example, is centered about his doctrine of rent. And the rent principle draws its power from the law of diminishing returns. How cogently it is argued from these premises that wages tend to equal a bare subsistence and that capitalists ultimately are frustrated by land owners is known to all students of economics. Of course they also know that the occupations which pay only subsistence wages are becoming less numerous. And there is tragic satire in the thought that farmers are garnering the economic surpluses at the expense of the owners of business. There is no lack of logic in the classical structure—no essential contradiction in terms. There is, however, a wide divergence between the hypothesis and the relevant facts or, if you please, the engineering. As regards production the restrictive tendencies which fence in the economic processes described by the classicists are diminishing returns of land, labor and capital and increasing disutility of work. These matters, to the engineering mind, are not hypothetical foundations for system building; they are rather problems to be solved. Their attacks on these problems have resulted in a clearly defined recession of the point of diminishing returns and in a complete revision of our quantitative ideas concerning productivity.

Modern followers of the classical tradition who busy themselves with constructing static systems may argue that the changes wrought by engineering science do not impair the foundations of their work; that diminishing returns and increasing disutility, while becoming less closely restrictive, continue to operate as ultimate forces in creating the market equilibrium with which they are concerned. This position, again, on purely logical grounds is perfectly tenable; on experimental grounds it may be verified by reference to the inertia of physical bodies, including those which are human. The danger which they run, however, is that the conclusions which they reach may in time be as remote from the facts as those spun from the fine reason of Ricardo. Perhaps the trends of technology are themselves more important materials for systematic study than those of which static economics is built.

Of the various general factors of production whose proportionality is seen by economists as involving the problem of diminishing returns, the most frequent contemporary reference is to the total functions of management. Mr. John A. Hobson, while not addicted to classical patterns of economics, has given us a clear statement of this position.

> Although there must be conceived to be an ultimate limit to the economy of large production dependent on the necessity of having recourse to inferior or more expensive sources of raw materials or power, this, save in rare instances, is not the actual limit. So likewise, though the practical limits set upon the elaboration of machinery and the division of labor may fix the maximum size of an individual plant, it does not limit the size of a business, which may contain a number of such plants, and will tend to increase this number so long as the net economy of business administration is subserved thereby. This being so, the only substantial limit to the growth of a business, from the standpoint of economy of supply, has reference to the application of administrative power; in other words, of the factors that constitute the business-unit, *ability of control and management must be regarded as a constant factor.* (Italics not in original.)

There are plenty of engineering evidences to support Mr. Hobson's opinion that there is, for any industrial establishment, a "typical magnitude" which tends to yield maximum efficiency and economy—at least, there is at any given time. But to regard management as a "constant factor" is to ignore the expansion which has been given it by scientific management. The volume *Scientific Management in American Industry* shows management not to be a "constant factor"; i.e., it is not inherent and immutable. It consists rather of an acquired and flexible technique which may be adapted to changing conditions of size.

The precise points at which the engineering and economic sciences converge are the very conditions which give rise to scientific management. Although operations which are manual, or which are in conjunction with the most primitive tools, may be studied with reference to "efficiency," it is only with division of labor, mechanization and increased complexity of organization that the special techniques of industrial engineer and economist are invoked or, for that matter, exist. These conditions are, in brief, the characteristics of large-scale industry. That modern industry is, and should be, organized into large units is well, but differently, understood by both engineers and economists. The engineers see in large-scale operations a host of ways of promoting physical efficiency. The economists incline to regard it as a means of reducing unit costs of production. The directors and managers of industrial concerns, conditioned in their thinking by

large and growing fixed charges and motivated by what their accounting systems tell them about unit costs, are pragmatic participants in the "mental revolution." Their participation is toward the nullification of Veblen's famous formula that industrial efficiency in producing goods is restricted by the interests of business men in securing profits. Business men have adopted and adapted scientific management for the very good reason that it pays. Perhaps it does not yet pay to give engineers *carte blanche* in industry; conceivably it never will. But the area in which they are permitted to work grows ever wider, and the Veblenian sabotage declines apace. The "mental revolution," like its industrial counterpart, does not take place overnight.

The problems of industrial engineers and economists converge insofar as physical efficiency and unit costs are complements to each other. Beyond that there is some divergence of their interests. The role of engineer is cast in a business setting. Scientific management has grown up in private and acquisitive industry. It could only cease being a doctrine and become a working principle when and because it promised to promote acquisition. It is true, of course, that the principle extends beyond the limits of individual factories and comprehends a host of services and facilities whose co-ordination and synchronization are essential to physical efficiency. It also is true that a general adoption of the methods of scientific management—tempered perhaps by careful consideration of the interests of wage-earning groups in steadiness of employment—would go far to promote the total industrial stability in which the economist is concerned. This is for the reason that scientific management replaces "matters of opinion," or "speculation" with measures and standards—with "facts" in the engineering sense of the word. That the measures and standards of scientific management may be used in creating such stability is assumed in the post-war programs of "rationalization" of industry. And yet there are ramifications through the economic structure of the very matters with which engineers are working—and to these ramifications the standards and controls of scientific management do not extend. Such for example, are the "abnormalities" of credit inflation, of unemployment, of over capitalization, of industrial depression, of over production. Engineers are thoroughly conscious of these mattters, and deeply concerned about them because they impede the work which engineers are trying to do within industry. Yet these are problems to which their techniques do not directly apply and concerning which they have no authority. Engineers and economists, the firmest of all believers in division of labor, leave each other to their respective tasks. And their dependence on each other is as great as that of workers on an assembly line.

Mr. Robert Bruère, in the masterly article on "Industrial Relations" which he contributed to *Scientific Management in American Industry*, treats a special phase of this divergency between engineers and economists. That scientific management has made important improvements in the immediate relations between employers and employes he is certain. Yet he points out:

> What goes on inside the factory is only one part of the problem of scientific management in its full meaning; the other lies within the life of the enveloping community. Important as are local shop rules and systems of wages, the common law and public opinion, together with the statutes through which the community gives expression to its unfolding objectives, not local shop rules or any system of wages, form the more important basis of industrial relations; for these are not merely relations between wage-working employes and property-owning employers as such, but are fundamentally relations between two groups of citizens who are equals in the sight of the law. The function of the modern science of industrial relations is not only to create harmony within the factory; its greater function is to give practical effect to this doctrine of equality in civil rights and individual opportunities which underlies all democratic government.

It is in clearing up the ambiguities in such matters as this, in substituting scientific knowledge for matters of opinion—in brief, in doing in their own field what the industrial engineers have done in theirs—that economists are challenged to participate in the "mental revolution."

News of the Sections

Japanese Branch

November 20: "Motion Study" by Lillian M. Gilbreth.

Central New York

November 22: "Next Steps in Production and Distribution" by Edward A. Filene.

December 20: "What Happens to a Trade Mark When a Patent Expires" by V. A. Dorsey.