The Engineer and His Work: A Sociological Perspective

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The impact on society of the products of engineering, as well as the engineers themselves, are pertinent sociological concerns (*1*). Sociology has a variety of special interests in both the engineer and engineering. In terms of sociological theory, engineering can be considered as simply one of the many occupations, or as an occupational subculture in its own right: a subculture with specific roles and values; attitudes and behavior characteristics; group relations and individual personalities; a specific technology and argot; and informal and formal relationships within a bureaucratic structure. In short, the occupational subculture is made up of the culture and social system of engineers qua engineers.

Sociology is also interested in engineering as a profession and in the products of engineers. Within this larger scope, it is necessary to examine the relationship between technology and society. Technology reverberates throughout the social order, affecting even the engineer himself. New processes of production affect the entire web of social relations, including the social relations of the engineer. Technology is not inherently good; its effects depend on the degree of social responsibility that each of its developers assumes. The increased specialization in technology has made it possible to escape social responsibilities by passing the buck—each specialist denies responsibility for the total product: "the effect may be one which none desired, and all brought about" (*2*). Bureaucratization also contributes to this attitude of "rationalized abdication of social responsibilities" (*2*, p. 569).

The year 1964 produced some shocks for the complacent engineer: the effects of the nuclear test ban treaty, the decline in the defense budget, the sharp restriction in new funding for strategic forces, the phasing out of many defense installations, the cancellation of contracts, and the suggestion of similar adversities to come (*3*). The engineer was sharply drawn into the mainstream of socioeconomic concerns and has remained there ever since. In this article we assess some of the sociological characteristics of the engineer who has been laid off and consider some sociological concepts pertinent to the engineer and his profession.

In 1967, Loomba published a study of the experiences of engineers and scientists who were laid off between 1963 and 1965 (*4*). These data were made available to the authors and served as the basis for a secondary analysis (*5*). The original survey involved the distribution of a questionnaire that resulted in responses from 1184 of the engineers and scientists who had been laid off. General questions of methodology, such as design, techniques, and sampling, are contained in pertinent sections of the Loomba report (*4*).

For this study, original data were used in a secondary analysis, within a descriptive design. The major purpose of Loomba's analysis was to describe the experiences of those engineers who were laid off during the 1963 to 1965 employment crisis in the California defense industry, based on their responses to the questionnaires. Largely descriptive in nature, the study affords insights into their experiences as they were suddenly thrust into the realm of the unemployed. The original questionnaire was not intended as a sociological study. Consequently, the secondary analysis focuses on responses that might lend themselves to interpretations from a sociological perspective. Where appropriate, various individual indices were combined to form indexes, statistical tests were computed, and the results were interpreted to assess sociological concepts.

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Salient Features of the Participants

The majority of the subjects were males (97 percent) between 41 and 45 years old. Most were married (84 percent), had an average of two children, lived in their own homes (about 67 percent), and were not excessively burdened with dependents outside the nuclear family.

Their career choice tended to occur within the family, as over 50 percent selected engineering because of this influence (or pressure). Teachers and counselors were the next most important career influences, followed by a more or less independent decision. Surprisingly, in view of its increased influence on the socialization process, the peer group fared poorly as a prime mover in the engineers' choice of their career. Interestingly, there is no evidence that engineers have much of an impact on the vocational choice of aspiring engineers. Consonant with the factors involved in the decision to become an engineer, the most telling reasons for the selection were, first, interest; second, the potential for advancement; and third, the prestige attached to the profession. Most of the engineers pursued a higher education: about 75 percent of them received at least a baccalaureate degree, and over 96 percent had some college. Most of the education occurred during the period after World War II. The engineers without college degrees usually assumed their status through informal educational opportunities and experience as technicians. Continued formal education was not popular among engineers, whether they had a college degree or not. However, a little more than 50 percent received further informal training, usually on the job. After receiving the degree, about 33 percent went into other occupations, usually business or sales; some started as technicians. They then tended to drift back into engineering within 5 years. A slight majority of the sample (55 percent) have been professional engineers for more than 5 years.

Prior to the layoffs, almost 50 percent had worked at the same company for 2 to 5 years, and about 25 percent had worked there for more than 5 years. Almost the entire spectrum of working time and experience was represented in those engineers involved in the layoffs. While working for the company, almost 67 percent felt that their training was not fully utilized, with 50 percent attributing this to a

lack in the need for their skills and 44 percent blaming poor management.

