

MICROELECTRONICS AND WORKERS' RIGHTS

ABSTRACT. A description of how microelectronics and robotics are tending to increase unemployment, followed by comparisons between the social policies of Western European countries and the United States with regard to this problem. A conclusion points out the need for a social philosophy of technology that acknowledges workers' rights.

The developed world is moving rapidly into what is generally referred to as a microelectronics revolution, one major consequence of which will be the demise of many traditional jobs and job skills. But not in comparable numbers. The transition is being eased, in some countries more than others, by so-called new technology agreements that protect workers presently employed. But little is being done, outside of Scandinavia, to develop jobs for people who will be seeking them in the future. What jobs there will be, especially for the unskilled or inappropriately skilled, may not provide enough income to support those who are thus employed. In a word, neither the proverbial sweat on one's brow nor even the knowledge stored behind will be sufficient conditions for earning one's bread. What, then, is to be the value of work in the age of the microchip; and what value shall we assign to those whose skills are merely quaint in such a high-technology driven economy?

At issue is a fundamental question of human dignity and social responsibility which until recently has been sidestepped as moot by most theoreticians, perhaps including even Marx, because of the extreme unlikelihood of an economy not based on human toil.¹ The twentieth century has seen the development of various systems of unemployment compensation and welfare maintenance. But in spite of this social cushion, the new technology is worrisome nonetheless to the extent that it involves what some have called "the collapse of work."² The methodology of futuristics in this regard as in any other is unreliable. But careful prognostication on the basis of recent developments and discernible trends does suggest that we face quite radical changes in our patterns of work.

Microelectronic technology will probably render entire industries, e.g., the postal service, obsolete. It has already transformed various work *processes*, e.g., tool and die manufacturing, printing and publishing, retail sales, banking, insurance, and clerical work, to a point at which in these sectors comparatively few jobs need to be done by hu-

mans. Many traditionally valued skills are being rendered obsolete, and fewer new skills are likely to be needed in the sectors affected.³

Consider just a few examples of what has already happened. Between 1969 and 1978 eight manufacturers of business equipment, as surveyed by Olivetti, reduced their employment by 20%. In three years, from 1975 to 1978, Ericsson, a Swedish manufacturer of telecommunications equipment, reduced its production workforce from 15 000 to 10 000. Between 1972 and 1979 in West Germany 35 000 employees in the printing industry lost their jobs, usually to a visual display unit (VDU). Similar changes have been documented in insurance, banking, and now clerical work.⁴ Even employment in the once labor-intensive production of computers declined by 50% from 1963 to 1965.⁵

In the production of machine tools, once requiring high-grade human skills, humans now do little more than monitor and feed information. Skills still needed are based more on analytic and logical ability than on workplace acquired experience. Clerical skills, which often include a range of administrative responsibilities, are now being dissipated by the word processor, which, not coincidentally, impacts inordinately upon women in the workforce.⁶ Electronic components of an earlier generation were produced by a workforce made up mainly (70–80%) of semi-skilled workers. New electronic components (large-scale integrated circuits) are produced by a workforce almost equally divided into thirds among trained engineers and technicians, semi-skilled workers, and unskilled workers.⁷ So in the area of microelectronics production we are witnessing an exacerbation of the division of labor first espoused by Adam Smith, encouraged by Charles Babbage, and implemented in the mechanical age by Frederick Taylor.⁸

There is no obvious limit to the range and variety of sectors that may be similarly affected. Yet it is more than mere coincidence that the sector first affected is decidedly blue collar. Repetitive work that requires minimal skills, e.g., in assembling, joining and handling, has been ripe for the arrival of the robot.⁹ A robot may be defined as a programmable, self-correcting manipulator of versatile automation components.¹⁰ According to one estimate, there are already some 15 000 robots installed around the world, about half of them in Japan and a fourth in the United States.¹¹ There are some 6–7000 units in the Soviet Union, but most of these are technically limited on only 3–4 axes of movement.¹² By 1986 the Russians hope to have added 40 000 additional units, and during the five years thereafter they will be installing sensory robots (see below).¹³ One hundred and fifty companies in Japan (five times as many

as in the United States) produced robots at a level of \$400 million in 1980, and expect to be producing at a level of \$2.2 billion in 1985, \$4.5 billion in 1990.¹⁴ In the United States, robot production was at a level of \$50 million/year in 1981, but may expand to \$250 billion by the turn of the century.¹⁵

