The main reason would appear to be the fact that in this book the analysis is limited chiefly to land and labor as the relevant factors of production. Although capital is not entirely excluded, it is not fully incorporated in the analysis. Probably the authors would say that capital is incorporated in technology in this treatment of the subject. The fact is, however, that besides an unprecedentedly high yield, modern variety technology is strongly characterized by capital intensiveness. Accordingly, farmers have to be able to come up with the necessary funds if they want to introduce such varieties. That is why the governments of the countries involved have formulated large-scale agricultural credit and finance schemes.

In spite of this fact, this book has not included capital in its analysis with the result that the core part of agrarian change has been overlooked and acquisition of economic surplus by farmers has been unduly stressed. In the analysis made by this book the factor share of capital is 30–40 per cent, or the highest of any production factor. Up until the 1960s the use of chemical fertilizer, farm chemicals, machinery, and other such input in Southeast Asian agriculture was minimal, and all that was needed for rice cultivation was land. Accordingly, land was by far the chief factor of production, and landlords who provide land and other services captured the lion's share of the product in land rent and other forms. The essence of agrarian change since the 1970s has been a decline in the relative importance of land and a corresponding rise in the relative importance of capital among factors of production as a result of the diffusion of capital-intensive MV technology. The changing pattern of peasant differentiation should be considered as taking place in this context.

However, in this book no attention whatever is given to this point, the focus being entirely on the relative shares of land and labor, and as a result, the share of labor has seemed illusively large since the share of capital has not been taken into account. Furthermore, the authors' awareness of MV technology is entirely used as a counterweight to population pressure which they consider to be the basic force in the growing poverty in Asia. If it were the only factor, there ought to be a considerable difference in the pattern of agrarian change between Java and the Philippines. Furthermore, population pressure is not something that suddenly reared it head in the 1970s or that is an Asian speciality. Considering its universal nature, it can hardly be identified as a reason for the agrarian change that is taking place in tropical Asia.

(Hiromitsu Umehara)

*Transatlantic Industrial Revolution: The Diffusion of Textile Technologies between Britain and America, 1790–1830s* by David J. Jeremy, Cambridge, Mass., MIT Press, 1981, xvii+384 pp.

Works on technology transfer have attracted wide attention recently, partly because the problem is a most urgent and practical one for developing countries. A study group in the United Nations University has been working on the subject since 1978,

but until recently historians have dealt with it in detail on only a few occasions. David Jeremy's work is a worthwhile contribution to the historical literature. Although the author did not put particular emphasis on problems which have emerged in the developing countries, this reviewer nevertheless thinks that his framework is applicable to many aspects of technology transfer today. The object of his research, the textile industry and, more especially, the cotton textile industry, deserves attention in academic circles precisely because it is still a major industry in developing countries. Readers can learn much from this concrete and detailed work.

Jeremy defines technology as "a spectrum, with ideas at one end and techniques and things at the other, with design as a middle term" (p. 4). Diffusion or transmission means "the spread of an innovation from its originating firm or economy to a host firm or economy" (p. 4). He divides the diffusion process into four stages: (1) creation of the potential for diffusion, (2) establishment of the pilot plant in the host country, (3) the spreading or diffusion of the imported technology within the host economy, and (4) modification of the imported technology to suit the factor endowment and social structure of the host economy. First he examines the circumstances that either hindered or promoted the spread of textile technology across the Atlantic and then the establishment of the industry in America, and then follows up with a study of the conditions that prompted the reshaping of imported technology.

One of the merits of Jeremy's book lies in the great number of photos and plans of mills and specific machines drawn from the Merrimack Valley Textile Museum and other institutes. Another is his prodigious learning. The two combine to make the book at once fascinating and readable. Furthermore, he has gone to a great deal of effort to seek out records relating to such things as patent registration and emigration, not to mention business records of various textile companies.

