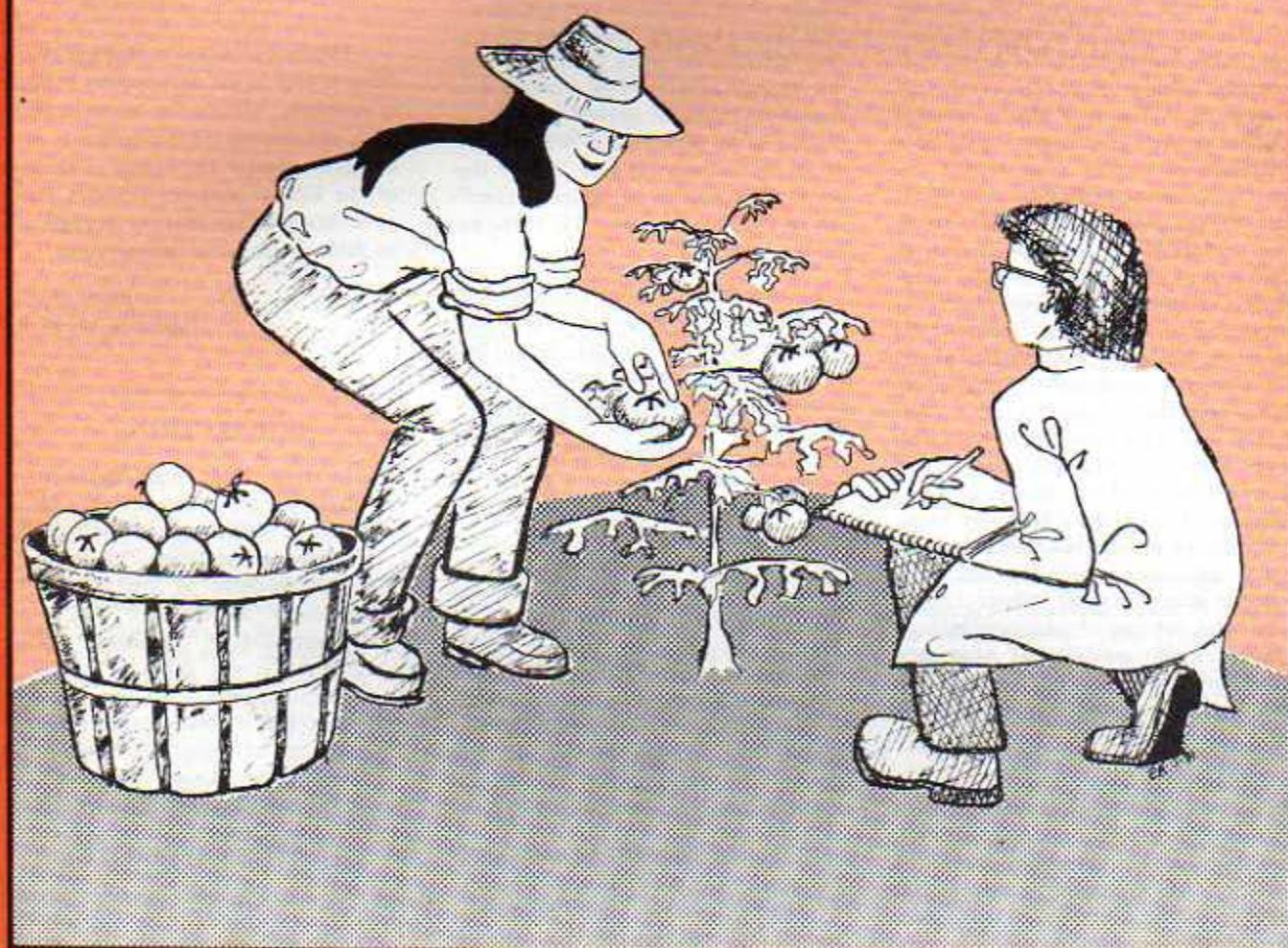


SCIENCE FOR THE PEOPLE

Vol. 13 No. 1

\$1.75

AGRICULTURAL RESEARCH AND SOCIAL CONFLICT



Technology and Productivity
Bottle Babies and Managed Mothers

letters

Dear SftP:

The Australian anti-nuclear movement presents several contrasts with the analysis of the US anti-nuclear movement presented by Joe Shapiro (July/August 1980).

As in the U.S., a major motivation of opponents of nuclear power in Australia is concern over safety and long-term environmental effects. Australia has no nuclear power reactors or firm plans for them, and the anti-nuclear struggle has mainly been focused against uranium mining. Uranium mining presents little direct physical danger to most Australians, except workers and Aborigines. Partly because of this, non-environmental issues have played a major role in the Australian public debate over uranium mining. Major topics in this debate since 1977 or before have included nuclear power's contribution to the proliferation of nuclear weapons, the impact of uranium mining on Aboriginal culture, the political and social threats of a nuclear society (including terrorism and attacks on civil liberties), the undesirable economic and employment consequences of nuclear power and uranium mining, the limitations of nuclear power as a solution to energy problems and the advantages of a 'soft energy path'. All these topics have wide implications. For example, a major issue has been made of the damaging consequences of Australia's economy being restructured around resource extraction (coal, aluminum, uranium) with a decline in manufacturing industry, all to serve the interests of transnational corporations. On the issue of Aboriginal land rights there has been a strong positive linkage between the anti-uranium and land rights movements.

Secondly, at least since 1976 when I became active in the anti-uranium movement, a large fraction of anti-uranium activists have been committed to the goal of helping achieve social change in the direction of democracy and self-management. Anti-uranium or-

ganizations have been structured and anti-uranium campaigns pursued in ways as consistent as possible with this goal. For example, emphasis has been put on avoiding political power building within anti-uranium organizations and on adopting campaigns which can involve wide sections of the community.

One major reason why so many activists have worked on the uranium issue in Australia is because the introduction of nuclear power has been seen as a potential support for elite groups whose political power can be based on control over expensive, dangerous, centralised technology which cannot be run democratically. Many leading Australian anti-nuclear activists for some years have seen the struggle against nuclear power as a transitional demand against the bureaucratic and corporate state. A key article which crystallised this view is Alan Roberts, "The politics of nuclear power", *Arena* (Melbourne), No. 41, 1976, pp. 22-47

Finally, there has been strong involvement by parts of the labour movement in the anti-uranium struggle. Key trade unions were involved from the very earliest days of the organized anti-nuclear power movement in about 1974, following on from earlier efforts against French nuclear tests in the Pacific. In 1976 the Australian Railways Union held a one day strike over uranium mining, one of the earliest direct actions. Since 1977 both the Australian Labor Party and the Australian Council of Trade Unions have had policies opposing uranium mining. These stances were achieved as a result of persistent efforts by anti-nuclear activists both inside and outside the labour movement, and through the general shift in public opinion away from nuclear power.

Compared to the US anti-nuclear movement, the Australian anti-nuclear movement has been highly politicised, and strongly linked with the Aboriginal

land rights movement, the peace movement and the labour movement. These differences can be traced to political and economic differences between the two countries. But the differences do suggest that Shapiro's conclusion that the main potential of the nuclear power issue is helping the development of political consciousness is too limited. The Australian experience suggests that the nuclear power issue has the potential for linking a wide range of social forces against developments which resulted from and which would strongly reinforce centralised bureaucratic and corporate power.

Finally I should add that not everything is rosy in the anti-nuclear struggle in Australia. Mining has begun at some sites, and this has led to a decline in anti-uranium efforts. The recent re-election of the Liberal-National Country Party government means that the struggle will be difficult for some time to come.

Brian Martin
Canberra, Australia

CORRECTION

In the September/October *Science for the People* on page 24 the quote which begins, "Epoxy is a dangerous substance..." is from a representative of the Danish Inspection Service and not a representative of the School of Pharmacy.

The *Bias of Science*, the book reviewed by Ross Feldberg in "Beyond the Margins of Error", *SftP* November/December, is available from ISBS Inc., P.O. Box 555, Forest Grove, OR 97115.

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Science for the People magazine is published bimonthly by the Science Resource Center, Inc., a non-profit corporation. The magazine is edited and produced by the national organization Science for the People. Our address and phone number are 897 Main St. Cambridge, MA 02139, # (617) 547-0370. We offer a progressive view of science and technology, covering a broad range of issues. We welcome contributions of all kinds: articles, letters, book reviews, artwork, cartoons, news notes, etc. If possible, please type manuscripts (double spaced) and send three copies. Be sure to keep one copy for yourself. Unless otherwise stated, all material in this magazine is copyright 1980 by *Science for the People*.

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about this issue

A persistent theme throughout the history of *SftP* magazine has been that science and technology are never politically neutral, and that their benefits accrue unevenly to different classes, the class holding political power receiving most of those benefits. In this issue we present two articles elaborating this theme in different situations.

John Vandermeer's article details the social forces which have operated in research associated with mechanical harvesting in the tomato industry. He shows how recent agricultural research provides technological solutions to the tomato industry's labor problems. The selection of questions to be asked, as well as the use to which answers are put, is influenced by class interests. The article uses the struggle between Midwestern farmworkers and the giant canneries as an example of such conflicting interests.

In the article that follows, Peter Downs details the changes in the work process due to the introduction of numerical control technology into St. Louis machine shops. He analyzes changes in the working environment, especially the deskilling of labor, and shows how an important consequence of the new technology is to weaken existing labor organization.

Another common theme in *SftP* magazine has been that the reductionist approach of most bourgeois thought can lead to superficial analyses that ignore the vital aspects of problems. Two articles in this issue point to such weaknesses in current analyses of some social/scientific problems while suggesting broader social contexts in which to treat the problems.

Anxiety about one's abilities is a common plight. Being anxious about one's abilities to do science is especially prevalent, while being anxious about one's abilities in mathematics occurs with such frequency that it is identified as a syndrome — math anxiety. Katherine Yih reviews a systematic attempt to study the phenomenon of math anxiety, and finds it less than adequate.

The infant formula problem created by Nestle's and other transnationals in the Third World is analyzed politically by Mark Wilson. While much has been written on this subject, Wilson's article is unique in attempting an analysis of those structural elements of capitalism and patriarchy which give rise to the problem in the first place. We hope his article will stimulate further discussion of this and related problems by presenting a method of analysis which goes beyond superficialities. We also include a summary of the facts of breast vs. bottle feeding and a batch of resources for use by activists.

Finally, in this issue we introduce a new feature that we hope will become a regular department in the magazine. The "Breakthroughs" column will present brief, non-technical summaries of recent developments in science and technology. Hopefully, by explaining the politically interesting elements of scientific results in everyday language, we will help open the door to making scientific results available to everyone as well as encouraging the political analysis of science and technology. We look forward to hearing from our readers about this new feature. Its future direction depends in large part on your response.

Tomatoes in the Midwest

AGRICULTURAL RESEARCH AND SOCIAL CONFLICT

by John Vandermeer

All but the most naive would admit that an important link exists between science and political concerns. Examples of such a link are everywhere. But detailed analyses from a left perspective are rarely seen. I here begin such an analysis for the mechanization of the tomato industry in the Midwest.

Recent developments in California demonstrate that research in agriculture and related fields is intimately tied to political and economic questions. A class action suit filed on behalf of agricultural workers by California Rural Legal Assistance asks that the University of California be prevented from continuing to use public funds for research that will reduce job availability for agricultural workers. Recent events in northwestern Ohio, coupled with research at several major Midwestern universities, underscore the political nature of the science associated with the development of tomato-harvesting technology. This scientific/technological innovation provides an excellent focus for an analysis of the interplay of science and politics.