The robots of the future will have "sensory" capability, in varying degrees depending on the task, both in regard to "touch" and in regard to "vision," and both are now becoming technically and economically feasible. A Mitsubishi robot, for example, "knows" when it has reached the correct object on a work-bench. A Hitachi robot is so touch-sensitive that it can insert a piston into a cylinder with a clearance of 20 μ in three seconds.¹⁶ Selective choice and evaluation of parts will be coming soon. Still in the future is a "thinking" robot that when shown what to do will determine the most efficient way to do it.¹⁷

The impact of robotization on the workforce is only gradually becoming apparent, but it clearly results in unemployment at least indirectly. General Electric, already a user and intending to become a producer of robots, will have a significant effect on both its own and others' payrolls. So far, GE has limited its workforce reduction to attrition.¹⁸ But it plans to robotize as many as half of its 30,000 assembly-line jobs to achieve 6%/year improvement in productivity. GE's U.S. competitor, Westinghouse, has established a Robotics Division and given it a mandate to robotize "any and all manufacturing areas."¹⁹ The PUMA (programmable universal machine for assembly), a \$20,000 robot arm developed by General Motors and Unimation, is expected to displace half of GM's assembly line workers by 1990.²⁰ Robogate, an assembly line robot developed and installed by Fiat, has not yet displaced many workers. But once sensory robots are installed the Italian manufacturer could, it is estimated, cut manpower 90% before 1990.²¹

In Japan, MITI, the quasi-governmental research arm of Japanese industry, is investing \$140 million over a seven-year period to achieve completely robotized assembly of a product, such as an automobile, the design of which could be changed simply by changing the system's software. Hitachi hopes to have smart robots doing 60% of its assembly work by 1985.²² This company has already opened a \$60 million prototype of a flexible manufacturing complex (FMC) that involves five fully automatic manufacturing operations, all interconnected and controlled by a hierarchy of computers, with humans on hand only as safety overseers of lasers used for treating and machining. It is expected that 20% of Japan's total factory output will be FMC'd by 1985.²³ Meanwhile, Fujitsu Fanuc Ltd.

has opened a \$38 million plant to produce other robots and computerized tools automatically, using robots, numerically controlled machine tools, and only one shift of 100 human workers to assemble robot-made parts.

If these developments in particular industries are expanded into larger-scale projections, the likely impact on the blue collar workforce takes on alarming proportions. According to one projection, in the last decade of this century robots will be producing half of all manufactured goods; and, as a result, up to one-quarter of the factory workforce may be dislodged.²⁴ Another estimate has it that increased use of robots and other electronic devices in U.S. industry will lead to a 30% decrease in use of workers, commonly by introducing an unmanned third shift: what the Germans call "*die Geisterschicht*."²⁵ According to yet another techno-seer, "smart robots could displace 65% or more of today's factory work force."²⁶

In the face of this rather sudden transformation of the means of production, even *sushin koyo*, the vaunted job security system of Japanese factory workers, has become vulnerable. The manufacturing workforce in Japan dropped from 14.4 million in 1973 to 13.7 million in 1980. The conclusion of a government study that the impact of microelectronics on employment would not be serious was heavily criticized, and the heretofore acquiescent unions have begun to worry.²⁷ One result: the Federation of Japan Automobile Workers' Unions has entered into an agreement with Nissan that protects the jobs of those presently employed against lay-off or downgrading due to the introduction of robots and microelectronics.²⁸ But the government is doing little to create new jobs.²⁹

