Fred Emery

Socio-Technical Foundations for a New Social Order? (1)

The myth of the machine and the cult of divine kingship rose together.
Lewis Mumford, *The Myth of the Machine*.

There are reasons to believe that the world economy is once again in the throes of a phase change. There are also reasons to believe that this phase change, like the preceding ones, will involve a paradigmatic shift in the organization of people around their work. If this is so, then our perceptions of what has happened in the past decade or more in the world of work may need to be modified; likewise our perceptions of where those changes are leading us.

I do not wish to dwell on the first proposition but will have to comment on it in order to give sufficient reason for us to take seriously the second proposition about the paradigmatic shift.

It was only in early 1978 that I was alerted to the possibility that the Kondratiev (1935) hypothesis (2) might have to be taken seriously. Since G. Garry's critique in 1943, 1 had regarded that hypothesis as "unproven." Since about 1950 1 had fully accepted the economists' claim that Keynes had advanced their science to the point that only governmental mismanagement could precipitate another depression, and that the Bretton Woods Agreements would enable any such outbreak to be confined to the mismanaged nation.

It has not been difficult to establish that Garry was wrong. Kondratiev's historical statistical series were certainly incomplete and inconclusive, but the trends he detected were fully validated by our analysis of the comprehensive series of historical statistics that were now available (Banks and Textor, 1971; Mitchell, 1975). Blainey's (1970; 1973) and Singer and Small's (1972) historical studies of gold discoveries and of wars had disposed of Garry's argument that "even if the K-cycles of activity/depression in the world economy did occur they were explained in terms of the exogenous factors of gold discoveries

(1) Revised slightly from the original in Human Relations, 35:1095-1122, 1982. The second part will be incorporated in a wider paper on educational paradigms in Volume 111.

(2) Kondratiev suggested that economic depressions occurred in capitalistic economies on a cycle of approximately 50 years.

and wars; hence they did not indicate any inherent and predictably recurrent instability in the world economic system." Garry seized on one further weakness in Kondratiev's Position, namely that he had not suggested a dynamic that might explain how the international system could generate such serious instabilities at approximately 50-year intervals. So long as this elaboration was absent, the Kondratiev hypothesis had doubtful scientific status; one did not know whether it belonged to meteorology, economics or psycho-cultural cycles.

The Massachusetts Institute of Technology computer simulation of a national economy has resolved this last problem in Kondratiev's favor (Forrester, 1976). Our national economies run in a way that generates the K-cycles. I might note in passing that the centrally planned economies have the same fundamental difficulty in correlating the production of consumer and producer goods. On the historical facts, the political revolution of 1917 did nothing to protect the Union of Soviet Socialist Republics from the 1930s depression and is doing nothing for the Soviet Bloc members now.

Granted the scientific status of the Kondratiev hypothesis, there is still the Practical question. Is the depression now on us; is this just another business cycle with the depression likely in the late ig8os; or is Walt Rostow (1978) right in his amazing suggestion that we went into the depression in late 1972 and are now on another long upswing? The facts only permit one of the first two answers. There could be some sort of brief recovery as in 1976-79, but that is unlikely to restore the so-called propensity to invest or effective demand.

I have come this far along this line of discussion because I think there is a relation between these developments and the seriousness with which em-Ployers pursue the quality of working life (QWL). I will go further to suggest that in periods of growth employers will toy with QWL in order to accommodate to cultural changes and will temporarily suspend such games during a downturn in the business cycle. However, in struggling to get out of a prolonged depression they will not be just playing. Let me now go back to the second proposition presented in my opening remarks-that these depressions are phase changes in the world system involving the ruling paradigm of work.

I concluded in 1979 that the Kondratiev hypothesis had to be taken seriously (for the reasons given above). It seemed obvious that each of the depression periods, the 1830-40s, 1880-90s, the later 1920S and the 1930s, should be studied for clues as to the nature and effects of this class of system crises. No national statistical series were available to me that would pinpoint the economic crisis of around 1790, and hence that critical period in modem history was left as a relatively shadowy thing compared to the interpretation of the other periods. (Phyllis Deane, in the second 119781 edition of her *The First*

Industrial Revolution, has presented statistical evidence that Britain suffered a deep economic depression in the 1780s and also in the 1740s [pp. 109-11, particularly **Figure l**].)

Certain common features stand out. The emergence of the world economy (circa 1780) and its regular breakdown at long intervals introduced a new element into social life. Prosperity, change and continual improvement in the conditions of life came to be seen as the normal way of things. After a generation and more of this, the proof of the social system does indeed appear to be in the eating.

The onset of a great depression is inevitably seen against such an historical background of progress. The social system that has come to be taken for granted by the general populace itself becomes the object of attention and questioning as people's expectations are dashed. The questioning is all the more critical because the economic setback does not at all seem like the result of crop failures, or the hand of God. What a depression challenges is not just a mass of individual expectations but a socially dominant worldview that has given sanction to many of the central institutions of the society and to their relations of mutual support or condescension.