A Brief Historical Sketch

The mechanization of harvest has always involved complicated social relations, most often those related to a supply of cheap labor. For example, when the McCormick reaper was introduced in the Midwest in 1831, it was not adopted by more than a handful of farmers because economies of scale required more than 50 acres in wheat, oats, or barley for its purchase to be economically rational. By 1860 the need for men to fight in the Union army severely reduced the mostly male labor pool for harvesting, thus increasing the wage demand of that labor and thus decreasing the acreage needed for the machinery to be profitable. By 1865 over 50% of the grain in the Midwest was being harvested automatically. Thus, the utilization of a technology which was fully available and widely known in 1830 leapt from only about 10% of the farmers after the first 30 years to over 50% five years later.(1)

The technology for agricultural mechanization is never simple. For example, the invention of the cotton stripper was not in itself sufficient to make automated

cotton harvesting widely accepted. Developments in breeding, cultivation, processing, storage, and transportation were also important. With each new development a greater fraction of the crop was automatically harvested. Gradually, over a period of about 40 years, the proportion of cotton that was mechanically harvested went from 1% to 95%.(2) During this time the displacement of farmworkers, the concentration of land into fewer and larger holdings, and the concentration of processing facilities all proceeded at the same relatively slow pace as mechanization.

In contrast to the mechanization of the cotton harvest, mechanization of the tomato harvest, at least in California, has proceeded at a blinding rate. In California it took 30 years to go from 1% to 95% mechanical harvesting in cotton while it took only six years to achieve the same thing in tomatoes. One factor that at least partly accounts for this difference was the strength of the United Farm Workers — ironically, by increasing their ability to demand higher wages and better job conditions, they encouraged a more rapid shift to mechanical harvesting. But a more important factor was the structure of the research establishment.

As mentioned earlier, technological advances in cotton mechanization happened more or less at random. This is not to say that a variety of scientific achievements were not prerequisite to full adoption of mechanization, but rather that many researchers working virtually independently of one another came up with these achievements at unplanned and more or less random intervals. Mechanization of tomato harvesting was the opposite. A "systems approach" was utilized(3) in which teams of researchers discussed what needed to be done to mechanize the harvest. Conferences were held, think-tank-like sessions were organized, potential

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problems with particular aspects of mechanization were isolated early and research into them was encouraged in a variety of ways. Thus, rather than a group of independent investigators deciding on research problems in isolation, research was coordinated and problems anticipated. Consequently mechanization proceeded at a phenomenal rate.

Since the entire systems approach program was openly planned and that planning relatively well-documented, it is possible to trace many of the underlying motivations and political pressures that were involved without resorting to undue speculation. But before analyzing the research establishment and its political functioning, it is necessary to discuss briefly the practical aspects of the mechanization of tomato harvesting.

Mechanizing the Tomato Harvest (4)

Central to the technology of mechanical harvesting is the simultaneous ripening of the fruits. Unlike farmworkers, a mechanical harvester goes through the field only once and must harvest all or nearly all the fruits — those that are too ripe or not ripe enough must be discarded. A variety of research efforts focus on the problem of simultaneous ripening. Uniform pest and weed control are necessary, transplanting or seeding must be done uniformly, fertilizer application must encourage uniform growth, etc. Thus, many research projects were initiated in, for example, pest control, weed control, transplanting technology, and fertilizer response to the purpose of insuring uniformity, not for increasing production. Additionally, breeding programs were established to produce varieties in which the fruits ripened as nearly simultaneously as possible. Biochemical and physiological research clarified the ripening process and ultimately led to the ability to artificially stimulate ripening by spraying ethephon. (Ethephon causes the fruit to produce ethylene prematurely — the ethylene causes it to ripen.)

The second major concern in research towards mechanization involved the ability of the tomato to withstand rough treatment by the harvester. This has never been a simple problem. For example, one of the first strains that could withstand mechanical harvesting, developed as early as 1943, had such poor synchrony of ripening that probably only 30% of the crop could have been harvested at one time. By 1947 a new type was developed which could withstand rough handling *and* had relatively simultaneous ripening qualities.⁽⁹⁾ But this type proved to be highly susceptible to Verticillium wilt, a common tomato disease. Shortly thereafter, a similar variety was developed with resistance to Verticillium wilt. But problems arose again: the fruit proved to be too small for commercial use. In spite of these early problems, by 1961 a large number of potentially useful strains were available. In that year researchers at the University of California conducted experiments with

248 different strains. While some of these have been incorporated into strains still in use today, the big breakthrough came later with the discovery that elongated varieties were far more resistant to rough handling than round varieties.

Finally, storage and processing problems arose as a consequence of mechanization. For example, the possibility of heavier infestations of fruitflies in the harvested product (since more damaged fruit might provide excellent habitat for these creatures) was anticipated early on. The ability to make tomato concentrate became very important with mechanized harvesting because much more of single peak load would exist than with hand harvesting. Varieties bred for simultaneous ripening and resistance to rough machine handling did not necessarily have the ideal biochemical makeup for processing, requiring further biochemical research.

These and other problems had to be addressed by the research establishment. Researchers exchanged information on a regular basis. Conferences, both formal and informal, were held to identify problems as soon as they arose. The whole mechanization process was treated as a system, with individual researchers being fitted into the various compartments of the system. Who are these researchers, where specifically do they get their ideas, and what influences act to direct their research?

The Research Establishment

The research establishment associated with mechanization of the tomato harvest ranges from New Jersey to California and from biochemistry to agricultural economics. In this article I limit the analysis to the Midwest, specifically northwest Ohio, northeast Indiana and southern Michigan, the area second only to California in tomato production. The research establishment most directly involved in aspects of mechanization in this area consists of researchers in three localities, Michigan State University (MSU) and its associated agricultural research station in East Lansing, Ohio State University (OSU) at Columbus and its associated agricultural station in Wooster, and Purdue University and its associated agricultural station in West Lafayette. Over the past 15 years approximately 60 researchers have been directly involved in research related to the mechanization of tomato harvesting (25 at Purdue, 17 at MSU, and 18 at OSU).

Identifying researchers and linking them with research in tomato mechanization is not always an easy task. Sometimes it is obvious, as in the case of Stan Reis of MSU, who helped develop many of the mechanization concepts currently used in the design of the mechanical harvesters produced by companies such as FSM Corporation, or Wilbur Gould at OSU, who breeds new tomatoes specifically suited for mechanical harvesters. But other examples are not nearly so obvious. Cherry of MSU, for example, is a biochemist whose research

seems marginally related to mechanical harvesting at best. Yet some of his publications are highly relevant to areas that other researchers at least have claimed to be of vital importance to mechanization. Finally, there are a few researchers who have been identified by one source or another (e.g. the *Tomato Yearbook*) as being tomato researchers, but whose publications I have been unable to locate. I include them as part of the research establishment even though they may not have produced a large amount of relevant research.

While these methods of identifying tomato researchers are bound to lead to less than perfectly accurate data, it is my feeling that errors on both sides are

the period 1969-1977 approximately \$20,000 in grant funds was contributed by the public sector specifically for research on tomato mechanization. The agencies involved were the U.S. Department of Agriculture, the National Science Foundation, and the National Institutes of Health.(5) Public funds expended jump to \$260,000 if we include the salary support for tomato researchers engaged specifically in tomato mechanization research. In other words, over a quarter of a million dollars of public funds were spent over the last 10 years for the mechanization of the tomato industry.(6)

This figure is interesting in light of the recent suit in California and Secretary of Agriculture Bergland's



equally likely (i.e. some researchers who clearly should have been classified as tomato heads were left out while others who are only on the fringe of the research establishment were included). Thus, at least a subset of the personnel involved in the research establishment in the Midwest have been identified (a small amount of tomato research also goes on at the University of Illinois, Iowa State University, and the private labs of the larger canneries). Having identified the personnel, we can ask more detailed questions about their work.

I have already indicated that research on tomato harvest mechanization followed along well-planned lines. But who was it that planned those lines? We might have a vision of Edison-like scientists approaching each problem as it is suggested by the immediately preceding experiments — the romantic picture of the scientist-inventor. Undoubtedly some of this image is not too far off the mark. But, as is usually if not always the case, other political and economic factors are involved in that planning process. We can begin to understand some of these factors by a close examination of funding sources.

As a case study we examine Purdue University. In

statement that it was "impossible to justify the use of Federal funds to finance research leading to the development of machines or other technologies that may increase production and processing efficiency but at the same time damage the soil, pollute the environment, displace willing workers, and reduce or eliminate competition".(7) For our purposes it is equally interesting to look at research support from private sources.

During the period 1969 to 1977 private grants specifically designated for tomato mechanization research amounted to \$46,340.(8) In addition to grants, a total of \$46,376 in gifts (for example, from Gulf Oil Chemicals Co., Lilly Research Laboratories, Mobil Chemical Co., Monsanto Agricultural Products Co.) was allocated to Purdue for research directly related to tomato mechanization. This brings the contribution from private sources in the eight-year period to \$92,716. Thus, private corporations contributed roughly \$100,000 over the last 10 years to Purdue University for research on the mechanization of the tomato industry.

If MSU and OSU are similar (and we have no reason to believe they are not), the three schools combined

received on the order of \$300,000 from private sources and \$750,000 from public sources for research in tomato mechanization in the last 10 years. These figures are *very* conservative and most likely represent a minimum. If more information were available, I suspect the figures would be considerably higher.(9) But the important figure is the relative amount of public vs. private contributions: over twice as much money from public sources as from private sources.

Without a doubt, a majority of the research has been paid for by the public. But the estimated \$300,000 in corporate gifts and grants must not be ignored. It is exactly these gifts and grants that determine to a large extent which questions get asked, in what order they get asked, where the emphasis should be for the next development, etc. For example, between the years 1971 and 1977 P.E. Nelson and G.H. Sullivan of Purdue received \$83,910 from Bishopric Products Company for the development of a bulk-storage processing system — an integral aspect of tomato mechanization in the Midwest.(10) Bishopric Products never was interested in obtaining higher yields of tomatoes or in bettering the quality of our foods or anything of the sort. They were interested in the bulk tanks they were already building for the brewing industry. Bulk-storage processing involves the partial processing of tomatoes into a concentrate that can be stored in huge tanks for later reconstitution, thus more easily accomodating the larger flow of tomatoes expected from mechanically-harvested fields.(11) If bulk-storage processing could become common in the Midwest, who would be in an excellent position to produce the tanks for the processors? Bishopric Products Co., of course! So Dr. Nelson, whose salary comes out of public funds and who held grants from public institutions and awards from numerous other corporate concerns, was at least slightly encouraged by \$83,910 from Bishopric Products to be interested in scientific questions associated with bulk-storage processing. Might the public funds that supported Dr. Nelson have been utilized somewhat differently if Bishopric Products had not contributed all that money to Purdue to help Purdue develop a market so they could sell more of their tanks? I shall return to this point later. But first I wish to delve more deeply into some subtler aspects of the research establishment.

As research proceeds into some particular aspect of mechanization, various problems are normally encountered. Those problems are solved frequently by turning to results obtained in related disciplines. For example, fruit flies (*Drosophila*) have long been one of the biggest insect pests on tomatoes (13). When mechanical harvesting was introduced, concern was voiced from the outset about the effect it would have on the fruit fly problem. Thus in 1966 R.C. Riley, an entomologist from Rutgers, stated:

Whether or not mechanical harvesting practices will increase or decrease, *Drosophila* contamina-

tion in processed tomato products is somewhat difficult to forecast . . . [I shall] focus on the measures we now have for controlling *Drosophila* and how these measures can be applied to mechanical harvesting practices.(14)

He then goes on to identify the areas, including sources of *Drosophila* infestations, how far *Drosophila* flies can detect odors, factors affecting the migration of *Drosophila*, the migratory habits of *Drosophila*. Topics such as these are highly reminiscent of the questions asked by ecologists and geneticists interested in nothing more than basic science.

