Chapter 5

The Primary Effects of Scientific Management

The generalized practice of scientific management, as has been noted, coincides with the scientific-technical revolution. It coincides as well with a number of fundamental changes in the structure and functioning of capitalism and in the composition of the working class. In this chapter, we will discuss, in a preliminary way, some of the effects of scientific management upon the working class; later chapters will return to this discussion after the necessary conditions for understanding it more fully have been established.

The separation of mental work from manual work reduces, at any given level of production, the need for workers engaged directly in production, since it divests them of time-consuming mental functions and assigns these functions elsewhere. This is true regardless of any increase in productivity resulting from the separation. Should productivity increase as well, the need for manual workers to produce a given output is further reduced.

A necessary consequence of the separation of conception and execution is that the labor process is now divided between separate sites and separate bodies of workers. In one location, the physical processes of production are executed. In another are concentrated the design, planning, calculation, and record-keeping. The preconception of the process before it is set

in motion, the visualization of each worker's activities before they have actually begun, the definition of each function along with the manner of its performance and the time it will consume, the control and checking of the ongoing process once it is under way, and the assessment of results upon completion of each stage of the process—all of these aspects of production have been removed from the shop floor to the management office. The physical processes of production are now carried out more or less blindly, not only by the workers who perform them, but often by lower ranks of supervisory employees as well. The production units operate like a hand, watched, corrected, and controlled by a distant brain.

The concept of control adopted by modern management requires that every activity in production have its several parallel activities in the management center: each must be devised, precalculated, tested, laid out, assigned and ordered, checked and inspected, and recorded throughout its duration and upon completion. The result is that the process of production is replicated in paper form before, as, and after it takes place in physical form. Just as labor in human beings requires that the labor process take place in the brain of the worker as well as in the worker's physical activity, so now the image of the process, removed from production to a separate location and a separate group, controls the process itself. The novelty of this development during the past century lies not in the separate existence of hand and brain, conception and execution, but the rigor with which they are divided from one another, and then increasingly subdivided, so that conception is concentrated, insofar as possible, in ever more limited groups within management or closely associated with it. Thus, in the setting of antagonistic social relations, of alienated labor, hand and brain become not just separated, but divided and hostile, and the human unity of hand and brain turns into its opposite, something less than human.

This paper replica of production, the shadow form which

corresponds to the physical, calls into existence a variety of new occupations, the hallmark of which is that they are found not in the flow of things but in the flow of paper. Production has now been split in two and depends upon the activities of both groups. Inasmuch as the mode of production has been driven by capitalism to this divided condition, it has separated the two aspects of labor; *but both remain necessary to production, and in this the labor process retains its unity.*

The separation of hand and brain is the most decisive single step in the division of labor taken by the capitalist mode of production. It is inherent in that mode of production from its beginnings, and it develops, under capitalist management, throughout the history of capitalism, but it is only during the past century that the scale of production, the resources made available to the modern corporation by the rapid accumulation of capital, and the conceptual apparatus and trained personnel have become available to institutionalize this separation in a systematic and formal fashion.*

The vast industrial engineering and record-keeping divisions of modern corporations have their origins in the planning, estimating, and layout departments, which grew in the wake of the scientific management movement. These early departments had to make their way against the fears of cost-conscious managers, whom Taylor sought to persuade with the following argument: "At first view, the running of a

* The Hammonds speak of Boulton, who in the eighteenth century conducted a large-scale machine-tool factory at Soho in England in association with James Watt, as an "adept in scientific management." But the very description they cite of his management method belies this notion, and highlights by contrast the methods of modern management: "While sitting in the midst of his factory, surrounded by the clang of hammers and the noise of engines, he could usually detect when any stoppage occurred, or when the machinery was going too fast or too slow, and issue his orders accordingly." [1] Boulton did, however, have a well-developed supervisory line organization.

planning department, together with the other innovations, would appear to involve a large amount of additional work and expense, and the most natural question would be is [sic] whether the increased efficiency of the shop more than offsets this outlay? It must be borne in mind, however, that, with the exception of the study of unit times, there is hardly a single item of work done in the planning department which is not already being done in the shop. Establishing a planning department merely concentrates the planning and much other brainwork in a few men especially fitted for their task and trained in their especial lines, instead of having it done, as heretofore, in most cases by high priced mechanics, well fitted to work at their trades, but poorly trained for work more or less clerical in its nature." [2] But to this he added the following caution: "There is no question that the cost of production is lowered by separating the work of planning and the brain work as much as possible from the manual labor. Where this is done, however, it is evident that the brain workers must be given sufficient work to keep them fully busy all the time. They must not be allowed to stand around for a considerable part of their time waiting for their particular kind of work to come along, as is so frequently the case." [3] This is by way of serving notice that no part of capitalist employment is exempt from the methods which were first applied on the shop floor.