It is this that makes every great depression a *potential* producer of social evolution. Close study of modem revolutions has led scholars to the same conclusion.

> Revolutions are most likely to occur when a prolonged period of objective economic and social development is followed by a short period of sharp reversal. The all-important effect on the minds of people in a particular society is to produce, during the former period, an expectation of a continued ability to satisfy needs which continue to rise-and during the latter, a mental state of anxiety and frustration when manifest reality breaks away from anticipated reality. The actual state of socio-economic development is less significant than the expectation that past progress, now blocked, can and must continue in the future..... The crucial factor is the vague or specific fear that ground gained over a long period of time will be quickly lost. (Davies, 1962: 6-7)

Before the emergence of the world economy the persistence of poverty and the frequent recurrence of starvation due to crop failures and wars did not bring about social revolution. At most, the sporadic uprisings confirmed that there was no alternative to the existing order but disorder, pillaging and brigandage. At best, the hope was for some justice within the traditional order, not a reordering that might free people from their traditional roles.

The social instability induced by the long waves in the world economy can be observed in each of the great depressions. The potential for social revolution is, however, as much manifested by counterrevolution as by revolutionary

action. The potential is far more widely manifested in the ferment of revolutionary ideas that appears to affect all areas of human endeavor in these periods and have passionate sway over the masses of people, not just the intelligentsia whose business it is to trade in ideas.

The ideas that come to have such a sway on popular thinking do not usually emerge in the period of economic crisis itself. Typically, they have gained intellectual currency in the period of economic slowdown before the depression. This makes it easier to discern which of the many ideas in this preceding period of intellectual (not social) ferment are likely to take hold. Similarly, the institutional changes that are closely tied to these new ideas are as likely to appear in the last days before the economic depression as in the period of depression itself. So in this respect also there should be some clues.

Some implications seem clear from the past history of depression periods. Thus we would expect that the onset of a great depression in the 1980s would hange the tempo and direction of the trends observed in the 1950s and 1960s:

- greater tension in the work force and in industrial relations;
- predatory behavior among corporations (corporate cannibalism);
- shrinkage of governmental budgets;
- renewed social polarization of haves and have-nots;
- popular challenge to the prevailing institutional myths about governance, the economy, religion, education, family and human ideals;
- a reversal of the movement to liberalize trade between nations (increasing autarchy).

Each *recovery* from economic depression also had certain common economic and technical features. Each time, recovery has been marked by:

- the adoption, on a large scale, of new technologies that created new markets and greatly enhanced investment possibilities (Schumpeter, 1939);
- the adoption of new forms of distribution to serve wider and more scattered markets;
- the emergence of new forms of energy that were cheaper, simpler to exploit and more flexible (from water power to coal, to electricity, to oil, to gas);
- a step-wise expansion of use of sources of raw materials and labor (for example, the opening of the prairies and tropical plantations and the great waves of internal and international migration);
- emergence of new forms of business organization (Aglietta, 1979).

It was some time before I realized that there was in all of this a critical integrating factor. It was apparently not enough for new investments and new corporate forms to bring together new technologies, new forms of energy and new supplies of labor. New forms of labor organization appeared. Nor apparently was it enough for each management and plant to find its own best solution. At each crisis a generalized solution appears to have emerged. Each time it was as if a new generation of labor was being subjected to a new form of

industrial discipline.

Let us examine those statements.

From Subjective to Objective Division of Labor

The first phase of industrialization did not emerge on the back of any particular technological revolution and certainly not on the back of the steam engine. Von Tunzelbaum (1978) has amply documented the fact that the steam engine and steam driven machines only became a significant factor in the textile industry of Britain in the recovery from the depression of the 1830s and 1840s.

The industrial system emerged on the basis of the "factory system," a form of work organization, *not* a new technology. At the heart of the factory system were the following features:

- the centralization of workplaces "under a single roof"----the physical definition of a factory;
- the fencing in of the factory and imposition of control over access or departure at the factory gate;
- the imposition of a strict working day and working week;
- the allocation, where possible, of work stations with fixed locations;
- a detailed division of labor that enhanced the role of semiskilled workers at the expense of the multiskilled craftsmen;
- the creation of a class of unskilled labor to enable the semiskilled operatives to devote themselves to their allotted tasks and provide a reserve force against daily fluctuations in attendance. In the cottage craft system only those in formal or informal apprenticeship were unskilled;
- the creation of a class of workers whose established and exclusive function is the supervision of the work of others-foremen.

Within the factories no one person produces a marketable product; he or she contributes to just a part or facet of the product. This focusing on details does not equip the workers to enter commodity markets as private producers. None of these essential features of the early system of manufacturing rests on the introduction of more efficient technologies, although hand tools went through a very rapid evolution to meet the requirements of specialized detail laborers.

The governing principle of the system of manufacture was the *subjective division of labor* within a master/servant relation. It contrasted markedly with the putting-out system. The putting-out system was still basically a free market in which cottage craftsmen negotiated the value they added to the merchants' material through the equipment and labor they had at their own disposal. It was a relation of symmetrical dependence, not the asymmetrical dependence of a

master/servant relation. The efficiency of cottage-based production rested on the flexibility of multiskilling, not on division of labor.

