

# **MECHANICS** **OF THE** **MIDDLE CLASS**

**Work and Politics  
Among American Engineers**

**Robert Zussman**



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# Acknowledgments

The engineers discussed in this book are men comfortable in a mechanical environment, at ease with computers and in laboratories and in machine shops, perhaps happiest when tinkering with their cars or around their houses. Yet, they are also quick to acknowledge that the quality of both their work and their homes depends on the help of their colleagues, friends, and, most of all, their families. A sociologist can do no less.

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# I. Engineers and the Middle Levels

Few strata have proven so persistently troublesome to sociological analysis as what I shall call loosely the “middle levels”—the accountants, technicians, officials, administrators, and middle managers of all sorts who work as salaried employees in industry and government. This book is about engineers, a social type distinctive to the middle levels, and is based in large part on interviews and observations in two companies, one in an older industry, the other in an industry technologically more advanced. It is a study of the engineers’ work, their careers, and their political beliefs. More generally, it is a study of the labor process, social class, and citizenship.

For many years—roughly from the mid-1930s through the mid-1960s—sociological treatments of the middle levels were dominated by the concept of “professionalization.” Drawing on the historical experience of doctors and lawyers, this tradition emphasized the development among the middle levels of extended professional training, codes of ethics, and professional associations. More important, this tradition viewed medicine and law as examples of occupational groups that stood outside the main lines of class conflict. Because of their long periods of training, their high ethical standards, and their powerful professional associations, medicine and law were taken to represent the triumph of disinterest over self-interest, of expertise over amateurism, of universalism over particularism. By imagining the middle levels as professionals, or at least incipient professionals, this tradition also imagined a transformation of American society in which the pecuniary values of business would cease to dominate even at the workplace.<sup>1</sup>

Yet, a treatment of the middle levels as professionals has never been convincing, for the middle levels are firmly embedded in a workplace and labor process that continues to be organized by

the principles of capitalism. As C. Wright Mills and others have pointed out, the old middle class of small entrepreneurs and independent farmers, as well as the classic professions of medicine and law, occupied their middle position because they were located outside industry, apart from either management or labor. In contrast, the middle levels assume their position by virtue of a location within industrial production and insofar as they share the characteristics of both management and labor.<sup>2</sup>

Indeed, the continuity of the middle levels with the industrial working class is perhaps stronger than with the independent professional. Neither the middle levels nor the industrial working class owns productive property; both are subject to the discipline of industrial organization; the life chances of both depend on a fate in a labor market; both are involved directly in production. Still, at least in the past, the middle levels have also enjoyed clear advantages over the industrial working class. In varying degrees, they have benefited from considerable wage differentials; they have not only been subject to industrial authority but, in many cases, have also exercised such authority; and, not least, entry into the middle levels has become the most frequent first step in careers leading to the uppermost reaches of corporate management.

The tension between their character as labor and their character as management is the starting point for most contemporary discussions of the middle levels. This book shares that starting point but also attempts to move beyond it.

## The Middle Levels

At least until recently, the middle levels in general and engineers in particular have been characterized by their easy adaptation to modern industrial organization. Unlike small shopkeepers and independent farmers, they are not victims of rationalized, bureaucratic enterprise but instead owe their very existence to it. Unlike entrepreneurs, they are neither heroic nor villainous representatives of economic individualism but “team players” and “organization men.” And unlike industrial workers, they have not been seen as a potential base for opposition to the modern social order so much as acquiescent participants in it. Although the rise and fall of shopkeeper and farmer, entrepreneur and industrial worker—along with the social and political conflict of which they have been a



part—are the very stuff of history, the middle levels have “slipped quietly into modern society.”<sup>3</sup> But their silence should not be mistaken for insignificance.

The middle levels in general and engineers in particular are a product of the differentiation of management from ownership, first noted by Thorstein Veblen in the early years of the twentieth century and subsequently celebrated as one of the decisive events of American industrial history.<sup>4</sup> Attached to the industrial corporation by the promise of stable salaries and stable careers rather than by the proprietary interests of venture capital, the middle levels represent the end of capitalism’s entrepreneurial stage and the beginning of its routinization. Charged with the day-to-day operations of the new multidepartment and multidivisional firm, they are both the creation and the chief carriers of the rationalized administrative procedures that characterize much of contemporary work.