Nor is the problem of displacement limited to developed countries. Computer-controlled assembly in the United States and Japan is now competitive with labor-intensive and increasingly expensive production elsewhere ("outsourcing"), and thus it is now less advantageous for electronics manufacturers to depend upon developing Asian countries for low-level assembly operations.³⁰

In a word, knowledgeable observers of the robot industry debate not the threat of workers displacement but only its magnitude. There is, however, yet another dimension to the displacement which amounts to a reversal of the thesis that the whole is greater than the sum of its parts. At issue here is the diminution if not outright demise of unions organized historically to protect workers *in their jobs*. The United Auto Workers expects to lose 200 000 of its 1 million members between 1978 and 1990. The International Association of Machinists (IAM) and the Internation-

al Brotherhood of Electrical Workers (IBEW) will also be hard hit. But microelectronics will eliminate white collar jobs as well. Employment in the U.S. postal service has declined from 70 000 in 1970 to 667 000 in 1981.³¹ And as the great giant AT&T moved toward its 1983 break-up into a long-distance service and five regional companies, the Communications Workers of America (CWA) focused its concern in bargaining a contract on the issue of job security.

What was of concern to employees of AT&T has been of no less concern to government leaders in Western Europe. The so-called Nora Report, submitted to the President of France Giscard d'Estaing in 1978, is especially pessimistic. According to Nora, the revolutionary telecommunications system about to be introduced by IBM and its American partners (Comsat and Aetna) is likely to undermine any claim to sovereignty on the part of a small nation state such as France.³² Nora's warning that small nation states must accordingly develop a collective policy in their own defense has in fact been translated into an agreement between IBM and the EEC countries to standardize many of its computer components. It is unlikely, however, that contracts and agreements such as these can prevent the technological unemployment that will impact, proportionally, no less heavily on middle- and even upper-level management rendered superfluous by the departure of those whom they have been managing.

If technological unemployment does occur in the years ahead more or less as here portrayed, it will so happen not because there are no alternatives but because robots and other microelectronic devices are already perceived as cost effective in the long run and hence a necessary condition for staying competitive in the industries affected.³³ At least one writer would add, however, that it is only by eliminating humans that microelectronic automation can be cost effective, because the greatest expense is incurred in trying to accommodate man in the loop. Says Lawrence B. Evans, an MIT chemical engineer:

The cost of complex electronic circuitry continues to decrease exponentially (by a factor of about 1/2 each year) due to large-scale integration (LSI) semiconductor technology. . . . The real cost of a system is in the hardware for communication between man and that system (displays, keys, typewriters) and this cost is a function of the way the system is packaged. Thus, automation functions and data processing become economic if they can be done blindly, without the need for human communication.³⁴

Estimates vary as to just how much less expensive it may be to use robots rather than humans; but that there will be significant savings is

widely assumed. As one writer puts it, a Japanese robot in automotive production can do at \$5.50/hr what a UAW worker does for \$18.10/hr (wages and fringes).³⁵ An estimate of this sort is typically based on a comparison between costs incurred from labor and costs of procuring and maintaining a robot. Robot providers claim that robot costs will be recouped within a three-year payback period from savings in labor alone. Of course, assumptions with regard to the cost of money, the cost of installation, and the cost of power and maintenance of a robot need to be adjusted up rather significantly in the present economy. But the initial cost of producing the robot may well drop from \$50 000 in 1980 to just \$10 000 in 1990. So recent estimates are probably at least in the correct order of magnitude. However, cost considerations have on occasion given way to a desire for product quality improvement, e.g., in production of Chrysler's K-car at the Newark, Delaware, plant and of GM's Fleetwood in Detroit, where \$8.5 million of robots save only \$120 000/yr. In such instances, of course, a more affluent market is targeted, and cost is expected to be recouped through sales.³⁶

What is more noteworthy about these cost-savings calculations from a societal point of view is that only internal costs are being taken into account, not the external costs, direct and indirect, that spill over onto society in the wake of technological upheaval.

