

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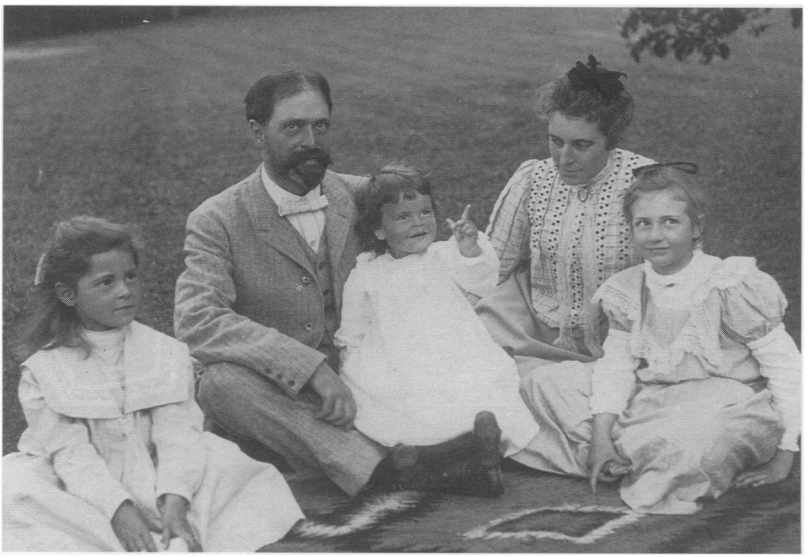
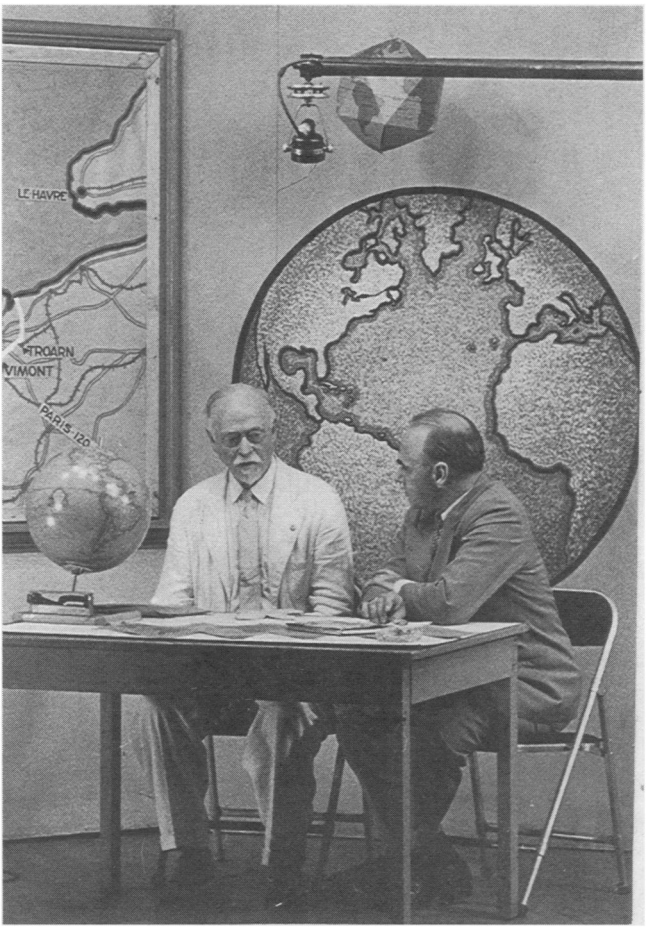
Irving Fisher. Courtesy of Professor George Fisher.



Irving Fisher and his wife Margaret Hazand Fisher with their three children in 1902. Courtesy of Professor George Fisher.

Irving Fisher and Margaret Hazand Fisher, celebrating their fortieth wedding anniversary, 1933. Courtesy of Professor George Fisher.



Irving Fisher on television with his world map, 1945. Courtesy of Professor George Fisher.