To take another example, mechanization has reopened a whole host of cultivation questions. Among them are those dealing with changing the density of plants to correspond to the needs of the harvester. In a recent paper on tomato densities, Kays and Nicklow of MSU state:

As density increases, plant-to-plant competition begins progressively earlier in the growing season. (5) Competition or "interference" may center on any of a number of requisites of the plants, the most common being light, water, and nutrients. During growth, plants effect substantial changes in their physical and chemical environment, such as the depletion of nutrients, utilization of available water, and physical changes in soil structure. These alterations may in turn, as illustrated by the classical example of nutrient depletion, be detrimental to the actual members effecting the change.(15)

As any ecologist would point out, both the language and the concepts are directly out of the conventional literature of plant ecology — supposedly a very basic non-applied science. Indeed, reference 5 in the above quote refers to a paper by the Australian ecologist C.M. Donald, a paper most frequently cited as one of the classic works in modern plant competition theory. The point is that none of these concepts would be regarded by a "pure" ecologist interested in basic science as particularly relevant to tomato mechanization or any other applied science. Yet it is in fact the case that these concepts are being put into the service of those researchers who already are involved in research aimed at mechanization.

These are but two examples that should serve to illustrate the intimate connection that must exist between applied science and technology on the one hand and basic science on the other. Without doubt, the results obtained in basic sciences are put to use in the applied sciences. In this case, results from physiology, bio-

(continues on p.25)

Computers Replace Machinists

TECHNOLOGY AND PRODUCTIVITY

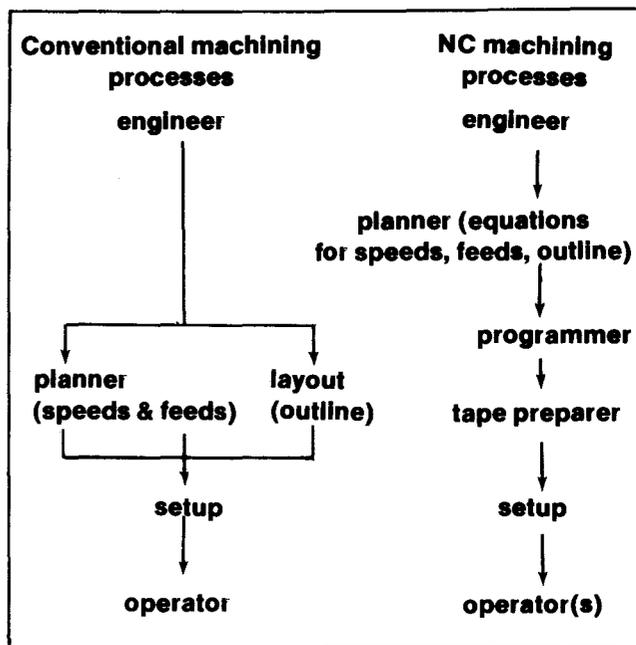
by Peter Downs

The introduction of new technology into a production process is generally seen by those on the American Left as reducing the level of skill required of workers to do the job. It is thought to simplify jobs, making them more boring and meaningless. Not surprisingly, then, many bitter working class struggles have been waged against new technology, and technology has in turn changed the forms of continuing struggles. Sometimes we forget that the primary reason for introducing new technology is to increase capitalists' profits by increasing worker productivity. Thus, technology intervenes at one of the foci of the class struggle and it must reflect the present course of that struggle as well as influence its future forms. In this article, I will examine some of the effects of the spread of numerical control (NC) technology on the metal machining industry and its workers, including some of the ramifications for the workers' struggle. The main purpose of this investigation is to inform that struggle.

Characteristics of Numerical Control vs. Conventional Machining

The most important changes in the machine tool metalworking industry in the last two decades have been associated with the elaboration of numerical control (NC) technology. Machine tools are numerically controlled when they are directed automatically by way of electrical apparatuses which receive instructions from a tape or deck of cards instead of from a human operator. The tapes or cards give the patterns for the parts with numerical coordinates hence "numerical control", and electronic processors control the apparatus to follow

the pattern. NC machine tools were first developed in response to the needs of the aerospace industry to produce complicated parts faster, more accurately, and at a lower cost than by conventional machining techniques. McDonnell-Douglas Corporation is still the national leader in the use of NC machine tools, but such tools are no longer restricted to the aerospace industry.



Numerical control of machine tools would appear to possess many advantages over manual control on two levels. On one level, parts which could not be made with conventional techniques can now be made with NC machine tools. Insofar as such parts previously had to be produced manually, productivity has been drastically improved. On a second level, automatic control of machine tool operations reduces the areas of human error. This suggests that low tolerances can be more easily maintained, inspections can be greatly reduced, and changing over from one part to another similar to it can

Peter Downs is a machinist living in St. Louis. He is a member of the St. Louis Chapter of SftP.

be accomplished more easily than with conventional methods. Whether or not such potential advantages are realized seems to depend heavily upon what is being produced. One frequent complaint about NC machines, however, is that they do not provide repeatability in part sizes, which is one of the reasons they have to be carefully monitored. (1) At McDonnell-Douglas, for example, NC milling machines tend to vary the thicknesses of parts while maintaining the pattern. Every single part produced at McDonnell-Douglas must be inspected and approved before it is used, whether it is produced by NC or conventional techniques. At Emerson electric inspection procedures for conventionally and NC-machined parts are identical. It is not clear that NC-machined tools are effective at cutting inspection costs or better at maintaining tolerances.

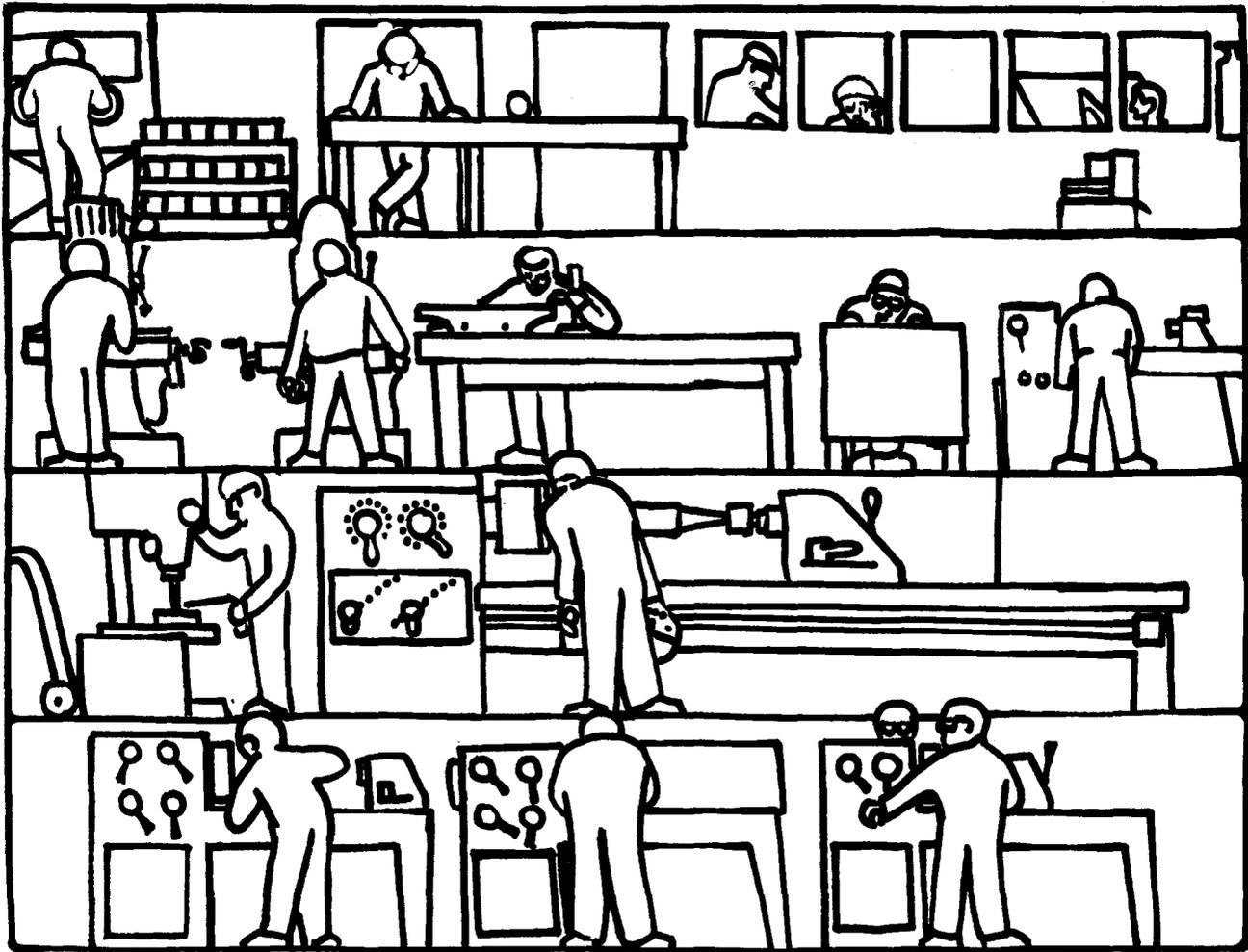
One advantage of NC machine tools, though, is the increase they bring in productivity. Since tooling and length of machining cycles are reduced, and the repetition of machining operations is automatically controlled, more parts can be made at lower costs. There are other factors, however, which tend to reduce this advantage. NC milling machines at McDonnell-Douglas, for example, begin their operations on a precision casting, whereas conventional machines usually start with a metal slab. The fixtures for holding the precision casting in place during the machining process are made by conventional machine tools, and all initial precision machining performed on the casting, such as drilling precision holes at critical positions, is performed conventionally. There is a division between work done conventionally and work done with NC techniques, but it is difficult to say for any particular part that, a priori, NC or conventional is better. The choice is a complex one for which every type of part is evaluated.

A conventional shop which is considering investing in NC machine tools must analyze much more than the particular machining operations for particular parts. It must also consider the costs of machines and installation; differences in supply costs, power consumption, and floor and storage space; and retrofitting costs, since the average useful life of an NC control system is less than half the life of a basic machine. (2) Ultimately, however, the decision is based on profitability, not the speed or quantity of production per se. Thus, if another way can be found to increase the productivity of labor, or increase the value produced by the laborer relative to the wage, it will be another viable alternative for the capitalist. Small capitalists, whose sums of capital are not large and whose job shops may not have the certainty of continually producing particular types of parts that the large capitalists' have, may prefer an alternative to NC techniques. Whatever choice is made, the primary concern of the capitalist is with increasing workers' productivity, which, since Braverman (3), for most of the American Left, has become synonymous with decreasing skill.

Skill Requirements

Machinists have always been skilled tradespeople. In the course of the machinists' training, s/he had to learn practical mechanics, algebra and trigonometry, blueprint reading and sketching, precision measurement, and the properties of various metals and their alloys. This course of study had been fairly constant for many years, since there were few technological changes in production from the 1930's until the 1960's. There may have been some movement of such "intellectual" duties as drafting and mathematics into the office, but machinists still had to possess a knowledge of metallurgy, mathematics, and drafting in order to read job specifications, catch errors, determine part dimensions, and select the proper cutting tools and cams for the most efficient cutting speeds and feeds for the job. Much of this knowledge, which includes knowing where to look or who to ask for more information when the need arises, was acquired through actual experience. Most trained machinists were responsible for operating a few specific machines and setting them up so they could manufacture the required part to specifications.