As managers, the middle levels have also been responsible for the discipline and motivation of the industrial work force. In place of largely autonomous craftsmen who worked at a pace of their own making and immigrant labor accustomed to the more natural rhythms of rural life, they have trained a work force in the stricter schedules of factory and office. Whether as frontline supervisors or from the greater distances of personnel and engineering departments, they have developed the full range of devices—from psychological testing and incentive payment to automated assembly—that constitute the apparatus of modern industrial control.

But the middle levels are also themselves labor, albeit typically better paid than most, and a significant part of the total work force. Although any estimate of their number is necessarily rough, depending on who is counted, most would include in the middle levels approximately 25 percent of the contemporary labor force: Engineers and engineering technicians alone account for over two million employees.<sup>5</sup> On the one hand, because the middle levels have typically seen themselves as different from unionized labor, they have tended to modulate industrial conflict. On the other hand, because the middle levels have typically brought to their work higher expectations for autonomy and self-expression, they have tended to raise new issues of industrial integration, particularly over the firm’s attempt to limit the very discretion that is often necessary for them to perform their jobs.

Finally, engineering, perhaps more than any other occupation, is

associated with the rise of modern technology. If nineteenth-century innovation was a haphazard affair—the work of independent, often scientifically untrained tinkerers—today it is more systematic. Beginning in the chemical and electrical industries of the early twentieth century and continuing in the most advanced of contemporary industries, the research department, staffed with university-trained scientists and engineers, has become an integral part of the production process. Innovation, especially technological innovation, has itself become routine. In all this, the middle levels—quiescent and glamorless—have brought to modern industrial life much of its distinctiveness.

### The Formation of an Occupation

Like any complex, internally varied occupation, American engineering is woven together from diverse strands, drawn from different times and places. One strand extends down from the canal and railroad construction of the early nineteenth century, another from the machine shops of the mid-century, yet another from the land-grant colleges and science-based industries of the latter part of the century.

Civil engineering—as a distinct, publicly recognized occupation—first emerged from the great internal improvement projects of Jacksonian America. A few of the earliest civil engineers were trained in Europe; a few more were trained at West Point; and a few more were trained in the private engineering academies that had begun to appear in the 1820s. Many of these school-trained engineers acted as consultants, following the practice in such better established professions as medicine and law. The school-trained engineers, however, were vastly outnumbered by others whose only training was experience; most of these latter engineers found salaried employment as resident engineers in charge of repairs and operations on canals and railroads. In origin, according to Calhoun, “this civil engineer was the creature of the organization in which he worked” and, in practice, he was “a respectable member of a bureaucracy.”<sup>6</sup>

American mechanical engineering emerged first from the machine and metalworking shops that produced the earliest locomotives and stationary steam engines. Owing little to either military

engineering or civil engineering, these shops drew primarily on the skills of the millwright and the mechanic, whose apprenticeship the engineer-to-be often shared. Moreover, these shops generated what Calvert calls a “shop culture” that afforded an importance to entrepreneurial activity and respect for the “dignity of hand labor” notably lacking in civil engineering.<sup>7</sup>

Yet, despite their distinct origins—and albeit for different reasons—civil and mechanical engineers shared a high social standing throughout most of the nineteenth century. In civil engineering, this standing was assured by a position in an organization: “the Engineer stood next to the Proprietor in a chain of occupations,” according to Calhoun, and “by this proximity he was assimilated to the position of the Proprietor.”<sup>8</sup> In mechanical engineering, high social standing was assured not only by the engineer’s entrepreneurial role but also typically by “upper-class birth,” which provided the “extensive social and business connections” necessary to fulfill that role.<sup>9</sup> By the late nineteenth century, however, the high standing of both branches of engineering was threatened by the rise of science-based industry and the concomitant rise of new, state-run engineering schools.