With the wisdom of hindsight we can see that the economic viability of the early system of manufacturing did not arise from greater productive efficiency. It certainly increased the rate of circulation of the merchants' capital and reduced transport costs, but it did not get more output from the same labor inputs. It was more *effective* in getting more work out of people, however, and hence more production. It was able to do this because, for the relatively free market of the putting-out system, it was possible to substitute the very unfree labor market of that era. That labor market was unorganized, except for the minority of key craftsmen and their apprentices.

It was also a market in which there were no customs, norms and traditions such as gave the servant some rights in the more personalized asymmetrical dependency of feudalism, and no legislative controls other than the existing criminal and property laws. The cottage craftsmen were under the constraints of community and kin to maintain some standards of civilized existence. The manufacturers were under no such constraint (Marcus, 1974). It is little wonder that the cottage craftsmen, for the most part, preferred slowly to starve to death rather than submit themselves or their family members to the tyranny and indignity of factory employment. It is little wonder either that they attributed their difficulties, first and foremost, to unfair competition arising from the unfree labor market of dispossessed people. Despite the myth that has arisen, the prime object of the Luddite movement was undercutting the manufacturer not the newfangled machines. Breaking up the machines had much the same significance as the traditional burning of the wicked landowners' hay ricks---striking at the hip-pocket nerve. In the first instance the manufacturer's capital was rendered unproductive until the machines were replaced, a lengthy process in those days, and in the latter instance the landowner was disabled from carrying stock through the winter.

Andrew Ure, who was writing at a time much closer to those events, was in no two minds about what was the central integrating feature of emergent industrialism. We remember Richard Arkwright as the inventor of the spinning frame. Maybe he just stole the idea for his invention as he subsequently stole so many other ideas, but Ure could see that

> The main difficulty....lay....above all in training human beings to renounce their desultory habits of work, and to identify themselves with the unvarying regularity of the complex automation. To devise and administer a successful code of factory discipline, suited to the necessities of factory diligence, was the Herculean endeavour and achievement of Arkwright! Even at the present day.... it is found nearly impossible to convert persons past the age of puberty into useful factory hands. (quoted by Marx, 1906, vol.1, p.463)

The principles of factory discipline had to be learned again when the Lowells founded the textile industry of New England (Kasson, 1977).

I have dwelt on this first phase of industrialism because it so clearly illustrates the central integrating role of principles of work organization. The early factory system of organization made it possible to adopt and successfully exploit existing inventions such as Arkwright's spinning frame and the overshot water wheel, inventions that quite likely would not have found a role in the putting-out system. Contrary to Schumpeter's thesis (1939), the factory system did not emerge just because those technologies existed.

We can see also that this first phase provided a fertile seedbed for the technological developments that were to be so eagerly seized upon in the next phase, *after* a needed principle of work organization had appeared.

The transition to the second phase of industrialism is important to our understanding of industrialism. It is important because we have tended to fuse the first and second phases and to see the factory system as the natural consequence of the invention of steam-driven machinery. The machinery available at the emergence of the second phase offered a great increase in efficiency, provided it could be powered by steam and located near sources of coal. This combination would have to provide an irresistible reason for centralizing labor in factories; this at least is such a rational explanation that we assume that it is what happened. Such is our myth of the birth of industrialism; and it remains a potent and persistent source of distortion in our attempts to understand what is happening in industry today. We even persist in using the term "manufacturing" when it properly relates only to the first phase before the emergence of "machinofacture."

The second phase emerges with the acceptance of an organizing principle that underlies all succeeding phases, at least until now. This is what Marx called the objective division of labor. The factory adopted machines to further reduce dependence on the small but critical group of craftsmen and to achieve the efficiencies that steam-powered machinery was beginning to demonstrate. With this development it no longer made sense to allocate people to work with those tools and tasks for which they were subjectively best fitted. People had to be allocated to whatever tasks were needed to keep the machines producing. These tasks were dictated by the design of the particular machines, but general classes of jobs emerged: for example, the attendants who watched the machines for signs of malfunctioning, the feeders and off-loaders, the sweepers, the oilers and greasers, the maintenance mechanics, the millwrights, the boilermen, the shifters and the storemen.

This process constitutes a very significant step in the regression of the product. Under subjective division of labor the product moves out of reach of

its producer to a commodity market that cannot be entered as a producer-seller. However, the detail taborer still contributes something of the product itself, even if it is only stitching a collar to a shirt. With machinofacture the operator is simply feeding and maintaining the beast: the beast takes the raw materials and makes the product. This is a figure/ground reversal. In manufacture the worker dictated what the tools did and apparently contributed greatly to the design and evolution of those tools. In machinofacture the machine dictated what the worker did, and factory workers contributed very little to machine design.