The level of skill a machinist acquired depended on the type of position s/he had. The most skilled were tool and die makers, whose work was also the most labor intensive. Tool and die makers can operate any machine tool. They build dies and tools that are to be used in production. This type of work is especially precise and includes a large number of manual operations. The next level of skill is that of the general machinist, who can set-up and repair any machine tool but does not do the kind of precision work characteristic of the tool and die maker. Somewhat less skilled are production machinists and machine operators, who generally know how to set-up and operate only one or two machines. On the average, machine operators know how to perform common set-ups on the type of machines they operate after one or two years of experience. The production of any part via machining utilizes the combined skills of many people. In conventional machining processes, those directly involved are the engineer, who designs the part; the planner, who plans the steps in the machining process; the lay-out person (for mills and drills), who outlines cuts on the metal stock; the set-up person, who mechanically prepares the machine tool for the operations required; and the machine operator. Some parts also require the services of the tool and die maker to build a jig or fixture to hold the metal piece properly for the machining operations involved in producing the part. In many conventional machine shops the same person plans the job and does the lay-out or the set-up. In smaller shops much of the set-up tends to be done by the machine operator. Yet there are also shops in which the operator does nothing but load the machine and start the operating cycle; all set-ups and adjustments are performed by the set-up person.



R. Winter

In NC machining processes the people immediately involved are the engineer, the planner, the programmer, the tape preparer or keypunch operator, the set-up person, and the machine operator. The lay-out for NC machining is done analytically by the planner, who still must select the proper tools, speeds, and feeds for the machining operations so they can be translated by the programmer. An NC machine operator is often responsible for set-up as well. The manual set-up required for a job may not be as skilled a task as on conventional machines, but NC machines have to be adjusted and corrected manually so often that only very skilled machine operators are trained to operate them. From the point of view of machine operators NC positions require more skill, but from that of set-up persons they require perhaps less skill. For tool and die makers, though, NC machines do mean a reduction in necessary skills since the jigs and fixtures required are much simpler than those required for similar jobs on conventional machines. This is one of the main areas of cost reduction with NC machining. Again, however, there are some contradictory tendencies. In conventional machining, operations generally start on a metal bar or slab. But, at McDonnell-Douglas at least, NC operations

start on a precision casting. Does the fabrication of such a casting require more skill on the part of foundry workers? Taken as a whole, the effects of NC technology are not simply to reduce workers' skill. NC machine tools do increase productivity, and therefore profits, but their effects on skills are complex.

NC and the Organization of Labor

The importance of NC machine tools to the working class goes beyond their effects on skills. Before the development of NC machine tools in the sixties, most large manufacturing companies had their own machine shops. By possessing an in-house machine shop a company assured its supply of machined parts necessary for production, without some of the transfer and management costs. In addition, large shops could benefit from economies of scale in energy, space, materials, and in labor costs via a greater division of labor. In some shops even the duties of loading stock into the machine were severed from those of the machine operator. These large in-house machine shops could also use a larger number of inexperienced machinists, and have them assisted by a small number of experienced machinists. The separation of function meant that the number of machines to

which each person was assigned could be increased so that the company could get more labor from the workers each day. These same conditions, however, made such shops prime sites for unionization. Today, most large corporate machine shops are unionized.

Advances in computer technology led to the spread of NC machine tools in the seventies. This in turn led to increased production of some parts and to decreased employment in many large shops. Emerson and Wagner Electric Companies, for instance, both eliminated many of their conventional machine tools in St. Louis, throwing hundreds of people out of work. Wagner Electric Company replaced its St. Louis machines with NC machines in a "right to work" state. Emerson Electric replaced many of its conventional machines with NC machines at its St. Louis facility. Both companies also increased the amount of work they contracted out to small and medium-sized shops. This trend has created a boom for these small shops.

The apparently rosy conditions for small and medium size shops seems to contradict the spread of NC machine tools. Smaller shops generally do not have such tools because of their large initial costs and because "job shops" cannot always predict what kind of parts they will be hired to produce next. In order to compete with NC, small capitalists must squeeze more out of their workers, which is easier to do when the shops are non-union. If small capitalists can squeeze the cost of making a part down below that of a part made by NC processes, subcontracting becomes an attractive alternative for large manufacturers. Certain types of work are not especially well suited to NC techniques, so they tend to be done conventionally and to be contracted out. These include small runs of simple parts (in the tens of hundreds of thousands) and even very small runs of complex parts when such parts are not similar to others that a manufacturer needs.

Labor Struggles in the St. Louis Machine Shops

The cost savings small capitalists are able to achieve are primarily reductions in labor costs. This is partially due to the spread of NC machine tools, which increases the productivity of labor in machining processes. This effectively reduces the value of labor in conventional machining processes. More importantly, I think, the unorganized state of workers in smaller shops makes it easier for capitalists, both large and small, to increase the exploitation of workers, i.e., to pay the workers for a smaller part of the value they produce, taking even more as surplus value, or profits. An example will help illustrate what this means for workers in smaller shops.

Parts Fabricators, Inc. is a fairly typical medium-sized shop employing about 70 people. In the fall and winter of 1979 these workers were working ten-hour

days with one-half hour for lunch. Lighting and insulation were poor and unsafe, and the buildings offered minimal protection from the weather. Most of the workers were paid between \$4.00 and \$4.75 per hour and the pay was subject to deductions for taxes, tools, and school, the latter because the workers were classified as "trainees". Thus, most of the workers needed to work overtime. Most of the machine tools in the shop were old, some of World War I vintage, and production involved a large number of hand operations. Deburring, for instance, which is an operation whereby sharp edges on a part are removed, was always done by hand, even though a large number of fully automated deburring machines are on the market.

This was the first industrial job that many of the workers at Parts Fab, who were mostly young men, some married and with children, had held. Previously, they had been employed in service industries or in the military. They kept working at Parts Fab because they thought that if they learned an industrial trade they would be able to make big money. High unemployment, especially for youth, meant they had few alternatives for learning a trade, or even working. People were afraid of what would happen if they lost their jobs. Where would they find other steady, full-time jobs? Since some large corporate machine shops had closed, they feared a glut of machine operators and felt they would need strong experience in order to compete effectively for available jobs. So each resolved to continue under the conditions at Parts Fab until s/he had a few years experience. Then too, as these were their first industrial jobs, they did not know what to expect. They did not know what was "correct" nor what their legal rights and protections were. Many thought they could only get a union if the boss wanted one. Even when they accepted that it was possible to get a union against the boss' wishes, their fatalism remained intact. The union, they thought, would win recognition and improved conditions without the workers doing anything. This is not to say that everyone hired by the company fatalistically accepted the job and the conditions as they were, but most people rebelled by quitting. In 1978 Parts Fab employed over 360 people for 60 positions. Most people stayed fewer than three weeks. Apparently, many young workers were neither desperate enough nor cowed enough to accept work under such conditions. Today this may be changing under the impact of the deepening recession and cutbacks in unemployment compensation and social services.

The fatalism of the workers who remained at Parts Fab was grounded in the material facts of their lives. Workers do have to work for a decent living, sometimes for any living at all. Unemployment is real. These conditions are used to the advantage of the boss, who constantly reminds workers of them. Despite government promises, workers, in fact, have few rights. Legal pro-

tections are weak, and procedural rules favor management. What rights workers do have are only those they can take. Claiming legal rights which are absent in practice is useful in initial organizing, but mostly because it implies that the power of the state is on the side of the workers, not the boss. When the opposite happens, what does it do to the organizing attempt?

Workers in small to medium size shops are generally not organized to take their rights, so they have none. Thus, the introduction of NC machine tools, which increases the exploitation of the workers who operate them by increasing the unpaid production of each worker, also increases the exploitation of workers in the smaller machine shops whose production complements NC machine tool production. In addition, NC processes affect the power of workers to fight back.



Looking Left/cpf

As Braverman (3) has pointed out, the automation of production under capitalism is designed to reduce the amount of worker control of production, while the shift of more production to small, unorganized, labor-intensive shops weakens the workers' fighting organizations, the unions.

In practical terms, it is the power of the workers to disrupt production today which is reduced, though the *potential* for disrupting, or usurping production is still there. The usual and legal way for workers to disrupt production is by collectively withholding their services, but, as noted above, the ability of existing unions to do this has been weakened by the spread of NC technology. Possibly the most difficult workers to replace are the programmers. But once a machine is programmed it can continue running for a long time and the programmer's services are not needed. Thus, if programmers were to strike, they would begin to feel the effects immediately while it might be months before it made any difference to the company. The machines cannot run without

operators to load stock and start and stop them, but new operators can be trained to perform these duties in a few days so these workers are more easily replaced, especially when unemployment and marginal employment are high. A strike of all job classifications would be more effective, but it does not eliminate the difficulties discussed above. If the machines are already programmed, management can first concentrate on finding new operators and prepare for a long strike.

Skilled machinists in small shops retain more direct control of their production, but a large company which contracts jobs to these shops is unlikely to be stopped by a strike at one, as it can easily shift production to another shop. Yet the large corporations probably control the fate, and the working conditions, of many of the small and medium-sized shops. An effective strike would have to be industry- or customer-wide, analogous to FLOC's (Farm Labor Organizing Committee) strike against Campbell's and Libby's where the farmworkers are directly employed by many small farmers. Since parts made in small shops are unlikely products of NC machine shops, a customer- or industry-wide strike would stand a chance of halting the controlling companies' production.

Conclusion

The introduction of NC processes in metal machining has affected the class struggle. It alters the skills required of production workers, but it is not clear that the skills required are lesser or greater than those needed for conventional machining processes. The major purpose of NC technology is to increase productivity and profits. This drive to increase profits has an economic consequence, as illustrated by the choice for a large manufacturer, between NC machining and subcontracting, and a political consequence, as seen in the moves against worker control and unionization. NC technology acts to increase productivity for the capitalist, and it thus acts to re-form the class struggle. It does not eliminate the working class from production, but it does change the conditions of production more to the immediate disadvantage of workers. □

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OVERCOMING MATH ANXIETY

by Sheila Tobias

Norton/New York, N.Y., 1978

\$10.95

For people who feel themselves to be failures at math, that they were never meant to understand the stuff in the first place, Sheila Tobias' book, *Overcoming Math Anxiety*, should be a revelation and perhaps a challenge. Tobias lets us know unequivocally how widespread math anxiety really is. We see the commonness of even many of the details of the sensation of failure in math class and in other encounters with math. In addition, we are given some ideas of how our individual problems might have arisen and how to solve them, for instance, that using intuition is "fair", even necessary — professional mathematicians use it far more frequently than we are led to believe in class, where the teacher knows the answers to all the problems already. The book is an important first step toward the elimination of math anxiety at the level of the individual.

Yet, there are some vital omissions. Notwithstanding the brave talk in the preface — "The book is mainly a discussion of how intimidation, myth, misunderstanding,

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and missed opportunities have affected a large proportion of the population" (p. 14) — the book settles into more of a *psychological* analysis of the problem than a political analysis of the institutionalization of math anxiety. It is very clearly recognized that math anxiety is more a problem of women than of men, and the math ability-sex connection is carefully criticized in the chapter on mathematics and sex, but somehow the problem is always personalized in the end: "Feelings are . . . at the heart of the problem" (p. 15). We are given personal incentives for wanting to get over a fear of math, we are given psychological analyses of how math anxiety operates, and we are given some pointers on how to shake off our individual hang-ups.