In the electrical and chemical industries, companies such as General Electric, Westinghouse, DuPont, and Dow generated an unprecedented demand for technical manpower. Impatient with the longer process of apprenticeship, these companies turned to the graduates of the land-grant colleges, which had developed out of the Morrill Act of 1862 and whose engineering enrollments had increased more than fortyfold between the 1870s and the beginning of World War I.<sup>10</sup> As a result, the number of practicing engineers in the United States increased from approximately 7000 in 1880 to well over 130,000 in 1920.

These new engineers were different from the civil and mechanical engineers who had preceded them. In all likelihood, they came from families of lower social standing. But, more important, they followed a very different career path. As Calvert concludes, the college-trained engineers were less likely “to enter situations in which they themselves would be entrepreneurs and were more likely to enter relatively large, bureaucratic corporations where . . . they bore no immediate interest in the profit and loss of the organization.”<sup>11</sup> Filling staff positions—as research engineers, sales engi-

neers, or even draftsmen—they no longer “stood next to the Proprietor in a chain of occupations.” Engineering had become a mass occupation.

The increase in scale and the altered conditions of practice created a crisis in engineering. What had once been an occupation secure in its social standing now manifested symptoms of almost “obsessive concern with social status,” including not least a series of attempts to improve that status.<sup>12</sup> If only briefly, in the early decades of the twentieth century, it appeared that engineers might become an independent force in both industry and politics.

The engineers’ ambitions were largely expressed in attempts at internal reform of technical societies. The American Society of Civil Engineers had been founded in 1867, the American Institute of Mechanical and Metallurgical Engineering in 1871, the American Society of Mechanical Engineers in 1880, and the American Institute of Electrical Engineers in 1884. Before 1900, none of these societies had been particularly concerned with either public policy or the conditions of engineering practice. None of the societies (with the partial exception of ASCE) had even attempted to exclude from membership business people interested in the field but lacking in technical qualifications. However, between 1900 and 1920, all the societies restricted their criteria for membership by emphasizing “professional” standards, and all but the AIME introduced codes of ethics. So, too, many of the societies began to publish papers on public policy issues such as conservation and industrial efficiency. Finally, the newly formed Federation of Associated Engineering Societies published a report placing most of the blame for industrial waste on management and recommending a shift from the twelve-hour to the eight-hour day in many industries.<sup>13</sup>

Nowhere, though, were engineering ambitions more explicit than in the work of Frederick Winslow Taylor, once president of the ASME and the leader of the movement for “scientific management.” To be sure, some critics have seen scientific management as an instrument of capitalist domination, essentially antilabor in its attempt to maximize profits by imposing a detailed division of labor over previously autonomous craftsmen. But Taylor himself saw scientific management as part of a comprehensive plan for the reorganization of industry, with control vested in a firm’s planning department headed by technically trained personnel rather than by entrepreneurs or owners. Indeed, Taylor was often as critical of

“the indifference of the employers and their ignorance as to the proper system of management” as he was of labor. In this sense, Taylorism was very much an ideology of the middle levels, a claim to a position in industry that would not only be independent of capital and labor, but dominant over them.<sup>14</sup>

Scientific management promised to bring efficiency to public administration, and this was a promise well suited to the Progressive temperament. One of Taylor’s disciples, Morris Cooke, served as director of public works in Philadelphia, where he became a staunch critic of municipal utilities companies, which he saw as a principal source of public corruption. Another, Henry Gantt, helped form the New Machine, an association of engineers concerned with the acquisition of “political as well as economic power.”<sup>15</sup>

In the context of these developments, Thorstein Veblen wrote the series of essays later collected as *The Engineers and the Price System*. Impressed by scientific management, Veblen accused the absentee owners of “sabotage”—the conscientious withdrawal of efficiency in the name of profit maximization—and contrasted them with the “technological specialists whose constant supervision is indispensable to the due working of the industrial system, . . . whose work it is to control the strategy of production at large and to keep an oversight of the tactics of production in detail.” These technologists, Veblen thought, had become “uneasily ‘class conscious,’ . . . beginning to take stock of that all-pervading mismanagement of industry that is inseparable from its control for commercial ends.” Thus, he continued, although without much optimism, “any question of a revolutionary overturn . . . resolves itself in practical fact into a question of what the guild of technicians will do.”<sup>16</sup>