In reviewing this transition it might appear that, although we had misjudged the nature of the first phase of industrialism, here at last were the real beginnings of industrial society. At least, we might argue, from about the 1840s technology came into dominance and began to dictate the pace of growth and the forms of industrial organization. Certainly the growth of industrial civilization between the world economic crisis of the 1830s and 1840s and the next great crisis of the 1880s and early 1890s was like nothing that could be recalled. The great industrial exhibitions of London and Paris in the 1850s were paeans of praise for the revolution wrought by the dominance of technology in the first age of machinofacture. Haeckel and many many others were preaching a new religion scientific materialism. God was irrelevant and the day of doom put off forever as the marriage of science, technology and industry guaranteed a prospect of boundless progress. Looking back, it is easy to understand and forgive this short-sighted ebullience.

Of more significance for understanding how that second phase of industrialism continues to color our present thinking is the fact that two such incompatible social philosophers as Max Weber and Frederick Engels arrived at this same conclusion, despite the "great depression" of the 1880s and early i 89os. Max Weber foresaw the bureaucratization of all walks of society, because this was the rational and predictable way of achieving efficiency in the allocation of resources to create reward. As Frederick Engels put it more eloquently, in terms that read like the Old Testament,

> If man by dint of his knowledge and inventive genius, has subdued the forces of nature, the latter avenge themselves upon him by subjecting him insofar as he employs them, to a veritable despotism independent of all social organization. (1894)

It was Lewis Mumford (1967) who so succinctly labeled this as the "myth of the machine." He thus identified a prime case of misplaced concreteness.

Machinofacture emerged from the womb of manufacturing. Machines were being designed for the factory market, not for the poverty stricken and nearly defunct cottage industries. Industry was dividing into the now traditional departments of producer goods and consumer goods, and the "foolproof" machine was coming into its own. The point is this: insofar as technology after

the 1840s appeared to set the pace for economic growth and to dictate the forms of industrial organization, it did so on the basis of the assumptions already established within the system of manufacturing. It completed the process of getting the craftsman out of the direct processes of production (not, however, out of the tool room and boiler room or out of maintenance).

Now let us stand back from the details of the first and second phases of industrialism.

A New Paradigm of Work

Taking a broader historical perspective, we notice that these earlier phases were of only academic interest so long as we, in the 1970s and 198s, thought that we were now confronted with the emergence of just another phase in the series. When it appeared that we might possibly be confronted with a system change, not just a phase change, a reconsideration of these early periods became imperative. Such reconsideration became imperative because it was necessary to identify the principles governing the whole system of industrialism through all of its phases, not just the specific principles governing the phase we are in and the phase from which it immediately arose.

In Futures We Are In (Emery, 1976), 1 thought it sufficient to tackle the latter task. I tried to spell out the paradigm of scientific management that Frederick Taylor devised to lead the way out of the economic crisis of the 1880s and 1890s. I also tried to spell out the paradigm of the assembly line, the paradigm that has dominated the post-1930s depression phase. I do not think it is difficult to deduce from that book what I thought would happen next in industrial organization. I clearly believed that a new paradigm of work was emerging and hence at least a new phase of industrialism. I do not think that I rated the change higher than that. My expectation was that the general adoption of the principle of "self-managing production groups" (semi-autonomous groups) would domesticate industrialism and promote changes in nonwork areas.

Within the new paradigm the foreman and the unskilled laborer would start to disappear, and the worker would gain the dignity of deciding what was to be done and what was meaningful work. At the same time, the product was tending to recede further as computer tape-instructed machines, microprocessors, diagnosed faults and physical sensors replaced human attendants. Self-managing groups and quality control circles reverse this tendency. As groups they can map a production line and identify something that is *their* product.

Kumar (1978) and Aglietta (1979) have confirmed what Marx and, 130 years later, von Tunzelbaum had asserted. Recovery from the deep crises of industrialism has always depended upon the emergence of a more effective

*socia*l form for eliciting productivity. No technology was sufficient in itself to create such a growth in productivity. At this point in time, we have to consider whether the new paradigm of work is just a reaction to the increase in automation of productive activities. Certainly, we find once again that the leadership in adopting the new paradigm of work comes from those that stand to gain most from the new technologies. But, yet once again, the widespread adoption of the technologies follows from and does not precede and determine the organization Of work. It is within the context of self-managing work groups and quality control circles that major corporations are seeking the adoption of new technol-Ogy (*Business Week*, May 11i, 1981). In such a context a technological change is significantly less threatening to workers (Emery and Thorsrud, 1976).

I think I have been wrong in thinking that all that will happen this time will be a replay of Schumpeter's scenario-a massive shift of capital into a new branch of industry. If that were so, then it would be easy to identify the microprocessor as the steam engine of the next phase of growth (Emery, 1978). Aglietta's arguments (1979:385-86) have convinced me that the critical growth must come from achieving greatly increased productivity in the infrastructure areas of health, education and welfare. This growth will come from opening these fields to private enterprise, as is implicit in the welfare scheme of guaranteed minimum incomes, and the widespread replacement of those bureaucracies by democratization of the workplace in hospitals, schools, prisons and the like. In this setting consumerism will sprout new wings.