In Part I, entitled "Constraints on the Diffusion of the Technologies," Jeremy deals with problems characteristic of the first stage of his schema. Comparisons are made between production factors in Great Britain and the United States: labor supply in the United States was scarce compared to demand because of the vastness of the land but capital was also scarce and the lure of greater profits was necessary to attract capital to the industrial sector of America. Another serious limitation was the narrow and fragmented nature of the American market. British secretiveness, prohibitory laws, and patent practices also affected establishment of a home industry in the United States, while it ensured increasing imports from Britain. Yet another problem was the tendency for the British industry to move toward the production of quality goods, promoted by its own particular balance of production factors. All these were limiting factors for the formation of cotton and woollen industries in the United States. Despite these substantial barriers, however, America also had some favorable conditions: shared cultural background, raw materials potential, motive power, and above all a reservoir of traditional skilled craftsmen. Nevertheless, after weighing the negative against the positive, the author seems to feel that the limiting factors overshadowed the favorable ones.

In Part II, Jeremy clarifies the roles of individual immigrants and of other agents in the process of technical transmission. Detailed case studies are provided concerning the transfer of major textile technologies: machine spinning, power loom weaving, and

mechanized calico-printing in the cotton industry, and the new mechanized techniques for woollens manufacture. It becomes clear that certain individuals played a decisive part in transferring these techniques to America. This meant that the rate of transfer was rapid, even though, as in the case of the power loom, the technology had to be modified in the host country. In any case, both international and internal diffusion were essentially human-embodied because other channels did not exist at that time. In Part III, entitled "Diffusion of the Technologies: The Impact of Aggregate Immigration," the author surveys U.S. government documents and immigration lists and concludes that, as a group, immigrants fell well short of requirements in the American cotton and woollen industries in the 1820s, viewed according to both qualitative and quantitative criteria. They were largely preindustrial skilled workers, and consequently did not take a leading part in the emerging American textile industry.

Discussion of the fourth stage, dealt with in Part IV under the title "American Modifications to the Imported Technologies," is most stimulating. According to the author, this stage started in America around 1813 except in the case of the card clothing machine. Modifications were essential basically because of the product market and factor influences in the United States. Initiation of the power loom and the supply of better quality raw materials played important roles in the shaping of such innovations as the Waltham system. Easy access to fine quality cottons enabled Americans to mass produce coarse cloth despite their crude production machinery using the Waltham system, and a series of Waltham machine innovations were subsequently patented. Although the Waltham system was essentially a "crude technology," that does not necessarily mean that the machines were cheap. In fact, the author argues that the cost of building a Waltham-type factory was greater than that of building an integrated mill in Lancashire. This, plus various pieces of patent evidence, leads Jeremy to the significant conclusion that the Waltham system was oriented toward labor-saving.

The manufacturing system which dominated the industry in Rhode Island differed from the Waltham system. The capital of firms there was smaller and the labor employed consisted of whole families, including children. Transformed mule spinning machines were used and were supplied by a number of engineering firms. The products included various types of cloth, and there was a tendency to produce quality fabrics. Taking these various points into consideration, the author concludes that the Rhode Island firms were concerned with capital-saving improvements, making only small modifications to existing machines rather than creating new ones. Rhode Island manufacturers were relatively short of capital and therefore looked for cost-saving improvements.

The author's analysis is exhaustive, and his long experience as a curator of the Merrimack Museum is put to good use. As a business historian, the reviewer has few criticisms of the book. There are, however, a number of points that might be further elaborated upon by the author in future works. For example, an analysis of the connection between labor force and land would help to make more concrete the situations which gave rise to the differences in manufacturing systems in Britain and America. Research into rural history has taught us that workshops (*manufacturen* according to Marxist terminology) were not prevalent in the textile industry in England, and that

the putting out, or domestic, system was dominant up to the introduction of machinery. Hand weavers employed in the putting out system continued to cultivate their own small holdings, and this small landholding system was especially predominant in Lancashire and West Riding of Yorkshire. The domestic system existed only rarely in the United States and this probably also influenced technology transmission and diffusion to some extent. For example, it may partly explain the time lag and the slow tempo of the transfer of spinning machines, because even if entrepreneurs were to build mechanized spinning mills they would not have found sufficient numbers of hand weavers to consume the produced yarn. This suggests that the key to the American textile industry was the introduction and modification of the power loom, and helps to explain why the cotton industry in America made great strides as soon as the power loom became available to American entrepreneurs. Thus it seems to me that differences with regard to the mode of agriculture in the two countries probably gave rise to different types of labor force supplied to the cotton industry.