By the mid-1920s, however, the engineers’ efforts to organize themselves as an independent force had been disappointed. The Federation of Associated Engineering Societies, which had taken the lead in attempts to unify engineering as a profession, disbanded in 1923. It was replaced by the American Engineering Council, which was, according to Layton, “dominated by business interests who exercised an effective veto over its affairs.”<sup>17</sup> Although scientific management became standard practice in many industries, it did so as discrete techniques and tactics, not as the comprehensive plan that Taylor had commended. The influence of engineers on

public policy, never strong to begin with, devolved into “technocracy,” a fringe movement that persisted into the 1930s, although with little support from engineers. Even Veblen, retreating from his earlier position, now characterized engineers as a “harmless and docile sort.”<sup>18</sup>

The crisis in engineering had been resolved by an apparently stable integration of the technologist into the business enterprise and by his acceptance of the dominant business ethos. To be sure, engineers in the twentieth century would not be entrepreneurs: Calvert estimated that no more than 10 percent of the engineers who graduated from one eastern technical school in 1904 would become proprietors or partners of their own firms.<sup>19</sup> But neither would engineers be independent consultants, organized as a “free” profession like doctors or lawyers; indeed, because they were products of the large-scale business organizations that employed them, they could not be. Within these organizations, though, engineers did have careers leading, if not toward proprietorship, at least toward management and business responsibilities. According to the influential 1930 Wickenden Report, sponsored by the Society for the Promotion of Engineering Education, it had become “almost always necessary for an engineer to leave the engineering of materials and enter the engineering of men to become very successful financially and socially.”<sup>20</sup> Now thoroughly dependent on the organization for his social standing, the engineer repaid it with his loyalty.

### Engineers in Advanced Industry

The attachment of engineers to the business ethos as it developed in the 1920s was strong, but neither complete nor final. The formation of the National Society of Professional Engineers in 1934, intent primarily on passing registration laws for engineers, revived the attempt at professionalization along the lines of medicine and law. A burst of unionization in the 1940s, although affecting only a small minority of engineers, raised the possibility of an alliance with the labor movement. Most important, the transformation of the conditions of engineering practice, begun in the late nineteenth century, continued in the years after World War II.

As the electrical and chemical industries had led the way in the early twentieth century, electronics and aeronautics have led the way since World War II. In these industries, the institutionalization

of research and development, begun in the early years of the century, has become pervasive. As late as 1955, industrial funding for research and development was no more than \$2.5 billion; by 1982, it had risen to \$38.5 billion, an increase of over 450 percent in constant dollars and over 1500 percent in current dollars.<sup>21</sup> In the second half of the twentieth century, as Braverman observes, “the scientific-technical revolution . . . cannot be understood in terms of specific innovations—as in the case of the Industrial Revolution, which may be adequately characterized by a handful of key inventions—but must be understood rather in its totality as a mode of production into which science and exhaustive engineering investigations have been integrated as a part of ordinary functioning.”<sup>22</sup>

Advanced industries require not only more technical knowledge, but also a different type of technical knowledge. As Bell argues, what has become decisive is “the centrality of *theoretical* knowledge—the primacy of theory over empiricism and the codification of knowledge into abstract systems of symbols that, as in any axiomatic system, can be used to illuminate many different and varied areas of experience.”<sup>23</sup> In this, industry has become more dependent on the university and engineering more dependent on science.

The number of engineers has consequently continued to grow, from just under three hundred thousand in 1940 to over one and a half million, over three-quarters of whom were employed in business or industry, in 1981. At the same time, the character of engineering has changed, with a considerably greater emphasis on graduate training: The number of doctorates conferred in engineering, never higher than 122 in any year before World War II, peaked at over 3500 in 1972 and has remained well over 2000 annually since.<sup>24</sup> So, too, engineers have been joined in industry by increasing numbers of natural scientists, computer specialists, and engineering technicians, with whom they often work on the complex, “highly engineered” projects characteristic of the advanced industries.