The first four paradigms of work can each be identified as members of a series. They all presuppose asymmetrical dependence and the correlative sanctity of managerial prerogatives. The generative principle of the series was that of maximizing the proportion of the working day that each worker actually spent on working. With the assembly line, the last excuse for taking a bit of a break from the job was eliminated; there was no longer any excuse for walking away to pick up something. Note, however, that the currently emerging paradigm is a break with that series. it presupposes relations that are more nearly those of symmetrical dependence as the production goals and membership of the self-managing groups become the subject of negotiation and the concept of managerial prerogatives becomes secularized. The generative principle is no longer that of extracting a high proportion of labor time from the working day. Efficiency of production is the generative principle for both work groups and managers. In this context individual workers regain some time of their own during the shift and an ability to pursue some purposes of their own. It is not quite as good as getting time off for golf, but it is a reversal of a 200-year trend that ended only with Lordstown in 1972.

This new paradigm does not fit into the historical series that I have outlined. It would have to constitute a system change, not just a phase change within the old system. A system change in the nature of the wage relation could not stop

short of a massive change in the social infrastructure creating the next generations of workers.

Emerging Characteristics of a New Social Order

With each of the phase changes in the socio-technical basis of industrial civilization we have seen something of the massive changes required in the associated social infrastructure. It has taken the wide-sweeping minds of people like Siegfried Giedion (1948), Lewis Mumford (1967), R.J. Forbes (1971) and Carlo Cipolla (1962) to reveal this to us. Because of the work of such people we have some sense of the great waves of migration, urbanism, secular education, artistic innovation, scientific discovery and so forth that have periodically convulsed industrial society. Now that we seem to be confronted with a system change and not just a phase change we must be prepared to confront even more radical convulsions.

There are any number of threads that one might pick up to trace out how our social infrastructure might evolve. I have chosen to pursue the educational thread. Education is the factor that became dominant in the motif woven by the last phase of industrialism and, in these last years of crisis, it has become the "whipping boy" for the collapse of personal and social expectations.

If this is the beginning of the end of the master/servant relationship, then what do we do with a system that has, since compulsory, secular education emerged in the 1880s and 1890s, educated young people to serve in the master/servant relationship? If industry and its administrative systems have had to move toward a self-governing paradigm of symmetrical dependence rather than asymmetrical dependence, then for whom are the educational institutions producing the old product? Producing people for mature industries and civil services locked into the backwaters of tradition must fail and cause dependent clients similarly to fail. Those industries are, of course, extremely vociferous in defense of their conservatism. Typically, they are the industries that find most comfort in avoiding change and are most able to get tariff protection by joining employers' federations, chambers of commerce and the like. It is second nature to them to get governments to provide them with what they need-including the kind of employees they need. The big powerful corporations in the science-based industries do not typically work through these bodies. They are, however, the pacesetters in employee practices. They are the ones the educationists must watch. The modem trend in education toward producing more independent and emotionally mature students would seem to be in keeping with the advanced personnel practices of the modem corporations.

At the same time the greater emphasis on education on the job calls into

question the massive investment we have made in higher education. The excessive division of labor that justified the mass production of experts has had its day. The higher degree will have about the same relevance to economic recovery as the V-8 car engine.

On the basis of the matters I have discussed, I cannot see how we can recover to take up the economic growth path we were on in the i 96os, nor can I see any hope of reestablishing autocracy as the norm of employment. If recovery is not likely to conform to tradition, if we must think along new lines, then we must try to see what are the most probable strands that will interweave to give us some sort of new system.

The major reason for the system change is a shift in values in the community profound enough to be referred to as a cultural revolution, rather than any shortage of resources. This effect has spread into the workplace and makes it impossible to recover productivity in the way that we did before. We cannot get the productivity out of our workers or managers in the traditional manner, not even with microprocessing. I have identified what I think are five salient strands for the making of a new system, four of which would be on anyone's collection of starters. They are arranged in Figure i in an order that depicts the extremes: the pressure for a low energy, high equity society on the one side and, on the other, the pressure for a high technology society.

I am not alone in thinking a low energy, more equitable society to be a very probable future for Australia. In 1978 the Sentry Insurance Company commissioned Roger and Merrelyn Layton, of the University of New South Wales, to do a survey of the Australian work force. In that survey, alternative scenarios of the future were put to people, asking them which they thought was most probable and which they thought most desirable. About one third of the sample of Australian workers, trade union leaders, managers and public administrators, when asked about the most probable futures, replied that they could not see past a continuing depression scenario. Of the two thirds who could see past a depression scenario, half saw a normal recovery to a 1960 type society of high energy usage and inevitable social inequity (although few thought it "most desirable"). The other half, however, reckoned that the most probable future was "small is beautiful"---"low energy" and "social equity". I was very surprised at this finding because I thought that this scenario would be known only to college educated people and middle-class trendies. The mass media in Australia had given this scenario no serious attention, so we have to assume that people had worked it out for themselves.