An assessment of their professional commitments and identifications indicated that 55 percent were not members of any professional societies and 89 percent were not members of any honor society. Almost 50 percent read between one and three professional journals regularly, while 11 percent read none at all. Finally, 85 percent had never had any patents issued, and 80 percent had never published.

The vast majority of the sample had been terminated involuntarily, with almost 20 percent receiving no prior notice of the layoff, while about 50 percent were given a leave of absence to seek new employment. Only 18 percent were offered a new job within the company, and this offer was refused by 85 percent. The chief reason for the refusal was the necessity to relocate. Of these company offers, one-third would have involved downward mobility; most of the rest would have involved a similar status, with a few advancements. About 20 percent of the sample found immediate reemployment. Of the rest, 25 percent were reemployed in less than a month, some 55 percent were out of work for 1 to 6 months, and 21 percent were unemployed for more than 6 months. At the time the questionnaire was distributed, there were still 100 unemployed engineers.

During the period of unemployment, several economic resources of a private and public nature were utilized. About 50 percent used unemployment insurance; very few turned to their relatives for assistance. The most popular resources were savings, unemployment insurance, and severance pay, in that order. The search for new employment involved a variety of resources, with the direct contact being the most popular and most fruitful approach. Newspaper ads and the use of friends were the next most popular and fruitful approaches. Finally, the job that was accepted was most likely to have come from the use of friends, direct contacts, and newspaper ads, respectively. The least effective sources for reemployment were the trade magazines and the professional societies.

In summary, the subjects showed a general resourcefulness and sophistication as they aggressively pursued new jobs and adjusted to the crisis of unemployment. The most helpful factors in the quest for new jobs were experience first, and then education. The major obstacles, aside from a paucity of jobs, involved aging, inadequate educational background, and high salary demands. Contrary to expectations, relocation per se was not a crucial factor; instead, job hunting was restricted by the reluctance to disrupt stable family patterns. This was partially evidenced by such factors as attachment to a residential area, a hesitancy about interrupting the children's schooling, and the wistful dissuasion (perhaps nagging) of the wives. Friendships were not considered particularly significant attachments, as peer group influences tend to diminish with time. Upon reemployment, 57 percent of the subjects received moving expenses, as opposed to 66 percent in previous, less critical layoffs. The difference is perhaps attributable to changes in the supply and demand of engineers.

Almost 75 percent of the sample had had previous experience with termination—sometimes voluntary, mostly involuntary. The number of those who voluntarily left their jobs decreased from 35 percent for the first job change before being laid off, to 21 percent for the second job change, to only 8 percent in the case of an instant layoff. Those who voluntarily changed jobs usually did not do so as a result of more lucrative offers. The reasons varied greatly, from dissatisfaction with the employer, to pursuit of the sun. It would be more nearly correct to apply the epithet of "industry butterfly" to the few rather than to the profession. It is possible that there is a core group of engineers who engage in the continued practice of flitting from one lucrative offer to another, but the majority prefer more stable commitments.

The sample demonstrated an overwhelming preference for the West Coast (over 90 percent), a popularity that seemed to increase over the years. The region with the greatest attraction was the San Francisco Bay area, followed by the rest of California and then the Pacific Coast. The least popular areas were in the South, particularly Mississippi and Alabama. Perhaps some of the alleged mobility of the engineer is due to an attempt to live in California, with job changes affording the opportunity to effect this move. At any rate, since so many had experienced previous layoffs, for one reason or another, the trauma (if there were one) may very well have been less due to the layoff per se than to the search for new employment in the unfamiliar context of a diminishing job market.

Defense versus Nondefense Employment

Both defense and nondefense plants were involved in the layoffs. In general, there were more similarities among the experiences of the engineers than there were differences. However, after combining and summarizing the differences that did occur, some general patterns emerged.

The general employment conditions tended to be better for the defense engineer than for the nondefense engineer. He received higher wages, was afforded a greater opportunity to further his training, was more apt to be compensated for his moving expenses, and was treated more considerately at the time he was laid off (for example, he was more apt to receive time off to seek new employment and was more apt to receive advance notice of his termination). On the other hand, the nondefense engineer seemed to be more satisfied with, and secure in, his job. He was somewhat less critical of management, particularly in the use of his skills, was more secure with seniority, and was less apt to be laid off.