In some important respects, Western European countries are far ahead of the United States with programs in place to smooth the transitions made necessary by industrial transformation. To be sure, there have been some enlightened steps forward in various places in America. But as a general rule neither the private nor the public sector seems really prepared to deal with the technological unemployment that is already becoming endemic in Western societies.

That workers should lose their jobs is, of course, nothing new. Nor is it unprecedented that the installation of a new technology is the immediate cause of losing one's job. It is not even new that technology should impact so heavily on one sector of the economy, since much the same sort of transformation resulted from the mechanization of agriculture beginning a century ago. What is new is the wide range of specialized skills that the new technology is rendering economically without value. But these skills have served society well for many generations. They have been acquired as a result, directly or indirectly, of socially supported priorities and programs. It is, accordingly, only the unconscionable or perhaps amnesiac society that would simply abandon the victims of its own devices.³⁷

European countries, at least in principle, have more lucrative unem-

ployment benefits than is the case in North America. The percentage of the labor force covered by such benefits is significantly higher in the United States than in Europe, where smaller firms and agriculture tend to be exempted from coverage. Nonetheless, there is substantial evidence that European societies assume greater responsibility for workers displaced by technology, especially but not only in Sweden and other Scandinavian countries.³⁸ Job-securing new technology agreements, now fairly common in Europe, are not unknown to American unions, notably the UAW and now also the CWA; but Americans in general still have much to learn in this regard.

What a society chooses to do collectively, however, depends greatly on the theories it espouses as to what properly ought to be done and in what manner. But theories about welfare given public support in the United States do not extend to individuals the courtesies recently received by a now resurgent Chrysler Corporation. Economists, resigned to the demise of the balanced budget, debate whether there is such a thing as a Phillips curve to account for unemployment and on occasion wonder if perhaps technological revolution is a factor after all, as Kondratiev and Schumpeter after him maintained early in this century.³⁹ Nor are economists alone in the at least tacit realization that the challenge we now face surpassed the lore of their trade. As we contemplate the microelectronic transformation of patterns of work, we find comparatively little in our traditional values and institutions that will help us deal humanely with the pervasive unemployment that it will engender. And this is especially the case because of a belief attributed to the Judaeo-Christian tradition that there is a conditional relationship between the means of subsistence and work.

As noted in a wry Haitian proverb, "If work were a good thing, the rich would have found a way of keeping it to themselves." To the contrary, of course, the rich are considered exempt, almost by definition, from the requirement that one work in order to live. Others are often excused if they are in some way disabled, by virtue of age (either too young or too old) or physical condition. In the absence, however, of some socially acceptable excuse, one is led to believe that one's value as a person is a function of one's utility as a worker. This utility, as Marx so well perceived, is based primarily upon market conditions, but as mediated by complex intervening structures due to social and political considerations. In a socialist economy employment tends to be a given, even if absenteeism reduces the amount of work actually performed to a minimum. In a capitalist system, the basic determinant of employment, even in an orga-

nized plant, is the needs of the employer, as defined, for the most part, by the employer.

In Anglo-American law, the employer's prerogative in this regard is expressed in the time-honored doctrine of "employment at will," that is to say, that an employee has rights *qua* employee only so long as the employer sees fit to continue that relationship. The harsh reality of dismissal may on occasion be obviated in a unionized work environment through a grievance procedure the ostensible purpose of which is to assess the propriety of the grounds for dismissal. But the grievance mechanism is ordinarily activated only to determine whether one individual rather than another ought to be employed at a particular job. If the employer determines that there is not enough work to go around or enough money to pay for the work, layoffs are taken to be inevitable, with only the terms and conditions thereof subject to negotiation. And if the employer, say, a multinational corporation, determines that all the work done in a particular plant can be better (read: more cheaply) done elsewhere (*via* "outsourcing") or otherwise (*via* automation), then the entire local workforce will be terminated.

