ment and the (constrained) rational choices of individuals. Employers practice "statistical discrimination." In the absence of complete information on individual applicants, they make decisions based on their perceptions of group characteristics. Since employers perceive that, on average, women are more likely than men to leave the labor force, they avoid hiring women for jobs that provide training in firm-specific skills. Consequently, women are less likely to have access to jobs that provide employment security and other advantages of implicit contracts. Moreover, since women are aware of structural barriers like statistical discrimination, they rationally avoid investing in training for careers that are likely to be closed to them, thereby turning employers' perceptions into self-fulfilling prophecies.

England and Farkas also apply their perspective to marriage markets, fertility behavior, child-rearing practices, savings and consumption across the life-span, legal issues regarding sex discrimination and comparable worth, and related issues. Their arguments are thoroughly grounded in the latest research in demography, sociology, and economics, and they are usually careful to distinguish speculation from conclusions supported by empirical evidence. The book will be valuable to scholars of gender, work, and family, and it is written in a style that also makes recent theory and research on these issues easily accessible to a general audience.

WILLIAM T. BIELBY
Department of Sociology, University of California, Santa Barbara, CA 93106

Projections Regarding Employment

The Future Impact of Automation on Workers. WASSILY LEONTIEF and FAYE DUCHIN. Oxford University Press, New York, 1986. xiv, 170 pp., illus. $24.95.

Charlie Chaplin's movie *Modern Times* (1936), about factory life in the age of mass production, reflects longstanding concern about the effects of automation on workers. An important aspect of this concern is workers' fears of displacement by new technology, and the computer revolution, which shows no signs of abating, has reinforced these fears. In an attempt to address the issue of displacement directly, Wassily Leontief and Faye Duchin, using the technique of dynamic input-output analysis, have presented projections of employment broken down by occupation through the year 2000 under alternative assumptions about the diffusion of innovation. They conclude that the production of projected output levels in the year 2000 will require 10 to 20 million fewer workers than production of the same output levels would have required in the absence of diffusion of new technology. However, they also conclude that output will grow sufficiently for the level of total employment to match closely the projected size of the labor force in the year 2000. Thus, at least with regard to total employment, fears of technology-induced displacement of workers are unfounded.

What these numbers mask is a fairly dramatic shift in the occupational composition of the required work force. Again according to projected output levels for the year 2000, up to eight million fewer managers and 15 million fewer clerical workers will be required, assuming reasonable rates of diffusion of new technology, than would be required if there was no diffusion. This decrease is accompanied by an increase of up to 5.5 million in the number of professional workers due to the diffusion of new technology. Leontief and Duchin's analysis is aimed almost exclusively at determining total employment levels by occupation and not with whether the available work force will fit the predicted occupational demands. The latter issue is clearly at least as important as (and not independent of) the aggregate level of employment, but I will not consider it in this review.

Input-output analysis (IOA), for which Leontief won the 1973 Nobel Prize in Economic Science, has made a fundamental contribution to our understanding of how the U.S. economy operates. Essentially, IOA can be thought of as providing a recipe of inputs required for the production of the output of any single industry and, by extension, of any combination of industries. The basic tool of IOA is an input requirement matrix, whose ij^{th} element is the quantity of the output of the j^{th} industry required to produce a unit of output of the i^{th} industry. Through this matrix, IOA provides a compact representation of the set of relationships among all productive inputs (labor, raw materials, and so on), intermediate goods (outputs of one industry that are used as inputs in another industry), and final goods (outputs that are consumed for their own sake) in the economy. IOA has proven to be very valuable in understanding the relationships among industries and inputs and in projecting the requirements for predetermined expansion of various sectors of the economy.

An innovation of IOA that Leontief and Duchin introduce in the present study is called dynamic input-output analysis (DIOA). This technique links together the production requirements of successive years in order to account for the degree of investment in capital equipment required both to replace worn out and obsolete equipment and to enable the production of increased quantities of various goods. This technique is described informally in chapter 1 of the book, which also contains an overview of the entire analysis and the results. The technique is described in more detail in a very useful appendix.

There are two major sets of predictions that must be made in order to forecast future employment by industrial sector and occupation. The first regards the effects of technological advances on the elements of the input requirements matrix. Chapters 2 and 3 of the book are devoted to careful, detailed discussions and syntheses of existing work on the effects of computers on factory production and office production, respectively. In the factory, the innovations considered include computer-numeric control of machine tools and the uses of robots in mass production. In the office, the automation of such clerical tasks as typing, filing, and bookkeeping is considered. In addition, the effects of the microcomputer revolution on managerial productivity are considered. These discussions are convincing in their analysis of the medium-term potential of new computer technology in these settings. In terms of the DIOA, projected values for the input requirements matrix as it is likely to be affected by the new technology are derived.