In another general pattern of responses, the defense engineer seemed to have greater difficulty than the nondefense engineer in finding new employment, particularly in defense industries. He also had greater difficulty immediately after termination, perhaps partially due to the state of the defense industry at the time of the layoffs. It was necessary for him to initiate more contacts before reemployment, and significantly more defense than nondefense engineers were still unemployed at the time of this survey.

In addition, the defense engineer evidenced considerably more occupational mobility than the nondefense engineer did. Besides changing jobs more often in general, after the layoffs the defense engineer tended to switch to nondefense jobs more often than the nondefense engineer switched to defense jobs. There are several possible interpretations of these data. The nondefense engineer may have felt more secure in and satisfied with nondefense working conditions than the defense engineer felt in relation to working

conditions in the defense industry. Although the market conditions may have been such as to increase the opportunities for employment in nondefense plants, it should be noted that the intra-industry mobility of the defense engineers was also evidenced over several job changes prior to their experience with instant termination. It is also possible that there was some dissatisfaction with, and hostility toward, the defense industry because of the manner in which the mass layoffs were handled by the industry, a general disillusionment as working experiences fell short of ideals, and a growing social consciousness of the defense industry's military ties (*6*).

There are several sociological concepts that are particularly pertinent to this analysis. Only three will be discussed here: professionalization, specialization, and mobility.

Professionalization

Engineering is at the forefront of the emerging professions. There seem to be several problems associated with this growing status. The problems are particularly acute for engineers because their identity is related to the structure within which they practice. The model for identifying a profession tends to be the old professions in which people have traditionally been self-employed, such as medicine and law, rather than the newer, salaried ones. It has been reported that some 88 percent of all engineers are employed in industry, and 10 percent in government (*7*). This tends to make the professionalization process a difficult one. The engineer himself has some concern about his self-image, as he feels the dual pressures for loyalty and commitment from both the host company and the profession (*8*). This may result in conflicting values, since he is forced to make local or cosmopolitan commitments. This problem is further complicated by his being torn between management and the worker. With which stratum should he identify? In the end, he seems to reject both: he is reluctant to join trade unions, but only a few become managers. A possible solution is identification with a profession, but engineering as a profession is still emerging and is not yet clear-cut. As a result, the engineer tends to be confused as to his identity and is relegated to an occupational limbo.

Becker and Carper suggested four major elements involved in the process of identification with an occupation (*9*). First is the occupational title and ideology. There is pride in the title and in what it suggests in terms of skills, services, and logical thinking processes. Engineering seems to fit in this element. Second is a commitment to a task. The various tasks of the engineer, whether they be narrowly defined or defined to include almost all job activities, seem to grip the attention of the engineer. Third is the organizational and institutional position. The engineer tends to tie himself in with the industrial system, or perhaps even with a specific company, rather than with the occupational structure as a whole. Fourth is the social position. This refers to the prestige and social mobility associated with the occupation. There seems to be ambivalence on the part of the engineer and the public about the social position of the engineer. His social mobility is more apt to be associated with socioeconomic criteria than with his identity as an engineer. In a study of six professions, which was completed before the technological explosion after World War II, it was found that the prestige of engineers did not compare favorably with that of the other professions (*10*). The increased specialization of the postwar engineer has resulted in public confusion over what the engineer is and what he does (*2*, p. 564). With this confusion, it is even more difficult to attach prestige to the profession. The engineer responds with chagrin, because he feels misunderstood, feels that the public does not recognize his contribution to their welfare, and feels that much of the credit that goes to the scientist rightfully belongs to him. The confusion is compounded by the practice, among many occupations of low status, of using the very term "engineer" in order to upgrade the occupation.

In a study of the professionalization of labor, three aspects of that process were suggested (*11*). First, there is technology, a specialized technique supported by a body of theory. The engineer certainly has this. Second, there is an organization, a career supported by an association of colleagues. There are engineering associations that set standards, have codes of ethics, and suggest licensing procedures, but how many engineers belong to and identify with the associations? Third, there is an ideology and a status supported by community recognition. Again, we have the question of prestige and the ambivalence associated with the position of the engineer.