This management right of "employment at will" is subject to modifications in several ways, notably either by agreement between the parties or by governmental intervention. In some countries, such as Italy and Sweden, mass terminations simply are not tolerated. In others, labor-management agreements at various levels assure employees access to information relative to contemplated technology changes ("data agreements") and/or opportunity in one way or another to limit the effects on personnel of such changes ("new technology agreements"). These NTAs may involve any aspect of a new technology, from safety in its operation to planning how it should be designed and/or under what circumstances it should be implemented.

Unions in many European countries have negotiated agreements with employers at plant, industry or national level to limit the impact of new technology on the present workforce, albeit not on any successors thereof. A common concern commonly the subject of agreement is the health risk associated with use of visual display units (VDUs). In Norway and Sweden in particular, both statutes and negotiated agreements assure workers a significant voice in determining how computer-based technologies are to be introduced. Especially important to these programs are (1) the establishment of workers representation in the decision-making process and (2) a program to develop computer literacy among the rank and file with the cooperation of academics. Similar but less progres-

sive developments have taken place in West Germany and in the United Kingdom.

Building a checklist of issues published by the Trades Union Congress (TCU) in 1979, British unions have negotiated over one hundred NTAs, mainly at company level or below and mainly for the benefit of white collar (clerical and managerial) workers. About half of the West German workforce is now covered by collective agreements that give special protection in the event of rationalization, e.g., in chemicals, leather and footwear, paper, textiles, metalworking, and especially (a recent focus of controversy) printing. As a matter of fact, it was primarily due to the initiative of the metalworkers' union in West Germany (IG Metall) that that nation's watch-making industry was finally prodded out of its complacency to switch from mechanical to quartz technology.⁴⁰

By contrast, only a comparatively small segment of the workforce in North America has been able to protect itself against obsolescence in the face of microelectronics. Two exceptions, the blue-collar UAW and the more white-collar CWA, have been noted above. And Canadian workers, it should be mentioned, were among the first to recognize and attempt to deal with microelectronically created unemployment. That U.S. labor unions are comparatively lethargic in the face of microelectronics is ironic, since it is they who were most upset about the (premature) threat of automation in the 1960's. What unions are seeking to achieve collectively in Europe, individuals have been achieving in the United States through litigation. In courts in various jurisdictions managerial personnel who have lost their jobs are convincing (similarly situated?) juries that they have endured "unfair dismissal" or "abusive discharge." These verdicts have resulted in damage awards typically in the \$200-300 000 range; but they have gone as high as \$4 million. The complaints assert breach of express or implied contract (in the employee handbook), breach of implied covenant of good faith and fair dealing, and/or public policy (e.g., in the case of a "whistle blower").⁴¹

If such recognition of employee rights in the United States should ever be extended beyond the management level to the workforce as a whole, then public policy with regard to unemployment will have achieved something like equilibrium across both oceans. And, as a matter of fact, the agreement entered into between AT&T and the Communications Workers of America contains most, if not all, of the kinds of rights with regard to new technology which Europeans have been demanding for over a decade.

As noted above, however, these NTAs protect at best only the present

workforce of a company or industry. They do nothing directly for job-seekers in the future who, in many instances, will find employment only, if at all, in kinds of jobs that have not yet even been created. Whether there will ever be enough new jobs to go around or whether working will remain a condition for subsistence are questions still impossible to answer. But in spite of the social inertia attributable to and instilled by the traditional work ethic, the time has come to develop ways to distribute wealth more equitably, e.g., by means of a negative income tax. And this in turn suggests a need for the concerns of social philosophy to be brought to bear upon our philosophy of technology. For, what the Germans call "humanization of the workplace" cannot advance without some consensus about ethical priorities and how these ought to apply to a society being transformed by microelectronics. These priorities, in turn, might well be generated from the old but never more appropriate maxim: TO EACH ACCORDING TO NEED; FROM EACH ACCORDING TO ABILITY.

AUTHOR: Edmund F. Byrne (born 1933) has advanced degrees in philosophy and in law. He is Professor of Philosophy at Indiana University – Purdue University in Indianapolis, and a member of the Indiana Bar. He has published a number of articles on the relation between law and technology, the humanization of technology, and is finishing a book on technology and work.