One can, of course, ask one question beyond that: even if people think that the small-is-beautiful scenario is the most probable future, do they understand enough about the way the economy works? Are they being realistic? One answer was given by a group in Argentina who modeled the major regions of

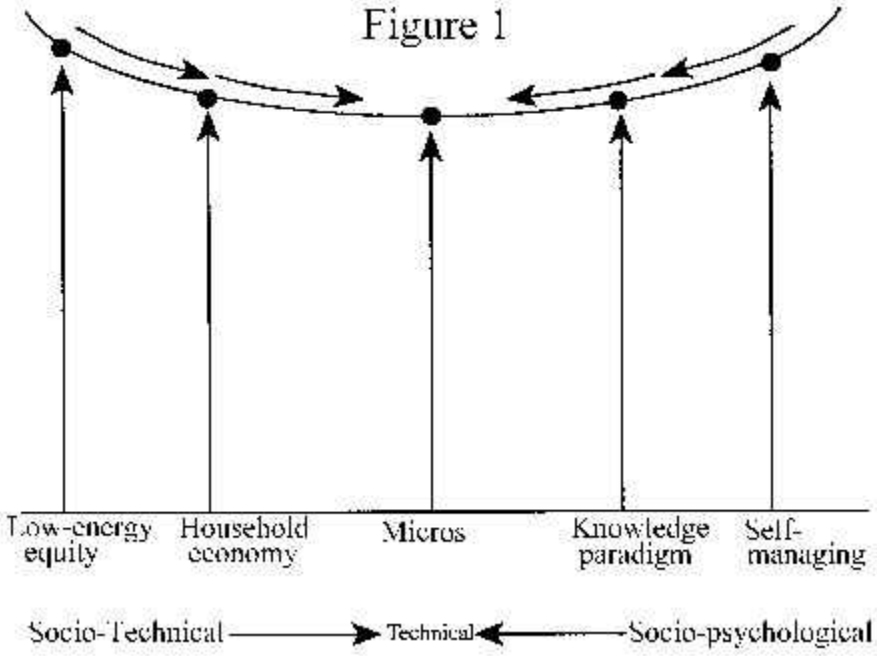

Figure 1. The clustering of emerging strands

the world economy in order to see what changes would have to take place to enable South America, Central America, South East Asia, India and Australasia to provide for the basic needs of their people in the year 2000 (Herrara, 1976). When they modeled these economies they tested the implications of two different optimization criteria. One was the classical capitalist system, where resources are allocated so as to maximize growth in the Gross Domestic Product (GDP). The other criterion was the allocation of resources so as to maximize the average life span of the population. They inferred, for a number of reasons, that optimizing to increase the average life span of a population was the best way to ensure movement toward a more equitable society. The first criterion corresponds to the Laytons' high energy, social inequity scenario and the second to their low energy, social equity scenario.

The Argentinian study then posed the question as to what growth rates would be needed under these different conditions to eliminate poverty by the year 2000. By their figures, Australia would need an average growth rate of 15 percent per annum, to achieve this goal if resources were allocated in the usual fashion. The Australian economy has never sustained anything like this rate of growth for any past stretch of 20 years. I have already noted that even a 3 percent growth rate has had to be discarded as over optimistic (Emery, I 978). We must also note that nowhere in sight are the energy resources that would be needed to fuel such growth rates. By comparison, this target of no poverty in

the year 2000 would be achieved by an average 2 percent growth rate if resources were allocated on the criteria of maximizing average life span. Put that way, the low energy, high equity scenario does not seem nearly as unrealistic as attempting to recover along the 1960s path of high energy, low equity.

I can keep my comments brief on two of the threads presented in Figure 1. The microprocessor revolution has been widely discussed, and we are beginning to realize that it is not just another technological step forward in the long series from water-powered looms and steam-driven hammers. In conjunction with electronic sensors and "chip memories," the microprocessor will inevitably revolutionize the interface between workers and machines, people and knowledge. The vast hordes of workers pouring in and out of mass-assembly plants, department stores and huge office blocks will become a thing of the past. Equally, the long, lifetime commitment to a job will also disappear. We have adjusted to this sort of problem in the past by formally recognizing all sorts of claims on the national wealth other than that of engaging in paid employment (for example, pensions, scholarships, fellowships, long service leave.)

Gershuny (1978) and Scott Bums (1975) have pointed to a related phenomenon: the rapid growth of various forms of self-employment and pursuit of ways of reducing dependence on salaried wages. The evidence they have adduced suggests that this is no passing fad. It is a trend, furthermore, that should be considerably strengthened by the spread of the microprocessors into household equipment. As with Singers' new sewing machine, the microprocessor overcomes skill barriers that previously gave home-produced products a bad name.