There were some indices of occupational identity and professionalization in the responses to the questionnaire. A series of questions was asked about professional contributions and associational ties. The responses were somewhat indicative of the ambivalent position of the profession. Although about 90 percent read technical journals regularly, more than 80 percent did not contribute to the profession through patents and publications, and over 50 percent did not associate through the professional societies (*12*). It is possible that the engineers focused on an industry rather than on an occupation. The engineer is concerned about his status and apparently would prefer a professional identification; however, he does not seem to be meeting some of the criteria necessary for this status.

Specialization

The historical criteria for dividing labor are age and sex. As a society matures industrially, it develops needs for further divisions, and professional and technical specializations become part of its industrial makeup—the more technologically sophisticated the society, the greater the degree of specialization. In some respects, specialization is similar to professionalization, but they are not synonymous. Actually, professionalization is one type of specialization—a type that is identified by an overall stress on ethics, ideology, and theory. In other words, all professional occupations are also specializations, but not all specialized occupations are professions. And while the engineer may be in an ambiguous situation regarding his professional status, he is definitely in no such situation regarding his specialization—he is a specialist of the highest order.

Occupational sociologists stress a variety of consequences of work specialization, with the majority of them fairly well agreeing on two of these consequences: First, specialization causes barriers to communication with workers in other fields and hence isolated islands of interest; and second, specialization leads to the breakdown

of ties between the specialist and his family. The first consequence, while valid, is not limited to engineers. Our communities are becoming enclaves of individuals with similar occupations, similar economic resources, similar recreational activities, and similar family patterns. Other than the geographical proximity of many of the respondents, there were insufficient data from the questionnaire to test this proposition.

The second consequence, that specialization weakens ties between the specialist and his family (essentially a specification of the communication barrier), is often the logical conclusion of specialization. The specialist may carry on his work in a location and under conditions that are often inaccessible and even forbidden to the other members of his family. This means that they cannot experience his physical work world; therefore, regardless of their desire to understand his complaints or the place where he works, they can only empathize to a limited extent. In addition, the very nature of specialization, with its high degree of technology, makes it difficult for the family to understand his work, and the problems connected with it. He, in turn, feeling that he cannot share his unique experiences with them, may cut them out of an important part of his life.

Weakened family ties, then, can be a logical concomitant of work specialization, but the data available here did not completely bear out this phenomenon. Well over 50 percent of the engineers cited the family as the primary influence in the choice of an engineering career. Since most of these individuals probably had made their career choices before marriage, the family in this instance refers to the family of orientation (for example, parents and grandparents) with whom the respondent was experiencing close ties at the time of his career choice. The person who experiences a close relationship with his family of orientation is quite likely to have set the pattern for experiencing a close relationship with his family of procreation, that is, wife and children.

The data also suggest other family-oriented relationships: 64 percent owned their own homes at the time of the layoff; close to 50 percent were reluctant to seek reemployment in other geographic areas, primarily because of attachments to home, relatives, children, or spouses; and only about 4 percent were divorced at the time of their layoff (*13*).

The indications are, then, that the high degree of specialization has little deleterious effect on familial ties per se. However, although the engineer may be family-oriented, the character of the family ties may be another matter. That is, the relationships within the family, though intact, may be strained. The difficulty in communication within the family, particularly on an effective, free, give-and-take basis, may contribute to the strained relations. The layoff can then exacerbate the situation.

Mobility

Mobility takes many forms. A change in jobs may involve a geographic move or just an occupational one, or both. It is possible to shift within the same occupation or from one occupation to another. Occupational mobility could result in a vertical change, where one either moves upward or downward in status, or in a horizontal shift, where one changes jobs but maintains the same status. The status change might be monetary in nature or hierarchical, in terms of the occupational or the organizational stratification system, or both. In 1961, 8 million Americans changed jobs for one reason or another (*14*). Mobility, then, is not an unusual phenomenon. Engineers, too, would be expected to engage in some mobility. However, there is no evidence from this survey that the mobility of the engineer even approaches the diaspora-like proportions found in the myth of the inconstant engineer.