One might argue that Tobias was not attempting an exposition of how math anxiety is yet another way male hegemony oppresses women. One might argue, and I would agree, that the book was intended as a guide and support for individuals who, already with an inkling that they were duped into math anxiety, are trying to step past it. But even if one means to approach the issue in that way, to help individuals now, including a political analysis is important. If one sees that one's fear of math does not simply derive from an eighth-grade teacher who happened

to be sexist or racist, but from a whole school system that was sexist or racist, and indeed a whole society that was sexist or racist, I think for some people the urgency to overcome it is heightened — it almost becomes one's *duty* to overcome it. (Maybe an analogy can be made with the problem of smoking. Many people, I am sure, have stopped smoking through a realization of its physiological effects and then a lot of hard self-analysis and will. But I also know people who, having tried for years to quit, suddenly succeeded after reading the *Mother Jones* article detailing how the tobacco industry shapes our desires, profits from our affliction, and maintains our habit through manipulation of legislation. This kind of view is apparently enough to enable some people to leap beyond what have been insurmountable difficulties.)

As mentioned before, Tobias does emphasize math anxiety as largely a problem of women. This is implicit throughout the book and explicit in the chapter, "Mathematics and Sex", where it is stated, for example, "Both boys and girls are pressured, beginning at age 10, not to excel in areas designated by society as outside their sex-role domain" (p. 78). Yet, in the preface, she is clearly equivocal about how much a feminist issue math anxiety is:

Four years ago, when I began, I hypothesized that mathematics anxiety and mathematics avoidance were feminist issues. Now I am not so sure. Observing men has shown me that some men as well as the majority of women have been denied the pleasures and the power that competence in math and science can provide. The feminists sounded the alarm. But, as a result, people of both sexes are beginning to reassess their mathematical potential. (p. 15-16)

In one passage, criticisms such as those I make are acknowledged:

Several feminists criticize the anxiety model, pointing out that since the causes of math anxiety lie in "political and social forces that oppress women" and are not wholly psychological and educational in origin, the goal of remediation should not be "the curing of an individual case but the elimination of the conditions that foster the disease." (p. 97)

But the identification of math anxiety as a feminist issue is seen by Tobias as risky.

The identification of mathematics anxiety as a problem for women could become two-edged. Focusing on one more female "disability" may feed the prejudices that already abound in the real world about women and math, women and science, and women and machines. We also have to consider the needs of women who are very competent in math and have a hard time proving this to their colleagues. Finally, we have to contemplate the possibility that attention given to this issue might expose women to exploitation by "math anxiety experts". (p. 97)

Would Tobias then see affirmative action programs as feeding existing prejudices about women and minorities not belonging in positions of power? Would she see the spread of women's crisis centers as exposing women to "rape experts", and therefore undesirable or at best some-

thing to be weighed against its supposed disadvantages?

Be this as it may, the sexism issue is at least addressed. In contrast, not the barest mention is made of math anxiety as if affects minorities or the working class in general. In spite of the purposely personal approach taken in the book, it would have gained power by including some degree of discussion of math anxiety as a manifestation of institutionalized sexism *and* racism in a class society.

Ultimately, a recognition and analysis of math anxiety as a social problem, whose origins, perpetuation, and solution lie in society, is necessary in order for us to begin working on it as such. Case by case rehabilitation alone cannot hope to eradicate social problems.

The book has provoked in me some thoughts about teaching. I think a great deal more attention needs to be given by radicals to the teaching of basic skills at the adult level. It is in basic-skills classrooms that we shall encounter the people oppressed by our educational system who have already determined to do something about it. Possibly they are seeking nothing more than a solution to an individual problem.



The duty of a radical teacher is to convert the quest for solutions to personal problems to action for solutions to social problems. This requires three processes, some easier than others.

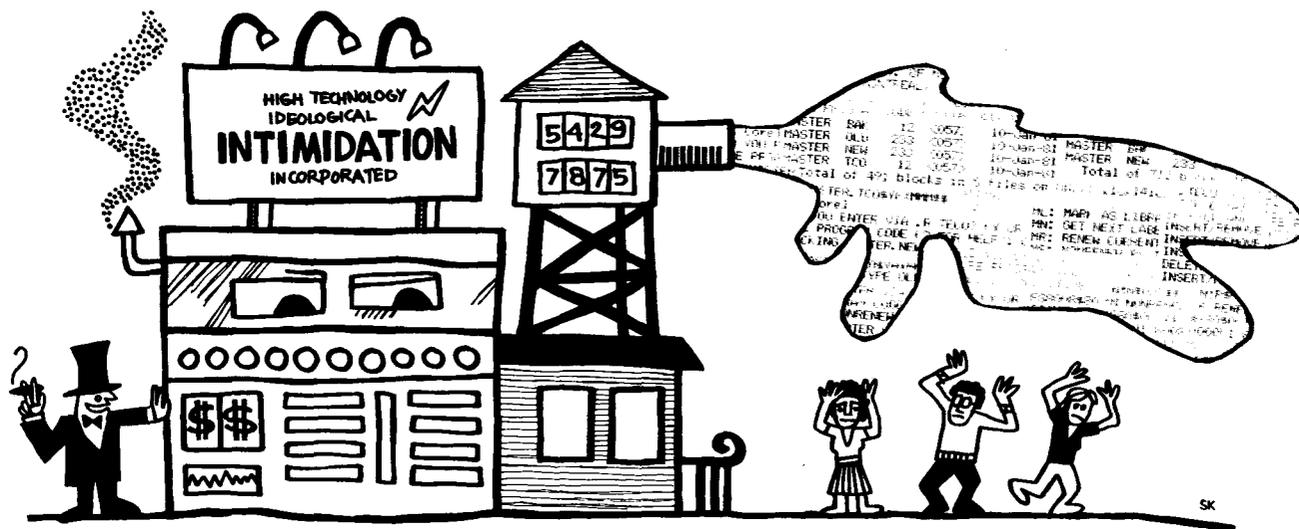
The first is of course *the teaching of the "subject matter" itself*. This, no doubt, calls for the usual drills, repetitive exercises, memorization, etc., depending on the material. Such is practice. However, effective teaching for adults should include the following two elements which are often omitted in schools:

The second element to be included is the elimination of individuals' feelings of special incompetence. Maybe this is best done by confronting the hang-ups in group talks. Tobias places a lot of emphasis on this:

I believe that this talking process is at the heart of the treatment of math anxiety. As we have seen, it helps some people to know that they are not the only ones to suffer from fears

essentially analogous to the first stage of consciousness-raising about any issue, and is absolutely prerequisite to useful action. It should be easily worked into group discussions, when it does not arise on its own.

The third process is *the making of political consciousness and activism*. This is what I conceive of as the second stage of consciousness-raising, the realization of one's own role in changing external circumstances. Obviously, this is most often a long and tortuous process, and



Steve Karian

First, wherever possible, the process(es) by which one arrives at the solution, acceptable punctuation, etc., should be explained logically and in terms of previously acquired knowledge. When there are several ways to solve a problem, they should be acknowledged, as for example Tobias acknowledges them in the chapter on word-problem solving. When there is no easy logic to explain something, as in the case of some mathematical postulates or spellings, this should be made plain. In other words, real, *generalizable* learning cannot happen without demystification of the problem-solving process.

of inadequacy about math or science. (p. 248) She describes the variations on "math therapy" or "math desensitization" used in workshops around the country. The discussion is instructive for teachers of other kinds of skills as well.

The socially important consequence of teaching basic skills in this way is the generation of self-confidence.

The second process in the duty of radical "remedial" teachers is *the provocation of the question of how and why one was kept ignorant for so long*. This analysis and questioning of external circumstances is

no one person ever really accomplishes it for another. But this must be the goal and inspiration of radical teaching.

Tobias gives both students and teachers much knowledge indispensable to the process of learning (or teaching) mathematical skills. Her own closeness to math anxiety, her travels to various math workshops and clinics across the country, her discussions with practiced teachers, provide us a wealth of accumulated experience.

The book is wanting with regard to raising political consciousness. I do not argue that this was ever its intent, only that it should have been. □

A Problem of Ideology and Social Relations

BOTTLE BABIES AND MANAGED MOTHERS

by Mark Wilson

Opposition to the aggressive marketing of infant formula by multinational corporations has gained widespread recognition and support over the last few years. Numerous humanitarian groups with widely varying political perspectives have joined in condemning the widespread and misleading advertising, ready availability, improper labeling, free samples, and direct sales of artificial infant foods. While being told that infant formula will improve the well being of both infants and mothers, its use, particularly in the Third World, is actually resulting in millions of infant deaths.

Thus far, the movement against infant formula has mostly focused rather narrowly on the health or promotional aspects of what has come to be known as the great "bottle baby" scandal. This growing movement has already generated considerable literature on the marketing, nutritional, disease, and micro-economic issues. In addition, there are many epidemiological and physiological studies that clearly show the superiority of breast feeding over infant formula (see box). However, the biological evidence, which is abundant and consistent, cannot be fully understood nor acted upon until it is put into a macro-political context. The focus of study must now turn to the underlying determinants of who eats how much of what: the productive and social relations of the ownership and control of science and technology, and the ideology that interacts with these relations. This essay is an attempt to outline some of the issues with particular regard to the bottle baby problem.

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Immediate Causes of the "Bottle Baby" Problem

The debate surrounding the "bottle baby" problem has focused primarily on the promotional tactics in the Third World by multinational corporations of developed capitalist countries. There is no doubt that massive media advertising, free samples, and advice from physicians and nurses (and company sales people who appear as such) have led many Third World mothers, who are quite capable of breast feeding their children, nevertheless to buy and use formula. (7, 17, 56, 60, 73, 51, 11, 12, 33, 42, 53, 59, 62, 67, 75, 76, 83) The high cost of formula that women are encouraged to buy leads to increased poverty. Over-dilution of the formula often causes infant malnutrition and/or death. It is in this sense that multinationals kill babies. However, by limiting our analysis to this more immediate level, we may be only tackling the immediate symptoms and not the underlying causes.

For example, if the "problem" is viewed as unethical promotion and ignorance, the solution must be regulation and education. Infant formula producers have to be asked, or forced to behave, more "ethically". In response, the corporations then argue that they are merely making available a product that mothers already want, that preparation and use instructions are clearly printed on the container, and that we must maintain a system of "freedom" and "democracy" to allow people to make choices and profits.

Secondly, since mothers are ignorant, national governments and health workers must be taught, and then pass on to the mothers, the value of breast feeding and the dangers of bottle feeding. (6, 42, 60, 33, 49, 54, 58) As a result mothers will know how to interpret, and more effectively shield themselves from, the company's sales efforts.



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Undoubtedly, these tactics have been somewhat effective; indeed, I support them as necessary immediate measures that appear to have improved the well being and survival of some infants. But however necessary this approach might be, it is not enough; it is acting on the symptoms but not the underlying causes. This reform approach to the bottle baby problem does not seriously challenge the set of social relations of power, or of the underlying and reinforcing ideology that ultimately create the conditions in which the problem exists and of which it is a part. By analyzing the problem within the confines of the existing system of social-political-economic relations, the criticisms that are mounted can only propose defensive, rear guard, reform. Only after there are millions of unnecessary infant deaths, and Third World countries deepen their dependence on the developed countries, is it possible to limit or redirect the marketing. But in addition, the "problem" can come to be seen as infant formula, not malnutrition and disease; as misleading advertising and not the oppression of women; as the high cost of formula and not the exploitation and oppression of the Third World. (15,80)

In part, I am raising a procedural issue of tactics and strategy. Most critics have largely ignored the strategic problems that involve a structural analysis and have focused on immediate action.