Just as I have suggested that the human energy crisis has been more critical for industry than the fuel crisis, so now I am going a step further to suggest that *the knowledge revolution may consist in the release of human capabilities rather than in microprocessors, optic fibers and satellites.*

Surpassing the Traditional Barrier Between Intellectual and Manual Labor

The massive growth of higher education and science-based technologies has served only to reinforce the historical antithesis between intellectual and manual labor. In a seminal monograph, Alfred Sohn-Rethel (1978) has spelled out in detail how profound and persistent is that antithesis. It emerged with Plato's philosophy, Euclid's geometry and Aristotle's formal logic. These unique, unprecedented and unparalleled concatenations of intellectual explosions all took place in the fourth century B.C. and, to all intents and purposes, rose in one tiny geographical spot, the grove of Academus, one mile northwest of Athens. It is said that when Plato opened his think tank there in 387 B.C., he

inscribed over the entrance, "Let no man ignorant of geometry enter here." In that one brief historical moment, intellectual labor proved that it could create a product incommensurably superior to any product of manual labor or the senses. They had produced truths that were timeless and universal. No such intellectual explosion occurred in any other culture, and nothing like it was to be seen until the seventeenth century in Europe. In that century the potential uniqueness of the product of intellectual labor was reasserted in the theoretical inventions of Galileo and Newton and Cartesian geometry. The precarious claims that the Aristotelians had for producing a unique and superior intellectual product by logical induction from the observed facts were gradually surpassed by the claims of science. After Einstein there was no doubt about what were the strongest grounds for defending the claim of the uniqueness of the product of intellectual labor. Those grounds were in science, not in law and theology.

If we are going to gain an understanding of the antithesis between intellectual and manual labor then we have to understand the nature of intellectual labor. No one, I suggest, is going to understand the nature of intellectual labor until they grasp what was done by Euclid, Galileo, Newton and Einstein. Nor will they understand the sacrifices that modem societies will undergo while they wait for another such genius. All the rest-the technicians, technologists and scientists-are but the army of ants who labor in vain if the queen ant does not turn up. The unique intellectual product cannot be produced by educating people in the sciences or any other body of scholarly knowledge. The facts are against any such idea. In each of the cases mentioned above there was a step forward in timeless, universal theory. Each step forward was a great step toward the understanding and control of natural forces. Each step was also a miracle. They were miracles because there was no apparent way in which these great advances in systematic theory could have emerged from just seeing something that others had not noticed, for example, an apple falling on one's head. They could not have arisen in the way that a recipe is discovered by a very perceptive cook or in the way that Edison contributed so much to our technical know-how. The theoretical advances we are talking about could only be the work of human geniuses, although that explanation tells us nothing about how to invent theory.

The division we observe today between scientists and technologists, the experts, and the ordinary workers at bench and desk is located quite precisely in the historical events that I have outlined. The division is first and foremost a division between those who can, alone or through their community, trace the logical proof of their ideas back to the great systemic structures erected by Euclid, Newton, Einstein and so forth and those who cannot. Years of graduate education are seen as necessary before people can be expected to be able to logically relate, through their disciplinary community, its textbooks, handbooks and professional journals, to these unquestionable systemic founda-

tions. More than that, the "science of psychology" postulates that only a few people have the innate ability to grasp these systemic concepts. Piaget's scheme of the psychological maturation of human intellect ends with the achievement of "Propositional operations" at adolescence. Very few people mature to the point where they can grasp the higher levels of abstraction. It was said, perhaps for effect, that at any one time there were only four or five people who really understood Einstein's theory of relativity. The implication was clear: intellectual knowledge had become so esoteric that there could be no question of participative management of that knowledge. And this was not trivial knowledge; it was the knowledge that built the bomb and offered the solution to energy shortages,

The few who can grasp and work with such "fourth order" concepts are at the peak of academic excellence and constitute the high priests of the scientific and technical establishments. The nearest parallel in the field of manual labor would be the inventors, and they rarely command social respect or support.

In the process of democratizing work we have not squarely confronted this historical division of intellectual and manual labor. The removal of the foreman and first-line supervisors only affected the source of know-how, not the locus of expert knowledge. Democratizing the workplace has certainly created greater openness at the boundary between expert and operative personnel, but the Polarity persists. It persists even when direct forms of participation in departmental management have been devised; for example, the "jury" system (Emery, 1981). In a sense, all of the forms of participation in management decision making must seem somewhat suspect when the experts employed by management constitute a special source of authority.

This is not just a theoretical possibility. Quite early in the Norwegian Industrial Democracy Program we identified two "black belts" of resistance to democratization. We were already very familiar with one. Beyond the reach of trade union agreements and the power of trade union officials there was a whole defense system based on local custom and usage and the assumption that any management-inspired change had to be a change for the worse. The second black belt had not been foreseen, or at least had only appeared as a shade of grey. We had thought of the engineers, chemical technologists and the like as simply part of middle management who would fall in line with the wishes of top management. We had not anticipated the extent to which they would feel threatened by the release of knowledge to the shop floor and had not realized the extent to which these experts had their own managers "blinded by science. "

The "deep slice" technique of participative design (F.E. Emery and M. Emery, 1976; 1974/VOI. 11) was a partial answer to this source of resistance. At least it gave the experts a chance to negotiate directly with

operatives about their new boundaries. Beyond that I blithely thought that this problem of "Red or Expert," as Mao Tse-Tung had phrased it, would be resolved by democratization of the educational process in the colleges and universities.