There are many reasons why engineers might change jobs. They are often charged with opportunism, as they allegedly solicit and flit from one lucrative job offer to another. In examining the relationship between job changes and salary, this charge does not seem to hold. Although there is an increase in salary over time, it is not so great that it cannot be accounted for by a general increase in wages through normal processes, rather than by a job change for a more lucrative offer. It should be noted that this survey included a large group of engineers, and certain individuals who may practice this kind of opportunism could be masked by the larger number who do not. Possibly there is a small number of individuals who are occupationally unstable and who solicit more lucrative offers (and who are easily seduced by the collateral solicitations of the industry). It would seem that opportunistic mobility, motivated by pursuit of the dollar, is not a general practice among the engineers in this study.

Another reason that the engineer might change jobs would be to work within the geographical area he prefers. The tremendous growth in the population of California in the past decades attests to its popularity among all occupational groups. When the engineer makes an initial move to the area of his choice, it would seem reasonable to expect him to take great pains to remain there. In the sample of engineers studied in this survey, each succeeding job change showed an increased preference for the West Coast, and a concomitant decrease in geographical mobility as they settled down in their preferred location.

Two other possible reasons for the mobility of the engineer are advancement and changes in vocation. One would expect few professionals to alter their occupational choice after investing time and money in schooling. This seems to be generally true of engineers in this sample. Most obtained full-time engineering jobs after receiving the college degree (71 percent). Of the rest, about 50 percent went into related occupations (technical and professional). Some went into sales and business, in a capacity that probably involved their engineering training in some way. Of those who did not go specifically into engineering jobs, almost 67 percent drifted back to engineering within 5 years. It would seem that, as in other professions, the vast majority tend to remain in engineering or closely related vocations.

Although the desire, hope, and expectation of advancement serve to lure the neophyte into the occupation (advancement was the second most popular reason for choosing engineering), there seems to be little hope for fulfillment, if we define it in terms of a move into management. One index of this was the responses to a question about the effect of job changes on status. In one job change, almost 50 percent moved into a different specialty and about 33 percent into a new status. However, only about 10 percent would define the change as upwardly mobile, with probably very few of these moving into management positions. It would seem that the occu-

pational flow of the engineers in the sample was more or less limited to horizontal mobility. That is, advancement may have been redefined in terms of more lucrative, more interesting, more challenging, or more prestigious jobs, rather than in terms of managerial responsibilities. This may, in part, account for the fact that the usual kind of mobility evidenced in the sample was intra-industry mobility, particularly between the defense and nondefense plants.

Movement between defense and nondefense plants occurred relatively frequently, with nondefense plants becoming increasingly popular. As was noted earlier, more and more defense engineers moved into nondefense jobs, and more and more nondefense engineers remained in that part of the industry. This touches on an important question: If the need should arise, could defense-oriented engineers easily make the transition into more commercial employment? The indications are that, as a group, they could. There may be problems for some, particularly for the engineers without college degrees, and it might involve some retraining and downward mobility for others, but, in general, the skills can be transferred and a successful adjustment is possible.

What mobility does exist among the engineers is also a function of the organizations within which they work. In some cases, the employing companies solicit job changes by a variety of inducements. They may offer higher salaries or certain fringe benefits. One such fringe benefit is the offer to pay moving expenses. This seems particularly true of the defense industry. In job changes before being laid off, over 65 percent of the engineers received moving expenses (73 percent for the defense and 43 percent for nondefense). In the first reemployment experience after the layoffs studied here, almost 60 percent of the sample received reimbursements. This may have served to convince the hesitating engineer that a change was desirable. In addition to the fringe benefits, mobility is induced by the relatively frequent layoffs. As has been noted previously, most job changes followed involuntary release from the job. Perhaps it would be more nearly correct to speak of an unstable industry, rather than of a mobile profession. Finally, the voluntary mobility that occurred may have been related to the discrepancy between an organization's ideology and the realities of the job. The inducements to join an organization probably include glowing job descriptions that fall short of the mark. The results may very well be disappointment and readiness to change.

Discussion

Within the limits of a secondary analysis, an attempt has been made to analyze the original data from Loomba's study of engineering layoffs. With the focus on the identification of problems and questions rather than on explanations, this analysis contains a mixture of speculations, hypotheses, and descriptive material. Of the three sociological concepts discussed, the data suggested that professionalization presented the individual engineer and the occupation with ambivalent and dichotomous references; specialization minimally affected the family orientation of the engineer; and mobility of the profession as a whole is somewhat less than is usually suggested and is principally involuntary.