Another point concerns the formation of process-integrated firms from the outset in the United States. G. J. Stigler's theory on the merits of the division of labor is not a satisfactory explanation, as Professor A. D. Chandler, Jr. has demonstrated. The tendency to integration in the cotton textile industry never altered in America over the course of time, unlike the case in Great Britain, where the situation seems to have depended entirely upon the business climate at the time firms came into being. As mentioned above, the introduction of the power loom was the decisive factor that activated the American cotton industry and it must be pointed out that F. C. Lowell immediately set about improving the Lancashire power loom on the assumption that he would integrate both spinning and weaving processes from the beginning. This development coincides with the beginning of rapid diffusion of the improved power loom in England.

Although in his introduction Jeremy mentions that the study of technological diffusion "eastward from Britain" still awaits thorough treatment (p. 3), his work is sure to stimulate historians engaged in studying the economic history of Asian countries. A number of works have been published on the history of the textile industry in Asia, but comprehensive works on technological transfer have yet to appear. As far as the Japanese cotton industry is concerned, the business environment differed greatly from that of the United States in a few basic points. One of the constraints on the establishment of a cotton industry in this country was the lack of tariff autonomy before 1911. On the other hand, by the time Japan was receptive, bans on machine exports were no longer in existence in the technologically advanced countries. A more serious barrier was the inability to improve imported machines during the formative period of the cotton textile industry. Japanese entrepreneurs had to import assembled machines as well as parts because they could not produce them domestically, and this entailed great expense. With respect to the choice of technology, however, Japan had an advantage: as a latecomer, it could choose from among systems originated both in the United States and Great Britain.

The author's four-stage framework for technology transfer was derived from his thorough study of the development of the American cotton and woollen industries. According to him, the period up to 1813 constitutes the third stage in which diffusion

of the imported technology took place. However, we must assume that if a pilot plant does not fit the business climate of the host country at all, such diffusion never occurs, nor can the pilot plant itself continue operation. This was the case in India, where several mechanized mills were built but failed before the first successful spinning operation got under way in 1854. In Japan, a pilot spinning mill was built in 1867. But after that, the developments Jeremy attributes to his third and fourth stages took place simultaneously, making it difficult in the Japanese case to differentiate between the two. Both the conversion from mules to rings and from domestic cotton to Chinese and Indian cotton took place in the early 1890s. Imported power looms were not suitable for producing cloth to the Japanese people's taste, so cloth woven on them was almost all exported. Sakichi Toyoda's power loom, patented in 1898, was aimed at producing cloth acceptable in the domestic market.

The business environment in India differed markedly from that in all the other countries under discussion. In India, human-embodied technology transmission from Lancashire continued over a long time, and engineers and mill managers from Lancashire were seldom replaced by natives. As for the replacement of mules by rings, India lagged far behind when compared with Japan, an obvious result of its heavy technological dependence upon Lancashire. These facts suggest that in the case of India it is also difficult to single out a third stage. The changes in India were not revolutionary, but evolutionary and gradual. Racial heterogeneity and a variety of languages were serious obstacles to technological diffusion, even if in one respect—easy access to raw material—it had an advantage over Japan.

I entirely agree with the author's opinion that technology transmission is a significant topic for economic history. In this regard, a crucial question might be the extent to which we should lay stress on factor theory in seeking to explain the conditions of the cotton textile industry in each country. It seems to me that mule spindles dominated in India until the First World War largely because English engineers were influential in deciding the type of machines to be used and because the policy of managing agents was apt to be short-sighted. It is true that in Bombay interest rates were high at that time, but I do not believe there was much difficulty in raising capital. J. N. Tata equipped his Empress Mills at Nagpur with ring spindles in 1877, but there were few quick followers. In this case, the human factor, or entrepreneurship, was obviously important.

Finally, let me again emphasize that none of the above comments in any way calls into question the general applicability of Jeremy's model. What we need to do is ask why such deviations appeared in the cases of Japan and India and clarify the causes —just as Max Weber once tried to do in another context. This book will undoubtedly stimulate such activity by business historians. (Shin'ichi Yonekawa)