In part, I am raising the issue of the "levels" of analysis and of causation: proximate-distant, immediate-ultimate. Malnutrition is, at the molecular

level, a problem of the amount and types of biochemical reactions. This is determined in part by behavior at another level: that of the whole organism. But with people, our individual behavior is largely affected by even "higher" levels, that of social groups. Our system of social relations and consciousness create both the possibilities and the constraints within which the biochemical reactions take place.

Further, I am criticizing the reductionism in analyses that separates levels, even parts of levels and emphasizes lower levels as more "basic", thus more important to our understanding. We end up knowing much about biochemical, much less about the political-economic aspects, and have virtually no understanding of how these and other aspects interrelate.

In what follows, I outline some of these productive and social relations as something subject to change rather than an accepted "given" of the bottle baby problem; these are some of the issues that must be addressed if significant changes are to be made.

Patriarchal and Capitalist Science and Technology

Among the most profound forces shaping the existence of most humans in the world today are the domination and exploitation of women by men, and of one class or nation by another. Patriarchy, capitalism and imperialism are complex, partly overlapping systems of social, productive, reproductive, and ideological relations that structure our beliefs and interactions with each other and with nature. An understanding of the "bottle baby" problem is incomplete without analysis at this level. However, it is as useless to simply assert this without further explanation, as it is impossible to attempt any detailed analysis here. Thus, I have outlined very generally some of the ideological, productive and social relations that are involved. My claim is that changing these social relations is ultimately necessary, but not sufficient, to eliminate the kinds of health/social problems of which the "bottle baby" syndrome is but one.

To understand why and how infant formula is currently produced and marketed, it is useful to consider how commodities in general are conceived and used, and the role of science and technology in that process. Most contemporary science and technology can be broadly viewed in terms of three characteristics: commodity production, reductionism/mechanism and objectivity.

First, capitalist science and technology, directed and controlled by the capitalist class, is used for the production of commodities. Whether or not what is produced is "needed", "healthy", "practical", or in any sense improves human well being is secondary to the concern that it be profitable and marketable. Thus science and technology are used to produce and promote commodities that maintain the dominance of the capitalist class. (14, 22, 32, 36, 79) In one sense, infant

formula is yet another of many commodities developed by science to increase the profits and power of the few who direct it.

Second, contemporary capitalist science, including medicine, is increasingly reductionist and mechanistic in its posing and solving of problems. The infant's overall physical, psychic and social well being can thus be reduced to a series of smaller isolated problems of which nutrition is but one. Nutrients are nutrients and the constellation of other interrelated factors is someone else's department. The conceptualization of all these processes as isolable is essentially mechanistic: much like a machine, the body (more recently the mind as well) is seen as a living machine operating according to mechanical/physical principles. Even though most parts are needed for the machine to function well, separate parts can be removed, improved and replaced. Infant formula is thus a fuel that can be seen as a replacement analogue of the fuel that has been isolated from the much more complex social and biological process of breastfeeding.

Third, the development of scientific objectivity and the attempt to separate feeling from thinking (actually the denial of feeling) has led to scientific objectification. Characteristic of most men (men being the dominant force in the development of science), objectification is particularly pronounced in the technology for and medical science administered to women. (9, 37) Women, infants, and breast milk all become objects to be treated, manipulated, duplicated, and operated. Referring to all women, Arditti has written that "scientists

have studied us as the reproductive systems of the species, and we have been reduced to our reproductive organs, our secondary sexual characteristics and/or sexual behavior." (10)

Little of this process, though assuredly some, is conscious action on the part of (male) scientists and capitalists. The sexism, elitism and objectification are part of an ideological and social system which structures thought and relations and allows many to see it as natural, inevitable and immutable. Yet, it is undeniable that men in general, and particularly those of the capitalist class, derive continued benefits of power and wealth from the system that they control.

These processes allow for infant feeding, like any other labor in the factory, field or home, to be organized and directed by science. The process of scientific management (22) has been extended to other activities of motherhood and has created the industrial model of baby feeding. (37) The three characteristics of science and technology: development toward commodity production, reductionism and mechanization, and objectification of people, can be seen as characteristic of medicine as well.

Medical Science, Women, and Babies

A male dominated medical science has, especially within this century, taken away much of the health care and healing power that was traditionally women's activity. (37, 10, 21, 22, 19, 25, 36, 49) Birthing in particular, and reproduction in general, have become a male controlled medical event. Accompanying this is the



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creation of specialized knowledge that forces women to become increasingly dependent upon (mostly male) physicians for advice. This is one of the major pathways by which women are encouraged to use artificial formula that they rarely need.

Infant formula as a commodity is promoted as essential food, but also as a non-prescription drug. This is, in part, a result of the investment and marketing history of the corporations that sell infant formula: agribusiness and pharmaceuticals. But the market had to be created and developed from its beginnings in the late 19th century. (8)

The tremendous success of the effort at marketing infant formula, as both food and as a "medicine", is based on the power of "expertise" in the medical profession and the power of advertisement, both of which play on people's fears and aspirations. This ideological power interacts with a real material inequality that includes lack of access to knowledge by women in general and poor women in particular. This has increasingly become a source of social control.

The medical system has not only expanded the number of kinds of matters it addresses, but also its

jurisdictions. (36) Through both processes this cooptation leads to increasing control. The medical system is replacing lay sources of help. Decisions about and knowledge of infant feeding which, in most cultures, have traditionally been those of the mother and a supportive network of other women (relatives and friends) (e.g., 55, 67, 75, 49, 10), are now the domain of science, medicine, and technology.

The relationship that birthing women have with the medical establishment is increasingly one of submission to authority. (37) (This has been the case for decades in developed countries and is increasingly the case in the Third World.) Established in clinics and hospitals, this dependence of mothers on medical "authority" is fostered during the hospital birth period, extends to most people wearing "whites" and is brought into the home where advertising bombardments reinforce what the "authorities" have said. Thus, the approach to, and effectiveness of, formula promotion has its roots in a deeper system of power relations between men and women, science and women's knowledge, the "expert" physician and the patient.

BREAST VS. BOTTLE CONTROVERSY

Results of health and nutritional studies. Epidemiological studies consistently show that, under the living conditions of most people in the world today, artificially-fed infants have much higher rates of mortality and morbidity (disease and malnutrition) than breast-fed infants (see Wray's recent review.*(86)) Studies in the U.S. and Europe show a pattern changing with time: before the mid-1930's all major studies showed significantly lower incidence of death and disease among breast-fed babies, while after the thirties the few studies done on relatively wealthy, well-educated people with access to health care facilities showed no significant differences in morbidity or mortality between artificially-fed and breast-fed infants. (Many other studies did show significant differences in morbidity.) This pattern is not repeated in the Third World: results consistently show significantly higher mortality and morbidity rates in infants fed an artificial formula diet. Other studies have shown that breast-fed babies have less childhood tooth decay. (69,77,78,3,4)

Socio-physiologic factors in the controversy. There is a multitude of studies showing the beneficial effects of breast milk and breast-feeding. (see 1,2,6,7,17,31,34 for reviews) The antibiotic properties of human colostrum and breast milk are now well known. (see reviews in 24,41,44,47,63,72,82) Immunoglobulins and phage cells transmitted to breast-fed infants increase resistance to pathogens. These elements are absent from artificial infant foods.

Infant formulas can closely replicate the known nutrient content of human milk (5,46), yet it is well documented that the nutrients that many infants actually receive from artificial feeding are grossly insufficient (17,56) or excessive. (69,45) Problems of under- or over-dilution of the artificial formula, and also the introduction of pathogens (17,56), are not present with breast-feeding.

*Numbers refer to references listed at the end of Wilson's article.

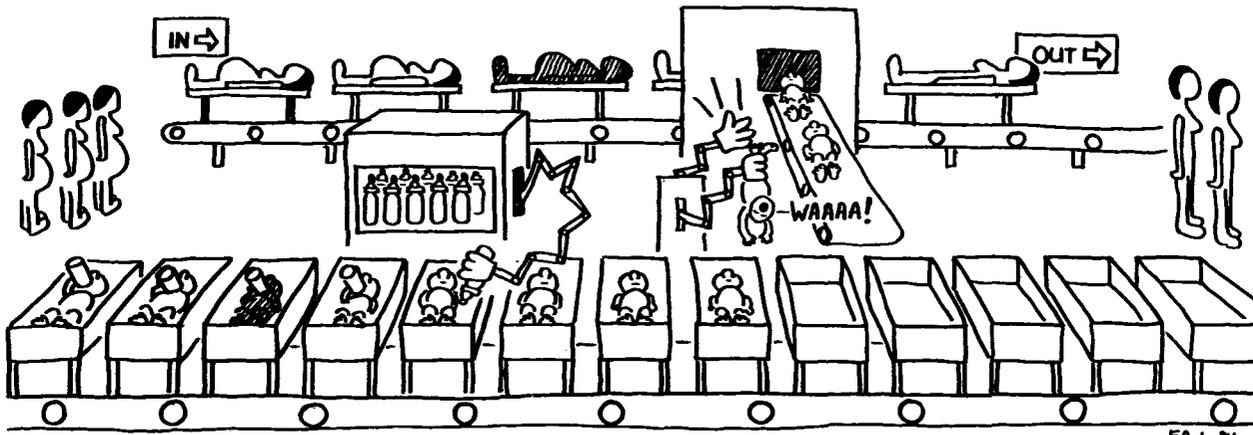
Most studies (3,43,55,60,61,66,73,74), especially those involving poor people, estimate greater per-family and national costs from bottle feeding of infants. Further savings would be expected from breast-feeding when the improved health and lowered health care expenditures are considered.

One to three percent of mothers fail to produce an adequate amount of milk due to organic, or natural, problems. Most mothers who fail to produce milk do so because they are fearful or not knowledgeable, psychological factors directly traceable to sociological conditions created by the use of infant formula (see the accompanying article), and to the promotional tactics used in its marketing. (see 27,28,30,51,57, 85,11,12,33,42)

Legitimate uses of artificial milk. Artificial feeding may be useful or essential in circumstances involving "inborn errors of metabolism" (4,18,70), illness of the infant (65), or illness or death of the mother. In some cases where pollutants contaminate breast milk or where the mother must receive drugs, artificial foods are necessary. (13,71,16) Lactation failure or inadequacy may also be compensated for with infant formula feeding, but these very problems would be reduced to 1-3% of mothers were it not for the prevalence of infant formula, as mentioned above.

In cases of extreme malnutrition mothers may be unable to produce the quality or quantity of milk for optimal infant nutrition. (see 51,57,85 for reviews) Use of formula feeding may be an appropriate palliative measure, but the high cost of the formula would more usually exacerbate the poverty and associated malnutrition. Ultimately, the problem is not physiological, but social, and it is at this level that solutions must be sought.

We are now faced with the problem of why infant formula is produced, marketed, purchased, and used in such quantity. It would appear that at the heart of the problem is the basic structure and ideology of the capitalist/patriarchal system, as shown in the accompanying article.



EA 1-81

Ellen Armstrong

Advertising and Ideology

An important component of the system just outlined is the process by which people, in particular women, come to accept these power relations. Advertising functions as an ideological force which supports and partly creates such relations.