The physical environment of the engineer seems to be both impressive and deceptive. It is clean, compact, well-planned, and apparently unlimited in resources; it is also cold and functional. The atmosphere is calm, yet not relaxed; it is noncoercive, yet restraining. The attempt to introduce esthetic elements into his physical surroundings, and, at the same time, to avoid ostentation, results in superficiality. There are few smiles, little joking, hardly any small talk, and no nonsense. Apparently physically relaxed, there is a sense of intellectual tension. The symbols of an advancing technology are prominently displayed: the mathematical formulas and the drawing boards. Yet one gets the feeling that both are too often used as mechanisms for a retreat from the realities of the problems, and not merely as tools for their solution. Although too harsh a characterization, the environment in which the engineer works is somewhat akin to an intellectual concentration camp. This intellectual captivity seems to be as much a product of the profession as of a given organization. There appears to be no room for the passions of man.

As an occupational group, engineers are characterized as heterogeneous. Internal stratification tends to be based primarily on education. The Ph.D.'s are at the apex of the system, which ends with engineers who have no college degree but who have received the title (and incorporated the image) through experience and opportunity. This latter group, whose visibility seems to be exponentially disproportionate to its actual size, is the pariah caste and is invested with most of the ills of the profession (*15*). Their genesis is presented within the historical context of the rapid growth of the industry and the inexorable demand for professionals that resulted. They are portrayed as lacking in basic skills, as potentially downwardly mobile, and as among the first to go when the industry is economically pressed. Each stratum apparently resents the others. The general resentment toward the nondegree caste might be engendered (among other things) by the fact that actual job requirements often force the engineer with a college degree into the technician-like activities and status of the engineer who has no degree. The greater occupational expectations of the engineer with a degree only increase this resentment.

One gets the impression that there is a consensus (even, to some degree, among working engineers themselves, since they are concerned about their self-image) that the engineer is object-oriented. That is, the engineer's training, as well as his entire occupational emphasis, is directed toward the manipulation of objects. This focus is then said to carry over into his relationships with other human beings. There is evidence of a dichotomy between what might be termed people-workers (those in the industry who serve people) and object-manipulators (the engineers). The people-workers tend to be resentful of the object-manipulators and take pains to avoid being identified with them.

Perhaps the resentment of the people-workers is best seen in their interpretation of the engineering layoffs, an interpretation that seems to be shared, to some extent, by management. They see the layoffs as advantageous to both the engineers and the industry. They seem to feel that the industry is undergoing a shakedown that will enable it to expunge the technologically obsolescent, the unmotivated, and the incompetent (*16*). Concomitantly, it is alleged, there is a general rededication to the ideals of the profession (which, however, sounds more like "You'd better straighten out or you, too, may go"). This is climaxed by a fervent declaration that the layoffs should

make future recruitment much easier, because only the motivated (that is, those with an interest in knowledge and ideals, not just money) need apply. There seems to be the feeling that the engineers, who have always had it so good (perhaps too good), will be better men for the experience. Although there is general recognition of the trauma of the initial impact, it is seen as short-lived, since there will soon be a readjustment and new employment. A continuing emphasis is placed on the need for the engineer to rededicate himself. The industry is cited repeatedly for its major efforts, both in helping the unemployed engineers to accommodate themselves to the layoff and in finding them new jobs.

An organization's presentation of itself is usually expressed through its ideology. This may take the form of a justification for its existence; it tends to be an expression of its ideas and purposes in idealistic and romanticized terms; and it focuses on what one ought to do, rather than on what one does. Both the engineering profession and the defense industry seem to possess an ample ideology. This same ideology may very well be the structure within which colleges and universities train new engineers. The profession is presented as at the vanguard of progress, the savior and builder of the nation, a haven for the brilliant and the creative, and an opportunity for, or even a guarantee of, unequaled material and nonmaterial rewards. The defense industry is presented as a paragon of capitalistic virtue, a laboratory for the development and fulfillment of creative talent, a guardian of the Protestant ethic, and the defender of the nation, with profit of secondary importance. This portrait of industrial and occupational paradise is bound to be found wanting. After some experience, the engineer finds his ideals wearing thin; at the same time, he is entrapped by affluence and family reponsibilities. An accommodation ensues. The company exhorts the profession to adhere to the very ideals that the company itself may corrupt—or at least not practice. As for the profession, most engineers find that the ideals are beyond their reach. Perhaps the layoffs may give the engineer an opportunity to reaffirm some version of his ideals in nondefense industries and small companies.