At first glance, the organization of labor according to simplified tasks, conceived and controlled elsewhere, in place of the previous craft forms of labor, have a clearly degrading effect upon the technical capacity of the worker. In its effects upon the working population as a whole, however, this matter is complicated by the rapid growth of specialized administrative and technical staff work, as well as by the rapid growth of production and the shifting of masses to new industries and within industrial processes to new occupations.

In the discussion of this issue in Taylor's day, a pattern was set which has been followed since. "There are many people

who will disapprove of the whole scheme of a planning department to do the thinking for the men,* as well as a number of foremen to assist and lead each man in his work, on the ground that this does not tend to promote independence, self-reliance, and originality in the individual," he wrote in *Shop Management*. "Those holding this view, however, must take exception to the whole trend of modern industrial development." [4] And in *The Principles of Scientific Management*: "Now, when through all of this teaching and this minute instruction the work is apparently made so smooth and easy for the workman, the first impression is that this all tends to make him a mere automaton, a wooden man. As the workmen frequently say when they first come under this system, 'Why, I am not allowed to think or move without someone interfering or doing it for me!' The same criticism and objection, however, can be raised against all other modern subdivision of labor." [5]

These responses, however, clearly did not satisfy Taylor, particularly since they seemed to throw the blame on his own beloved "modern subdivision of labor." And so in both books he went on to further arguments, which in *Shop Management* took this form:

> It is true, for instance, that the planning room, and functional foremanship, render it possible for an intelligent laborer or helper in time to do much of the work now done by a machinist. Is not this a good thing for the laborer and helper? He is given a higher class of work, which tends to develop him and gives him better wages. In the sympathy for the machinist the case of the laborer is overlooked. This sympathy for the machinist is, however, wasted, since the machinist, with the aid of the new system, will rise to a higher class of work which he was unable to do in the past, and in addition, divided or functional foremanship will call for a larger number of men in this class, so that men, who must otherwise have remained machinists all their lives, will have the opportunity of rising to a foremanship.
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> The demand for men of originality and brains was never so great as it is now, and the modern subdivision of labor, instead of dwarfing men, enables them all along the line to rise to a higher plane of efficiency, involving at the same time more brain work and less monotony. The type of man who was formerly a day laborer and digging dirt is now for instance making shoes in a shoe factory. The dirt handling is done by Italians or Hungarians.[6]

* I ask the reader, in passing, to note the bluntness of the phrase "a planning department to do the thinking for the men." The functions of planning departments have not changed, but in a more sophisticated age, and one in which debates rage about the organization of work, the managers are forewarned, and it is not thought necessary to speak so plainly.

This argument gains force in a period of growth, of the rapid accumulation of capital through production on an ever larger scale, and of the constant opening of new fields of capital accumulation in new industries or the conquest of pre-capitalist production forms by capital. In this context, new drafts of workers are brought into jobs that have already been degraded in comparison with the craft processes of before; but inasmuch as they come from outside the existing working class, chiefly from ruined and dispersed farming and peasant populations, they enter a process unknown to them from previous experience and they take the organization of work as given. Meanwhile, opportunities open up for the advancement of some workers into planning, layout, estimating, or drafting departments, or into foremanships (especially two or three generations ago, when such jobs were customarily still staffed from the shop floors). In this manner, short-term trends opening the way for the advancement of some workers in rapidly growing industries, together with the ever lower skill requirements characteristic at the entry level where large masses of workers are being put to work in industrial, office, and marketing processes for the first time, simply mask the secular trend toward the incessant lowering of the working

class as a whole below its previous conditions of skill and labor. As this continues over several generations, the very standards by which the trend is judged become imperceptibly altered, and the meaning of "skill" itself becomes degraded.