As a political-economic system which thrives on consumption by most and accumulation by a few, capitalism, neo-colonialism and imperialism consistently require aggressive promotion. Advertising "works" in that it creates a "need" for some product or increases the frequency of sales of a commodity that is already being bought. (14, 38, 74) As one New York investment banker frankly feared: "Were advertising not so important, . . . food would be bought on the basis of economy and nutritional value." (64) More and more with the development of monopoly capitalism, price competition has decreased as a means of attracting purchases. Advertising that focuses on variation in appearance, packaging, and reputed qualities increasingly determines what we buy. (14) The *apparent* superiority of one product over another is sufficient to establish its dominance. In this case, we see the establishment of the apparent superiority of bottle formula over breast milk, even though the formula costs much more. Ironically, the users of this expensive formula, expensive mostly because of advertising costs and not the cost of production, are paying dearly for the very advertising that is coercing them to buy it! Baran and Sweezy summarize the problem nicely:

The function of advertising, perhaps its dominant function today, thus becomes that of waging, on behalf of the producers and sellers of consumer goods a relentless war against saving and in favor of consumption. And the principle means of carrying out this task are to induce changes in fashion, create new wants, set new standards of status, enforce new norms of propriety. The unquestioned success of advertising in achieving these aims has greatly strengthened its role as a force counteracting monopoly capitalism's tendency to stagnation

and at the same time marked it as a chief architect of the famous "American Way of Life". (14, p.128)

Anti-Science Victim Blaming

"Structural" constraints such as these just outlined have for the most part not been questioned by infant formula critics. There are exceptions, such as Jelliffe and Jelliffe who do criticize the "commercialization" of formula and the "iatrogenic"* nature of bottle fed malnutrition. (51, 43, 52, 76) However, the danger that this approach engenders is that it can become simplistically anti-scientific and anti-technological. For example, Jelliffe attributes the problem in the decline of breast feeding to "linear-Westernism" and the "dramatic scientific discoveries and ways of thought which occurred with the industrial revolution and with the parallel medical revolution of the last century". (43, p. 233) Without identifying the social forces that lie behind the thought and applications, we can only conclude that science and technology *per se* are at fault. Similarly, the "iatrogenic" effect of the physician's advice, operating here via the advocacy of infant formula, can be used as an argument against physicians and even against knowledge.

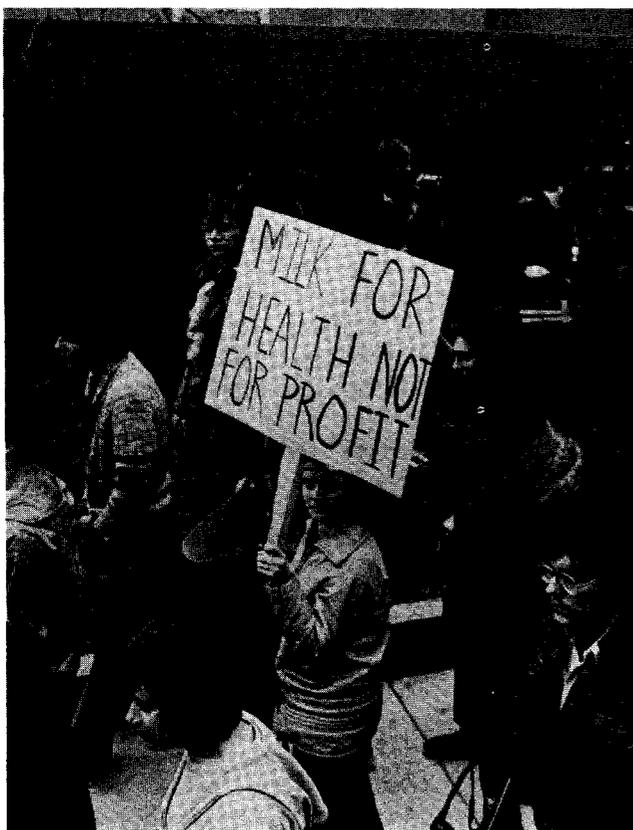
The science/technology problem is not "whether", but "which" and "for whom". No doubt some technologies and sciences are inherently undesirable from an anti-sexist, anti-racist and anti-capitalist point of view. But this must not become an argument against all science. Science can be used to benefit oppressed peoples though generally only when it is under their control.

Most studies of the "social" issues concerning the rapid increase in infant formula use are in one sense descriptions rather than analyses: "urbanization," increase in "working mothers," "lack of education," "modernization", etc. This makes it easy to blame the victim for the unfortunate choices she has made. While it is clear that advertising and other promotion has "pulled" women into the infant formula syndrome, they are not

*Iatrogenesis is the process of the *creation* of illness in patients by the actions of medical personnel. (see 50)

simply helpless pawns. There are real forces that show seemingly irrational choices to be tactically rational choices in an irrationally constrained and oppressive situation.

For example, bottle feeding represents the only real alternative (albeit more risky and costly) to many women who work and hence cannot breast feed. At-the-job, paid nursing time and child care facilities are not going to be willingly offered by a capitalist whose priority is minimizing costs (primarily labor costs) while maximizing the amount of commodity produced. (The proliferation of child care facilities during World War II, which were removed at the end of the war, is a special



Ellen Shub

case that actually supports this claim.) Unlike China, where paid post-partum leaves, creches, and nursing breaks allow women to maintain their jobs and income, and still breast feed (26), women working as wage laborers in most of the capitalist world have no such opportunities.

While formula makes the sharing of infant feeding possible, in practice, of course, it is typically the mother (or aunt or grandmother) who prepares and administers the bottle, and cleans up after. At a time when more childcare technology is being developed, mothers are actually spending *more* time at it. (25) It is not surprising that, especially in sexist societies, Third World and developed, where cleaning, childcare, cooking, etc. (and often wage labor as well) are women's work, women will

want at least to allow the possibility that someone else might help with infant feeding.

Although some have argued that the roots and continued existence of sexist divisions of labor and power lie in women's biology (39), I argue that sexism is a social disease for which there is no technological fix (least of all, one coming from a male dominated technology!). Indeed, it is the pattern of most technological development and commodity production under capitalism that it further oppresses and alienates the people who use it. (22) The interjection of commodities into social relations and the increasing dependence on commodity acquisition and consumption in developing a sense of well being lie at the heart of this process. Infant formula is an example, but it also has direct material roots. Artificial feeding was originally pushed in the U.S. beginning in the late 1800's (see 8) not only because its sale made profits but perhaps also because its use permitted the inclusion of reproductive-age women into the wage labor force (thus only compromising slightly their unpaid labor in the home).

There is however the danger of a reactionary backlash in which demands for the elimination of oppressive and exploitative sexual division of labor, in the family and at the factory (that must accompany a non-exploitative increase in breastfeeding) are dropped and breastfeeding is seen as simply a motherly duty. Breastfeeding is neither magically easy nor simply part of a larger set of "womanly" activities (23) that keep mothers at home tending to their "natural" functions.

It is true that breastfeeding is one of the jobs that only women can perform. It is, however, also one of many activities that are socially prescribed by a system of male dominance. The liberation of women is a problem of changing society, not eliminating biology. What Arditti writes regarding pregnancy is equally valid when applied to infant feeding:

... it is paradoxical that the excesses of an impersonal technology developed by males in a sexist society can be viewed as important for the liberation of women. . . . Technology will not erase 50,000 years of female oppression. (9, p. 31)

A feminist or anti-capitalist analysis must not view technological developments as necessarily liberating; oppression and exploitation are not determined by our biology or by "nature", but are created by people in particular kinds of social formations and relations.

Conclusion

The type of analysis just outlined, if used to develop a course of action, might not appear very promising. A major reorganization of social relations and ideology is not likely to be won within the next month or two, and in the meantime, malnutrition and disease in the Third

World is claiming thousands of infants daily. But such an analysis, when more fully developed, is not intended for short term reform. Rather, I think it serves other purposes.

First, by critically questioning the deeper roots of malnutrition, we are better able to understand relationships among levels of causation and across "disciplines"; this allows for a more comprehensive attack on the problem and can induce others to work for social change where heretofore, the problem may have been seen simply as one of technology or ignorance. This is *not* an issue to be addressed only by specialists in infant nutrition. Furthermore, it may serve to unite and make more effective people who are struggling over particular issues that have the same underlying causes.

Secondly, we become better able to oppose the tendency (resulting from our training) to examine problems as isolable units to be solved one at a time. The relationship of the particular infant feeding problem to those of

poverty in general, poor sanitation, inadequate housing, insufficient education, sexism, and elitism can be understood as part of the general problem of development in the Third World. Thus, we can begin to see the possibilities of working to change a few of the more pervasive social/ecological relations that underlie many particular manifestations.

Third, the integration of short term and long term efforts becomes an issue. It becomes possible to ask not only what tactics might be developed to immediately oppose the oppressive conditions, but how these tactics fit into a long term strategy for social change that will eliminate many problems (though create new ones) and minimize the need for short term responses. It raises the possibility of the realistic planning for health and not simply the fight against ill-health. Only then can the use of infant formula become part of a preventative system of well being instead of the immediate cause of disease and death. □

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Agricultural Mechanization

(continued from p. 8)

chemistry, genetics, and ecology are used in research designed to mechanize the tomato harvest.

But a more important, if subtler, link exists between basic and applied science. As the results of basic science are put to the service of applied science there must be occasions where the basic science has not yet come up with answers to the problems posed by the applied. Can the basic scientists avoid the subtle influence of the needs in the applied sector? Indeed, *should* they avoid them? And what questions in basic science have been avoided because of these subtle influences coming from the applied sciences?

Documented answers to such questions are all but impossible. But some indications can be obtained from examples. My own research has been concerned with a variety of questions associated with plant populations. In the course of my investigations I have been influenced by other researchers with a slightly more applied approach than my own. That influence has encouraged me to consider the relationship between crop productivity and various factors of the plant population (for the purpose of understanding what ecological factors, in principle, can lead to higher productivity). Without a doubt, my basic science has been influenced by questions emanating from the applied sector. But the influence goes much further. Once having incorporated questions of productivity into my subconscious, further theoretical considerations led me to the conclusion that productivity could most easily be increased by inter-

cropping — planting more than one type of crop on a given plot. Most often the response from other researchers was, “but modern harvesting techniques cannot deal with intercrops”. My research on intercropping was considerably delayed by that response. And where did that response come from? It came from a world view, or ideology, that accepted certain ways of doing things as given. That acceptance in turn had been conditioned by years of applied research in agriculture aimed in a particular direction, namely toward mechanical harvesting of single crop systems. Thus, the relationship between my “basic” science and applied science was (and still is) a two-way street. The questions I ask are partly influenced by the perceived needs of applied science, and the questions I neglect to ask are likewise partly influenced by the conventional wisdom of applied science. It is my contention that all basic scientists are subjected to the same influences and are likely to respond in the same way — whether they admit it or not.

In this short analysis of the research establishment I have tried to demonstrate that the research of a group of scientists working at the level of applied science and technology is influenced strongly by funding from private corporations, though supported mainly by public monies. These researchers are influenced by and exert an influence on other researchers, some of whom regard themselves as involved only in basic research. (There are, of course, other links that are important to the research establishment, such as cooperative arrange-

ments, formal and informal, with governmental and industrial research institutes, but I shall not dwell on these here.)

But this description of the research establishment is somewhat one-dimensional so far. To understand its dynamics we must understand the social forces in which it is imbedded and under which it evolved. To understand that social fabric one must fully grasp the fact that there is a war going on in the Midwest, a class war.