The second set of required predictions regards the output level of each industrial sector. Leontief and Duchin use projected final output levels for 1990 derived by the U.S. Bureau of Labor Statistics (BLS), making an adjustment to take account of the outputs required to produce the capital goods implicit in the assumed new technology. These projects are then extrapolated to the year 2000. The BLS projections are based on forecasts of population trends as they relate to both the labor force and the consuming population, and they rely on historical relationships between these demographics and outputs. The assumed output levels are combined with the input requirements matrix in order to derive the overall demand for various types of labor in the years 1990 and 2000.

There are two important weaknesses in the analysis. The first, inherent in the input-output technique, is that it is assumed there is a fixed recipe for the production of any good. There is no scope for substitution of

cheaper for more expensive inputs as relative prices change. The core of Leontief and Duchin's analysis is about how the recipes will change in response to the diffusion of technology, but the diffusion of technology is itself a response that changes relative prices of inputs and relative costs of different recipes for the same output. It is very difficult to predict rates of diffusion in this context. For example, the analysis is essentially current only as of 1980, and it is possible that the actual diffusion of microcomputers in offices by 1985 exceeds even the authors' predictions for 1990. This is not to say that the assumed rate of diffusion or the input requirements matrix is generally wrong. However, I am not confident of the accuracy of the assumptions made.

The second weakness is that the level and sectoral mix of output is assumed to be fixed and independent of the degree of diffusion of technology (with the exception of the direct production of high-technology capital equipment). The diffusion of technology affects the final costs (and hence prices) of goods. It is likely to make technology-intensive goods less expensive, and standard economic theory predicts that the demand for such goods will increase. It may also be true that the increased demand will speed the diffusion of new technology if there are economies of scale, minimum efficient scale, or learning effects that lower its cost. The DIOA cannot take any of this into account. Technology has no effect on final demand in the model. That its effect can be important is obvious from a single example: the introduction of the assembly line in mass production by Henry Ford in 1913. This resulted in lower production costs and prices, which surely stimulated demand for the Model T in particular and automobiles in general far beyond what would have been predicted by a model of the sort Leontief and Duchin use. The computer revolution may well have similar effects. Witness the proliferation of microcomputers, video cassette recorders, calculators, and digital wrist watches.

Overall, it may be that Leontief and Duchin's employment projections are not far wrong. However, the careful observer must place a very large confidence interval around their estimates. More attention needs to be paid to the effects of diffusion of technology both on the input requirements matrix through relative input prices and on the level and mix of outputs through relative output prices and even through the development of new products before I will feel confident about such projections.

HENRY S. FARBER
Department of Economics, Massachusetts Institute of Technology, Cambridge, MA 02139

Native History in North America

Cultures in Contact. The Impact of European Contacts on Native American Cultural Institutions, A.D. 1000–1800. WILLIAM W. FITZHUGH, Ed. Smithsonian Institution Press, Washington, DC, 1985. vi, 320 pp., illus. $29.95. Anthropological Society of Washington Series.

Since the 1950's considerable progress has been made in combining historical documentation with ethnographic insights in order to study what happened to native societies since early European contact. In recent years, however, ethnohistorians have realized that European accounts tell us very little about material culture and numerous mundane aspects of native life. They are also increasingly aware that changes occurred in native societies as a result of European activities in North America long before the earliest historical records of these societies. Yet, though archeological data are increasingly seen as having a significant role to play in the investigation of early relations between native peoples and Europeans, a clear relationship between archeology and the study of native history has still to be defined.

In 1981–82 the Anthropological Society of Washington sponsored a series of lectures intended to provide an archeological perspective on the earliest periods of contact that would emphasize "the effects of European contact on the institutions that organized native societies." Nine papers based on these lectures survey the eastern seaboard of North America from Greenland to Florida and the Caribbean. The major gap in coverage is Newfoundland, the Maritime Provinces of Canada, and the St. Lawrence Valley, a region that was visited annually in the 16th century by more European ships and men than traveled between Spain and its colonies in the New World. The omission of this region also means there is no discussion of French-Indian relations, the northern fur trade, or recent extensive and very productive research on protohistorical and historical Indian archeology in southern Ontario. Nevertheless the papers present an interest-

Greenlanders from the Nuuk area captured and taken to Europe by David Dannel in 1654. This portrait was painted by Dannel in Bergen, Norway, after his return from Greenland. [From H. C. Gulløv's paper in *Cultures in Contact*; collection of the National Museum of Denmark]