Sociologists and economists, nevertheless, continue to repeat Taylor's argument in a world of labor that has become, for the largest portions of the working population, increasingly devoid of any content of either skill or scientific knowledge. Thus Michel Crozier, in *The World of the Office Worker*, concedes that as office work has become an immensely enlarged occupational field, its pay and status advantages over factory work have virtually disappeared: "A mass of unskilled employees assigned a series of simple unchanging operations." "It is this general pattern of evolution," he says, "anticipated by Marxist theoreticians, which constitutes the principal argument in favor of the thesis of proletarization of white-collar employees." His response, strikingly similar to Taylor's, differs from the latter only in that, in place of "Italians and Hungarians" he is pleased to use women as that category of the labor force for which any job is good enough: "The proletarization of white-collar employees does not have the same meaning at all if it is women, and not heads of family, who comprise the majority of the group." [7] As he explains:

> It is true of course, on the other hand, that the 900,000 French office workers of 1920 certainly had a more bourgeois status than the 1,920,000 white-collar employees of 1962. But to the 600,000 male employees of 1920 there now correspond probably 350,000 supervisors and 250,000 highly qualified employees whose status is at least equivalent to that of their predecessors of 1920. As for the 650,000 females newly entered into the profession, thirty years ago they were laborers, seamstresses, or maids. As deadening and as alienating as their assembly-line work may be, for them it may constitute a promotion.
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> . . . To be sure, the professions of white-collar employees and minor functionaries are, on the whole, considerably devalued compared to their status only fifty years ago. But this devaluation of the great mass of jobs has been accompanied, we have seen, by a much greater differentiation and a change in recruitment. The majority of white-collar tasks are less interesting, less prestigious, and bring lower remuneration, but they are carried out by women with reduced aspirations. . . .[8]

As craftsmanship is destroyed or increasingly emptied of its traditional content, the remaining ties, already tenuous and weakened, between the working population and science are more or less completely broken. This connection was, in the past, made chiefly through the craftsman or artisan section of the working class, and in the earliest periods of capitalism the connection was quite close. Before the assertion by management of its monopoly over science, craftsmanship was the chief repository of scientific production technique in its then existing form, and historical accounts emphasize the origins of science in craft technique. "Speaking historically," says Elton Mayo, "I think it can be asserted that a science has generally come into being as a product of well-developed technical skill in a given area of activity. Someone, some skilled worker, has in a reflective moment attempted to make explicit the assumptions that are implicit in the skill itself. . . . Science is rooted deep in skill and can only expand by the experimental and systematic development of an achieved skill. The successful sciences consequently are all of humble origin—the cautious development of lowly skills until the point of logical and experimental expansion is clearly gained." [9]

The profession of engineering is a relatively recent development. Before the engineer, the conceptual and design functions were the province of craftsmanship, as were the functions of furthering the industrial arts through innovation. "The appearance of the modern engineer," Bernal says, "was a new social phenomenon. He is not the lineal descendant of the old

military engineer but rather of the millwright and the metal-worker of the days of craftsmanship. Bramah (1748–1814), Maudslay (1771–1831), Muir (1806–88), Whitworth (1803–87), and the great George Stephenson (1781–1848) were all men of this type." [10] Those even slightly familiar with the history of technology will recognize the importance of the names on this roster, to which can be added James Watt, whose trade was that of mathematical instrument maker; Samuel Crompton, who was himself a spinner from the age of fourteen and continued, in the absence of patent protection, to earn his living as a spinner even after his spinning mule was in widespread use; and many others.* It should also be noted that up to 1824 it was illegal for a British mechanic to accept work abroad, a restriction inconceivable in our own day; the reasons for this were clear so long as the craftsman remained

* Despite the flood of mechanical invention in recent times, it would be impossible to construct such a list for this century. One can think of Frank Whittle, originally a rigger for metal aircraft, who played an important role in the invention of the jet engine, and John Harwood, a watchmaker and watch repairman who invented the self-winding wristwatch, patented in 1923. Hoxie reports that while he was preparing his study of scientific management, during the World War I period, he "saw in one shop an automatic machine invented by a workman which did the work of several hand workers. 'Did he receive any reward?' was the question asked. 'Oh, yes,' came the answer, 'his rate of pay was increased from 17 to 22 cents an hour.' Instances of this kind could be multiplied." [11] But in more recent times such cases are rare. A study of the occupational characteristics of a random sample of persons granted patents in the United States in 1953 showed that "about 60 percent were engineers, chemists, metallurgists, and directors of research and development, and that most of the rest were non-R.&D. executives; almost none were production workers." [12] Here we may pause to give a decent burial to Adam Smith's third argument in favor of the technical division of labor: that the worker, with attention focused upon a single repeated operation, would devise machinery to facilitate that operation. Such truth as it once possessed has long since disappeared in the conditions of capitalist production in which the worker is neither encouraged nor permitted to understand his or her work.

the repository of the technical knowledge of the production process.