NOTES

- 1 See Clive Jenkins and Barrie Sherman, *The Leisure Shock* (London: Eyre Methuen, 1981). See also Josef Wolkowski, "The Philosophy of Work as an Area of Christian-Marxist Dialogue," *Dialectics and Humanism*, vol. 5 (Winter 1978), 113–122.
- 2 Clive Jenkins and Barrie Sherman, *The Collapse of Work* (London: Eyre Methuen, 1979). See, however, J. L. Missika *et al.*, *Informatisation et Emploi: Menace ou Mutation?* (Paris: La Documentation Française, 1981), pp. 73–74.
- 3 Guenter Friedrichs and Adam Schaff (eds.), *Microelectronics and Society: A Report to the Club of Rome* (New York: NAL Mentor, 1983), pp. 115–202; Christopher Evans, *The Micro Millennium* (New York: Washington Square, 1979), pp. 121–145; Tom Stonier, *The Wealth of Information* (London: Thames Methuen, 1983), pp. 99–122.
- 4 European Trade Union Institute (ETUI), *Negotiating Technological Change* (Brussels: 1982), pp. 8–11, 16. See also Ian Benson and John Lloyd, *New Technology and Industrial Change* (London: Kegan Paul, 1983), pp. 39–43.
- 5 Paul Stoneman, *Technological Diffusion and the Computer Revolution* (London: Cambridge University Press, 1976), p. 177.
- 6 ETUI, *op. cit.*, pp. 12–18. Regarding impact on women, see Ursula Huws, *Your Job in the Eighties: A Woman's Guide to New Technology* (London: Pluto Press, 1982).

- 7 ETUI, *op. cit.*, p. 20. The terms 'skilled' and 'non-skilled' translate into American usage the author's terms, 'qualified' and 'non-qualified.'
- 8 *Ibid.*, p. 33. A comprehensive analysis of this process, from a Marxist perspective, is that by Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York and London: Monthly Review Press, 1974). See also Benson and Lloyd, *op. cit.*, pp. 31-47.
- 9 ETUI, *op. cit.*, pp. 8-10.
- 10 Jasia Reichardt, *Robots: Fact, Fiction and Prediction* (New York: Penguin, 1978), p. 141; Wayne Chen, *The Year of the Robot* (Beaverton, Or: Dilithium Press, 1981), pp. 9-24.
- 11 D. Smith "The Robots (Beep, Click) Are Coming," *Pan Am Clipper* (April 1981), p. 33; E. Janicki, "Is There a Robot in Your Future?", *The Indianapolis Star Magazine* (Nov. 22, 1981), p. 55.
- 12 "Russian Robots Run to Catch Up," *Business Week* (Aug. 17, 1981), p. 120.
- 13 *Ibid.*
- 14 "The Push for Dominance in Robotics Gains Momentum," *Business Week* (Dec. 14, 1981), pp. 14, 108. See also *Business Week* (April 5, 1982), p. 40; (June 27, 1983), p. 40.
- 15 Smith, *op. cit.*
- 16 Reichardt, *op. cit.*, p. 140.
- 17 "Racing to Breed the Next Generation," *Business Week* (June 9, 1980), pp. 73 and 76.
- 18 "How Robots are Cutting Costs for GE," *Business Week* (June 9, 1980), p. 68. See also "General Electric: The Financial Wizards Switch Back to Technology," *Business Week* (March 16, 1981), pp. 112-3.
- 19 "Robots Join the Labor Force," *Business Week* (June 9, 1980), pp. 62 and 64; "GE is About to Take a Big Step in Robotics," *Business Week* (March 8, 1982), pp. 31-32.
- 20 "GM's Ambitious Plans to Employ Robots," *Business Week* (March 16, 1981), p. 31.
- 21 "Racing to Breed the Next Generation," *op. cit.*, p. 76.
- 22 "The Push for Dominance in Robotics Gains Momentum," *Business Week* (Dec. 14, 1981), p. 108.
- 23 "The Speedup in Automation," *Business Week* (August 3, 1981), p. 61. See also Paul Kinnucan, "Flexible Systems Invade the Factory," *High Technology* (July, 1983), pp. 31-37, 40-42.
- 24 "High Technology: Wave of the Future or a Market Flash in the Pan?," *Business Week* (Nov. 10, 1980), p. 96: chart. "The Coming Impact of Microelectronics."
- 25 "The Speedup in Automation," *op. cit.*, pp. 58-59. See, however, "Robots Bump into a Glutted Market," *Business Week* (April 4, 1983), p. 45.
- 26 "Robots Join the Labor Force," *op. cit.*, pp. 62-63, 65.
- 27 See Kuni Sadamoto (ed.), *Robots in the Japanese Economy* (Tokyo: Survey Japan, 1981); "Japan: The Robot Invasion Begins to Worry Labor," *Business Week* (March 29, 1982), p. 46.
- 28 *International Metalworkers Federation News* (May, 1983).
- 29 "A Changing Work Force Poses Challenges," *Business Week*, Special Issue: Japan's Strategy for the 80's (Dec. 14, 1981), pp. 116-118.
- 30 "Automation is Hitting a Low-Wage Bastion," *Business Week* (March 15, 1982), pp. 38-39. See also *ibid.* (Dec. 14, 1981), p. 40; Juan F. Rada, "A Third World Perspective," in *Microelectronics and Society*, *op. cit.*, pp. 203-231; Ira C. Magaziner and Robert B. Reich, *Minding America's Business* (New York: Vintage, 1983), pp. 99-101.