These developments have not as yet inspired the same degree of self-reflection and political activism that characterized engineering in the early years of the twentieth century, but they have stirred many speculations about what engineers *might* think and *might* do and where they are located in the class structure. To mention only a few: Galbraith, drawing on one strand of Veblen’s thought, argues that engineers are leaders of a “technostructure” that has as-

sumed effective control of industrial policy; Mallet and Gorz, drawing on a different strand of Veblen, argue that engineers are in the vanguard of a “new working class” whose “love of workmanship [is] incompatible with capitalist profitability”; Gouldner argues that engineers are part of a “New Class”; Poulantzas contends that they are part of a “New Petty Bourgeoisie”; Barbara and John Ehrenreich include them in a “Professional-Managerial Class.”<sup>25</sup> All these speculations have merit, but two broad conceptions have dominated recent discussions: one, that engineers will, at last, “professionalize”; the other, that engineers will be subject to a process of “proletarianization.”

### *Professionalization*

Professionalization in engineering—or in the middle-level “bureaucratic professions” more generally—should not be confused with professionalization as it took place in medicine and law. The “free professions,” having successfully linked the right to practice with graduation from a certified training program, are characterized by monopolies over the market for their services. As a result, doctors and lawyers are protected from competition from practitioners in related or emerging fields. The bureaucratic professions enjoy no equivalent protection. Although registration laws exist for many of the bureaucratic professions, they are typically less restrictive than those for medicine and law. In engineering, experience may be substituted for certification by degree, and registration itself is required only of the principal officer of a corporation rather than of all employees of that corporation. For the most part, corporations are at least formally free to hire whomever they like for engineering positions. As a result, neither engineering nor any of the other bureaucratic professions has enjoyed the collective control over entry to practice characteristic of the free professions.<sup>26</sup>

Engineers, however—like accountants, teachers, or social workers—may still find the free professions an attractive model. Even in the absence of a monopoly over the market for their services, they may lay claim to professional standing in order to distinguish themselves from undifferentiated labor and to share in the generally high prestige reflected from medicine and law. In this sense, professionalization in the bureaucratic professions should be understood, in large part, as ideology.

Although professionalism among the middle levels may origi-



nate in ideology, it is distinctively anti-ideological in rhetoric. The “matter of factness” of engineers, as well as the calculation of accountants, the disinterestedness of teachers, and the objectivity of journalists, represent a claim to the preeminence of reason over self-interest and of universalism over particularism. In this sense, the middle levels equate professionalism with the possession of specialized skills and what Larson calls “monopolies of competence.”<sup>27</sup>

Although education is not as definitive of position in the bureaucratic professions as in the free professions, many middle-level employees are graduates of specialized programs. This education is not only the basis of the middle levels’ claims to professional standing, but also a source of differentiation among them. As Freidson argues:

The sociological rather than the merely technical or economic significance of a long period of training in putatively complex and abstract skills . . . lies in its tendency to develop institutional commitments on the part of those trained. Such trained workers are inclined to identify with their skill and with their fellows with the same training and skill.<sup>28</sup>

Extended training in specialized areas thus produces “not merely general skill-class, or mass solidarity, as is sometimes the case with industrial workers in trade unions, but disciplinary or occupational solidarity.”<sup>29</sup>

Occupational and professional solidarities among the middle levels are also encouraged by the organization of career lines. Insofar as the skills of engineers, accountants, teachers, and social workers are based on formal education rather than on-the-job training, they are easily transferable from organization to organization. Unlike the industrial working class, whose jobs have “no social or economic foundation for their persistence beyond the plants, agencies, or firms in which they exist,” bureaucratic professions can “realistically envisage a career over most of their working years . . . during which they maintain a particular occupational identity and continue to practice the same skills no matter what institution they work in.”<sup>30</sup>

Such occupational identities may make for tensions with industrial authority—between the “cosmopolitanism” of an occupation practiced in many settings and the “localism” of employers concerned only with their own firms.<sup>31</sup> Or they may occur between