The working craftsman was tied to the technical and scientific knowledge of his time in the daily practice of his craft. Apprenticeship commonly included training in mathematics, including algebra, geometry, and trigonometry, in the properties and provenance of the materials common to the craft, in the physical sciences, and in mechanical drawing. Well-administered apprenticeships provided subscriptions to the trade and technical journals affecting the craft so that apprentices could follow developments.* But more important than formal or informal training was the fact that the craft provided a daily link between science and work, since the craftsman was constantly called upon to use rudimentary scientific knowledge, mathematics, drawing, etc., in his practice.** Such craftsmen were an important part of the scientific

* The effects of the decline of apprenticeship were felt as long ago as the time of the Hoxie report, which says: "It is evident, however, that the native efficiency of the working class must suffer from the neglect of apprenticeship, if no other means of industrial education is forthcoming. Scientific managers, themselves, have complained bitterly of the poor and lawless material from which they must recruit their workers, compared with the efficient and self-respecting craftsmen who applied for employment twenty years ago." [13] These same scientific managers have not ceased to complain bitterly, as is their wont, of the characteristics of a working population which they themselves have shaped to suit their ends, but they have not yet found a way to produce workers who are at one and the same time degraded in their place in the labor process, and also conscientious and proud of their work.

** In a discussion of the craftsmen of the Industrial Revolution, David Landes writes: "Even more striking is the theoretical knowledge of these men. They were not, on the whole, the unlettered tinkerers of historical mythology. Even the ordinary millwright, as Fairbairn notes, was usually 'a fair arithmetician, knew something of geometry, levelling, and mensuration, and in some cases possessed a very competent knowledge of practical mathematics. He could calculate the velocities, strength, and power of machines: could draw in plan and section. . . .' Much of these 'superior attainments and intellectual power' reflected the abundant facilities for

public of their time, and as a rule exhibited an interest in science and culture beyond that connected directly to their work. The flourishing Mechanics Institutes of the mid-nineteenth century, which in Britain numbered some 1,200 and had a membership of over 200,000, were in large measure devoted to satisfying this interest through lectures and libraries.[15] The Royal Institution, which existed in England to further the progress of science and its application to industry, was forced, when it became a fashionable place to visit and wished to preserve its exclusivity, to brick up its back door to keep out the mechanics who stole into the gallery.[16] Samuel Gompers, as a cigarmaker living in New York's dense working-class district on the Lower East Side in the 1860s, saw and experienced this same working-class interest:

> Cooper Union provided opportunities for formal study courses as well as lectures every Saturday evening which were usually attended by from twenty-five hundred to three thousand. Nothing humanly possible ever kept me from attending those Saturday night lectures. I was fairly quivering in my intense desire to know. Mental hunger is just as painful as physical hunger. Every Saturday night some great scholar talked to an open meeting and gave most wonderfully illuminating results of experimentation and study. Sometimes Professor Proctor told us of the wonders of astronomy—of what science had learned of time and distance, light, motion, etc. Truths gleaned in these lectures became a most vital part of me and gave the world marvelously inspiring meaning. Those lectures were treasured opportunities to hear authorities in science tell what they were doing and thinking. I attended these lectures and study classes over a period of twenty years.[17]

technical education in 'villages' like Manchester during this period, ranging from Dissenters' academies and learned societies to local and visiting lecturers, 'mathematical and commercial' private schools with evening classes, and a wide circulation of practical manuals, periodicals, and encyclopaedias." [14]

We may marvel still at the British silk weavers of Spitalfields, whom Mayhew found, in the middle of the nineteenth century, living in incredible poverty and degradation, and who, but a short time before, when the day of the skilled hand-loom weaver was not yet over, had made their district of London a center of science and culture:

> The weavers were, formerly, almost the only botanists in the metropolis, and their love of flowers to this day is a strongly marked characteristic of the class. Some years back, we are told, they passed their leisure hours, and generally the whole family dined on Sundays, at the little gardens in the environs of London, now mostly built upon. Not very long ago there was an Entomological Society, and they were among the most diligent entomologists, in the kingdom. This taste, though far less general than formerly, still continues to be a type of the class. There was at one time a Floricultural Society, an Historical Society, and a Mathematical Society, all maintained by the operative silk-weavers; and the celebrated Dollond, the inventor of the achromatic telescope, was a weaver; so too were Simpson and Edwards, the mathematicians, before they were taken from the loom into the employ of Government, to teach mathematics to the cadets at Woolwich and Chatham.[18]

The same remarkable history characterized the weavers of Yorkshire and Lancashire, as E. P. Thompson notes: "Every weaving district had its weaver-poets, biologists, mathematicians, musicians, geologists, botanists. . . . There are northern museums and natural history societies which still possess records or collections of lepidoptera built up by weavers; while there are accounts of weavers in isolated villages who taught themselves geometry by chalking on their flagstones, and who were eager to discuss the differential calculus." [19]

The destruction of craftsmanship during the period of the rise of scientific management did not go unnoticed by workers. Indeed, as a rule workers are far more conscious of such a loss while it is being effected than after it has taken place and the

new conditions of production have become generalized. Taylorism raised a storm of opposition among the trade unions during the early part of this century; what is most noteworthy about this early opposition is that it was concentrated not upon the trappings of the Taylor system, such as the stopwatch and motion study, but upon its essential effort to strip the workers of craft knowledge and autonomous control and confront them with a fully thought-out labor process in which they function as cogs and levers. In an editorial which appeared in the *International Molders Journal*, we read:

> The one great asset of the wage worker has been his craftsmanship. We think of craftsmanship ordinarily as the ability to manipulate skillfully the tools and materials of a craft or trade. But true craftsmanship is much more than this. The really essential element in it is not manual skill and dexterity but something stored up in the mind of the worker. This something is partly the intimate knowledge of the character and uses of the tools, materials and processes of the craft which tradition and experience have given the worker. But beyond this and above this, it is the knowledge which enables him to understand and overcome the constantly arising difficulties that grow out of variations not only in the tools and materials, but in the conditions under which the work must be done.

The editorial goes on to point to the separation of "craft knowledge" from "craft skill" in "an ever-widening area and with an ever-increasing acceleration," and describes as the most dangerous form of this separation

> the gathering up of all this scattered craft knowledge, systematizing it and concentrating it in the hands of the employer and then doling it out again only in the form of minute instructions, giving to each worker only the knowledge needed for the performance of a particular relatively minute task. This process, it is evident, separates skill and knowledge even in their narrow relationship. When it is completed, the worker is no longer a craftsman in any sense, but is an animated tool of the management.[20]

A half-century of commentary on scientific management has not succeeded in producing a better formulation of the matter.*

Notes

1. J. L. and Barbara Hammond, *The Rise of Modern Industry* (London, 1925; reprint ed., New York, 1969), p. 119.
2. Frederick W. Taylor, *Shop Management*, in *Scientific Management* (New York and London, 1947), pp. 65–66.
3. Ibid., p. 121.
4. Ibid., p. 146.
5. Frederick W. Taylor, *The Principles of Scientific Management* (New York, 1967), p. 125.
6. Taylor, *Shop Management*, pp. 146–47.
7. Michel Crozier, *The World of the Office Worker* (Chicago and London, 1971), pp. 13–17.
8. Ibid., pp. 18–19.
9. Elton Mayo, *The Social Problems of an Industrial Civilization* (Boston, 1945), pp. 17–18.
10. J. D. Bernal, *Science in History* (London, 1954; revised ed., 1957), p. 389.
11. Robert F. Hoxie, *Scientific Management and Labor* (New York and London, 1918), p. 94.
12. National Commission on Technology, Automation, and Economic Progress, *The Employment Impact of Technological Change*, Appendix Volume II, *Technology and the American Economy* (Washington, D.C., 1966), p. 109.
13. Hoxie, *Scientific Management and Labor*, p. 134.
14. David S. Landes, *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present* (Cambridge and New York, 1969), p. 63.

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* In this connection, see also Friedmann's *Industrial Society*, where he summarizes "the first reactions of workers" to Taylorism in the United States, England, Germany, and France.[21]