Having now gone over a draft of Trevor Williams's new book (1982), 1 think I have been glossing over a much deeper historical conflict between education and democracy. It is not simply a matter of debureaucratizing universities. My earlier confidence had come from a number of educational experiments that I had carried out in universities in the postwar decade.

Compared with traditional programs it seemed well proven that most people benefited from controlling their own learning and their use of resources, including the negotiation of staff time and efforts. These experiments never ran longer than three years, never involved more than one class at a time and all included a good proportion of mature ex-servicemen. I was not particularly concerned that some students did not take kindly to such democratization, even though these exceptions included potential scholars who eventually made the professorial ranks. Equally, I was little concerned that these experiments were aborted as soon as I moved on. These seemed to be the usual preliminary reactions to new ideas.

The experiments reported by Trevor Williams have for me effectively reversed the figure/ground relation. He reports on experiments with undergraduate and postgraduate courses in management that have been under his control for the greater part of the 1970s. He reports also on a massive in-house educational program with the managers and technologists of Telecommunication Australia. On the surface the results are simply a repeat of what I and many others have demonstrated, that is, that most people do obviously benefit from the democratization of their learning. But this time there was a difference. Williams's work was on a scale that could not be ignored by the parent nstitution, and he stayed around long enough to "cop the flak."

There was one other matter contributing to the reversal of my perceptual field. I had been very closely involved with Trevor Williams in the designing and redesigning of his experiments without realizing that any radical shift in meaning was involved. However, with Merrelyn Emery I had been intensively engaged in studying the future of communications technologies and had been forced by the evidence to conclusions that converged on those arising from Williams's work. In the older technologies of the telephone exchange and the architecture of main-frame computers, it was sufficient to identify the way that designers had, without thinking, followed the same design principle as that embedded in bureaucratic organizations-reliability through building in redundant parts (Emery, 1967). In the newer technologies involving the electronic handling of visual information, we were finding that the most fundamen-

tal assumptions were ones that concerned not these organizational alternatives but epistemological assumptions about the sheer physiological ability of peo-pie to gain information from the world around them. Wilbur Schramm, the international salesman for Education Tele-Vision for some two decades, has once again demonstrated that there is a fundamental mismatch between what television should be able to do, on those epistemological assumptions, and what it actually achieves (Schramm, 1960).

What Williams has done, in an eminently practical and constructive way, is to show us that as the outer layer of bureaucratic assumptions is peeled away, the underlying assumptions about the incompetence of people to team from their experience are evoked. As these deeper assumptions are evoked, the achievements of democratization are first challenged and then destroyed or encapsulated. Such a process of encapsulation was observed in Norway in the 1970s after the successes of the ig6os. Historically, the negating processes have been found after most radical and popular revolutions (Marcuse, 1966). In this case such destruction is not in the cards because there is no other way that offers comparable growth in productivity. Encapsulation is in the cards. Quality of working life could become a management tool that creates an elite of multiskilled highly rewarded employees against a backdrop of large-scale unemployment and a multitude of short-term, part-time jobs in service indus-tries. Note, however, that an encapsulation that preserves some of the critical managerial prerogatives within the corporation still does not seal off the enrich-ing effects on the community of such multiskilled, self-respecting workers.

The major service that Williams has done for us is to identify the fact that democratization of an area as significant as work cannot evade encapsulation unless the educational process is radically changed. This is not a new problem, but then I, and I guess many others, have not been looking back at the history of leaps and tumbles whereby we got to the spectacular period of growth in the years 1955 to 1972. 1 use Williams's work as a vehicle to identify the emerging challenges in the process of democratizing work. There is now little that is scientifically challenging in confronting autocracy in the workplace. I find that there is a great deal in confronting the "meritocracy."

It would appear that whenever industrial society is in one of its recurrent periods of economic downturn and social turmoil, as in the 1960s, the relation-ship of education and democracy becomes a leading question.

Author's note, 1961

The concern expressed at the end of this 1982 paper was not misplaced. In 1988 Shoshana Zuboff published her perceptive case studies of "informated" technologies-In the Age, of the Smart Machines. By inforinated technologies

she means computerized, automated technologies that not only operate according to pre-determined programs but also record and analyze what the program, equipment and operator are doing during the operation and, if necessary, some of the changing states of the operational environment. It is the world of the microprocessor-controlled operations that infonns at the same time as it instructs. The productive capabilities of these informating technologies can be realized only by operators who have the conceptual skills required for diagnosis and optimization of system performance; or by managers replacing operators at the workface. As Zuboff evidences, there are some plants where both operators and managers have realized what they are confronted with. Some operators find it hard, if not impossible, to cope with the change from manual labor to intellectual labor. Many more managers find it difficult to accept that their status as the intellectual workers in the plant is being undermined. The informating technologies challenge the boundaries between intellectual and manual labor. That is a challenge that has to be understood in psycho-social terms.

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