The engineer's attitude toward advancing his knowledge of engineering is paradoxical. At the forefront of technological advances, the engineer helps create new vistas for knowledge, yet tends to be antagonistic to the consequences of the very changes he helped bring about. He seems to feel that he should not have to undergo any more formal education. This attitude is perhaps best expressed by the bitter remark of one unemployed engineer: "I paid the price of admission once; why should I have to pay it again?" The engineer instigates change, yet he abrogates responsibility for its consequences and is reluctant to keep up with it.

Conclusion

The extent to which one can generalize from this study is moot. The original sample was designed to be extensive and representative. However, it is geographically restricted and deals only with engineers who were terminated. It did include engineers from every stratum of the profession. The engineer and his work seem to be in deep trouble. Further, studies that are directed toward an assessment of the problems, from which might emerge suggestions for solutions, are imperative. The layoffs and their consequences can no longer be viewed as short-lived concerns that are peculiar to a small part of the profession. They are not simply economic problems that diminish with increased government spending, full employment, and affluence. They involve a whole spectrum of consequences, including the engineer's self-image, his family and social life, the nature of the industry and its environment, and the recruiting and training of future engineers.

References and Notes

1. We thank R. P. Loomba for permitting us to use his data, and for his invaluable consultation. The analysis and interpretation of the data are the authors' responsibility.
2. R. K. Merton, "The machine, the worker, and the engineer," *Social Theory and Social Structure* (Free Press, Glencoe, Ill., 1957), pp. 562–573.
3. These shocks have been repeated in recent industry layoffs.
4. R. P. Loomba, *A Study of the Re-employment and Unemployment Experiences of Scientists and Engineers Laid Off from 62 Aerospace and Electronics Firms in the San Francisco Bay Area During 1963–1965* (Department of Labor, Office of Manpower Policy, Evaluation, and Research, Washington, D.C., 1967).
5. A.R. participated in part of the original study in the role of a consultant.
6. Although there are undoubtedly many parallels between the 1964 layoffs and the 1969–1970 layoffs, they occurred within dissimilar sociopolitical contexts, with some differences as a result. For example, in the present layoffs there seems to be an increase of concern with social issues, particularly with reference to the war in Vietnam, pollution, and technology's relationship to both. In addition, cracks are appearing in the traditional, individual solutions to being laid off. Are more engineers leaving the profession now? Is there a growing trend toward such group solutions as unionization? Is there a greater tendency to assign more responsibility for layoffs to government and industry rather than to fate or the nature of the business?
7. W. Kornhauser, *Scientists in Industry* (Univ. of California Press, Berkeley, 1962).
8. These dual pressures do not exist in all professions, but tend to exist more where both the occupational environment and the content of the discipline are bureaucratized, as they are in engineering. The sociologist, for example, may work in a bureaucratic structure such as a university and still maintain control of the discipline; the doctor and the lawyer maintain control of their disciplines to a large degree. Interestingly, the engineer who teaches in a college or university is also, to a large degree, in control of the discipline.
9. H. S. Becker and J. Carper, "The elements of identification with an occupation," *Amer. Sociol. Rev.* **21**, 341 (1956).
10. M. F. Nimkoff, "Opportunities for prestige in six professions," *ibid.* **8**, 470 (1943).
11. N. N. Foote, "The Processionalization of labor in Detroit," *Amer. J. Sociol.* **53**, 371 (1953).
12. The nature of the industry is such that it contributes to this problem. An occupation that uses science as its method usually includes the sharing of its findings with the community in its ethos. Working with classified material relating to national defense economic competition, or both, makes it very difficult for the engineer to control his occupation.
13. By extrapolating from the 1960 census data, about 4.8 percent of the general population in the same geographical area as the respondents were divorced in 1966.
14. T. R. Brooks, "The problem of mobility," *Dun's Rev. Mod. Ind.* **82**, 54 (1963).
15. Only about 3 percent of the engineers who responded to the questionnaire had an educational background of completion of high school or less, while fewer than 25 percent of the sample had less than a college degree.
16. The evidence from the study does not bear out such a systematic process of weeding out.