- 31 "The Speedup in Automation," *Business Week* (Aug. 3, 1981), pp. 62-67; "Technology Challenges Postal Union," *In These Times* (Aug. 17-23, 1977), p. 8.
- 32 Simon Nora and Alain Minc, *L'Informatisation de la société*. Rapport a M. le President de la Republique (Paris: La Documentation Française, 1978). English edition. *The Computerization of Society* (Cambridge, MA: MIT Press, 1980).
- 33 See Tom Forester (ed.), *The Microelectronics Revolution* (Oxford: Basil Blackwell, 1980), pp. 159-160, 192-195, 383.
- 34 "Industrial Uses of the Microprocessor," in Forester, *op. cit.*, p. 144. Originally published in *Science* (18 March 1977).
- 35 Janicki, *op. cit.*, pp. 54-55.
- 36 Information based on an unpublished study by graduate students at Carnegie-Mellon University entitled "The Impacts of Robotics on the Workforce and Workplace," Pittsburg, PA., June 14, 1981.
- 37 A particularly pointed example involves the manufacture of machine tools. See ETUI, *op. cit.*, p. 13.
- 38 See Roger Kaufman, "Why the U.S. Unemployment Rate is So High," in M. J. Piore (ed.), *Unemployment and Inflation* (White Plains, NY: M. E. Sharpe, 1979), p. 160; Magaziner and Reich, *op. cit.*, pp. 12-18, 143-154; 211-214, 271-276, 333-334.
- 39 See Benson and Lloyd, *op. cit.*, pp. 49-55; David Wheeler, "Is There a Phillips Curve?" in *Unemployment and Inflation*, *op. cit.*, pp. 46-57.
- 40 ETUI, *op. cit.*, pp. 50-51. For historical background to this development, see Benson and Lloyd, *op. cit.*
- 41 "It's Getting Harder to Make a Firing Stick," *Business Week* (June 27, 1983), pp. 104-105; "Fire Me? I'll Sue!" *American Bar Assoc. J.* 69 (June 1983), 719. Compare Paul O'Higgins, *Worker's Rights* (London: Arrow Books, 1976), pp. 62-72; Jeremy McMullen, *Rights at Work: A Worker's Guide to Employment Law*, 2nd edition, with supplement (London: Pluto Press, 1979), pp. 144-184; *Cessation de la Relation de Travail a l'Initiative de l'Employeur* (Geneva: Bureau International du Travail, 1980).