Class Warfare in the Midwest

The production of tomato products in the Midwest involves three distinct but inter-related groups: processors, growers and workers. Processors include Campbell's, Libby-McNeill-Libby, Hunt, Heinz, and Stokely-Van Camp. (15) Growers include both small-scale and large-scale, with many more of the former than the latter. Growers are on contract to and largely under complete control of the processor. For example, at Libby's plant in Leipsic, Ohio the acreage a grower contracts for is based on his/her yield-per-acre average over the previous three years. In 1978 these amounts ranged from five to two hundred acres. The contracted acreage and the individual's "average yield" then set a limit on the quantity of tomatoes a grower can bring to Libby's. The contracted tonnage may be exceeded by up to 10%. If more than that is produced, it must first be offered to Libby's, and if Libby's refuses the excess, it may be sold on the open market, with Libby's permission.

The tomato plants themselves are owned by the processor. Some growers are given seeds in the spring, but most are given plants which the processor starts earlier in the South and then brings up to Ohio. Once the plants are in the ground, representatives of the processor inspect every farm once a week, looking for diseases, insects, etc. They then advise farmers as to what and when to spray.

Most harvesting is done by migrant workers. It is estimated that about 19,000 migrants harvest tomatoes in the Midwest (10,000 in Ohio, 7,000 in Indiana, and 2,000 in Michigan). Working and living conditions are substandard as documented in many sources. Most come from Texas, fewer from Florida, and an increasing number from Mexico. (16)

In an attempt to improve working conditions, increase wages, and fight for other benefits, migrant farmworkers in northern Ohio founded the Farm Labor Organizing Committee (FLOC) in 1969. FLOC's purpose has been to organize the workers into a unit capable of negotiating its position in the food industry. In the early seventies FLOC won contracts with many tomato growers. The contracts guaranteed a minimum price per hamper from those growers, and some minor concessions with regard to living and working conditions.

Yet, because of the complex productive relations involving the three groups, the approach of negotiating

contracts with individual growers was ultimately self-defeating for the farmworkers. The growers were caught in a bind: because the processors had driven prices they were willing to pay down to rock-bottom level, growers could not easily pay more for labor. Because regional competition is intense (with California dominating production), Midwest processors are forced to cut production costs as much as possible. Growers are getting less and less. Frequently, when faced with the additional demands made by labor, small growers will simply go to a different crop. But the processors always have other growers waiting to sign contracts. The union was putting itself in the position of squeezing the grower even more and effectively driving those growers willing to sign contracts out of the tomato business.

Having gone through an analysis similar to the above, FLOC changed its strategy from dealing only with the farmers who hire migrant labor to dealing more directly with the canneries. Thus, strikes in 1978, 1979, and 1980 were directed against those growers who were under contract to either Libby's or Campbell's, two of the major producers of tomato juice and ketchup in the area. One of the central demands of the strike is that FLOC be included as a third party in the annual contract negotiations between the canneries and growers.



Workbook/cpf

The strike has been directed against only those farmers under contract to either Libby's or Campbell's, the major processors in the area. The canneries reacted swiftly. Libby's immediately filed a \$1.8 million suit against FLOC for losses due to the strike (for which a settlement has recently been reached). Also, within a month they assembled a giant new evaporator at their Leipsic, Ohio plant.

FLOC was well aware that its confrontations with the processors would reinforce existing trends toward mechanization. This gave greater urgency to their organizing efforts with the hope that workers would have some control over the implementation of machine production. FLOC is not opposed to mechanization — it welcomes the advent of machines in the fields, but on the workers' terms. That is, the introduction of machines in the field work must go hand-in-hand with training displaced workers for new jobs and supporting them and their families until new jobs are secured.

Thus, what has been developing since 1969 in the Midwest is a struggle between two classes, the class represented by the five giant processors and the class represented by the 19,000 workers. Large and small growers and the workers inside the canneries are presently either bystanders or fighting on the side of the processors (a smaller number are fighting on the side of the farmworkers). But the major struggle is between labor and capital, between farmworkers and processors.

It is in this social background that the research establishment must be viewed. It is a fundamental error to view the main problem as one of less nutritious food, or damage to the environment, or changing patterns of land tenure, although all these may ultimately be consequences of mechanization. The main problem is that research is conceived, planned, and carried out from the point of view of one particular class, the class represented by the processors. Furthermore, this "class bias" does not merely refer to the developing technologies nor to the applied sciences that serve them, but extends all the way to the basic science itself. This may be a bitter pill to swallow for many people, especially for scientists.

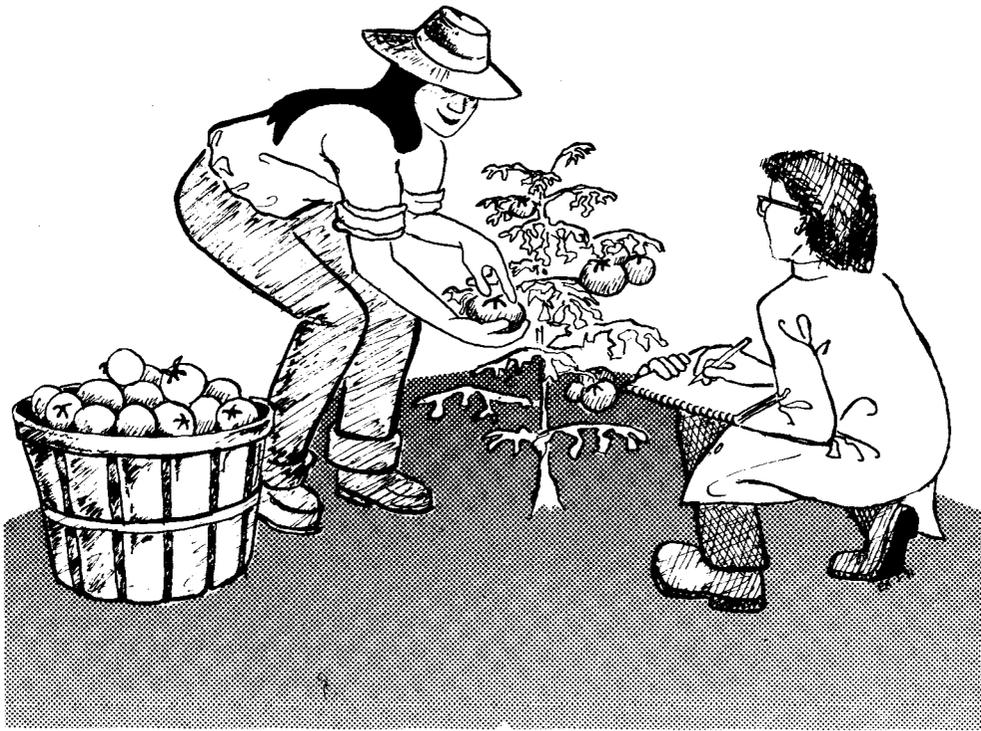
Which Class Will the Scientist Serve?

Through numerous informal interviews with farmworkers I have discovered a great deal of job dissatisfaction (hardly a surprising result). In answer to the question, "how could the job be made better?", I have received many interesting answers. "Develop a way of eliminating the stooping", "plant the tomatoes less densely (so each whole plant can be scanned more quickly)", "stop spraying pesticides (so the children are not exposed to residues on the ground)", "design a better container to receive the hand-picked tomatoes", are just a few of the examples. In general, the responses were all posing research problems aimed at the fundamental question "How can the farmworkers job be made less noxious?" (Obvious qualifications to that question are "without decreasing the number of jobs available" and "without devaluing the price of labor".) Such concepts may seem strange at first. Some people automatically respond to the question "How can the farmworkers job be made less noxious without decreasing the number of jobs available and without devaluing the price of labor", as if it were somehow internally contradictory. They seem to have adopted an underlying assumption that research in agriculture is for the purpose of decreasing the number of workers needed. They equate increased production with increased production per dollar invested where labor is not more than dollars invested. But who invests those dollars, and who reaps the profits of the production? Why are not questions of job quality and preservation regarded as valid questions? Because those in a position of posing the "interesting" research questions are ideologically in step with the processors.

What if the problems posed by the workers were taken seriously? It may be instructive to construct such a scenario. Suppose, for example, researchers took seriously the desire for a pesticide-free environment. A number of farmworkers and researchers would get together to ask what sort of management strategy would be required to enable growers to spray less pesticide, and what sort of basic and applied research would be necessary to achieve that management technology. Probably they would come to the point that some sort of integrated pest management scheme would be best. (17) The requirements that jobs not be lost and labor not be devalued might suggest that techniques of sampling insect larvae and eggs, needed to project in this future infestation rates, be developed in such a way that farmworkers could be trained to do them in a short time. This would both preserve jobs and possibly increase the value of labor. Once these concepts became fixed in the minds and practice of researchers, they would be in a position to ask further questions, most of which cannot even be dreamed of at this point: perhaps questions to do with handling devices to collect insect larvae, or improved digging devices to sample nematodes in the soil, or counting screens to more easily assess insect egg density. In short, a whole new field of study would be created, one with its own questions and problems and perhaps even with its own rules of evaluation, one which looks like the old way of doing it in some respects, but takes its underlying mission as something quite different — to serve labor rather than capital.

Is such a scenario likely to happen? Of course not, at least not with current political and economic structures. In 1966 a number of interested parties were invited to Purdue University for a symposium on the mechanization of tomato harvest, another planning session to coordinate the diverse fields of study needed to fully mechanize the tomato harvest in the Midwest. The group numbered in the hundreds and was initially addressed by Max D. Reeder, General Manager of the Agriculture division of the H.J. Heinz Co. Mr. Reeder opened with the following remarks:

It is my pleasure to talk to this *representative* group interested in 'Mechanization of Tomato Harvesting'. I would judge that the processors represented in this room today account for 90 percent of the tomatoes produced for processing in the United States. Growers present would be less than 1% of the tomato industry; and, although there are many research workers present, they are a minority of the number actually being paid to do some work relative to tomatoes. . . . If I have a purpose, it is to emphasize that mechanization is the only choice if our industry is to continue to expand in the market place. Growers, processors, research workers and consumers all have a stake in mechanization. (Emphasis mine.)



Ellen Armstrong

Both the words and the tone are indicative of the problem. Growers, processors, research workers and consumers were to sit down and decide on the nature of future research in the developing tomato industry. But absent, by design, were the farmworkers or their representatives and the cannery workers or their representatives. Although Dale E. Moore from the giant tri-valley growers was present, absent was Ike Zebel whose 200 acres just got bought up because he could not afford the greater costs of production imposed on small growers by the wonders of mechanization. And while the growers, processors and researchers present undoubtedly consume ketchup on their hamburgers, no consumer advocates in the broader sense were to be found in the audience. Researchers were to get their ideas and future directions from this body, a body representing the interests of a particular class. If their ideas were good enough, they might have gotten \$83,000 from Bishopric Products to develop them. Alternatives which serve labor were not even thought of and even if they were they would get neither the necessary funding nor the prestige and career advancement that comes with the mainstream capital-serving ideas. Researchers may be innocent dupes or even unwilling conscripts, but they in effect were one class of people in their war against another class.

Notes on Developing a Radical Science Practice

The two scenarios just developed were (1) science as it is — researchers engaged in basic and applied research aimed at the mechanization of the tomato harvest — and (2) science as it could be — researchers engaged in basic and applied research aimed at the improvement of

farmworkers' jobs. The first is science in service of the bourgeois class, the second is science in service of the working class. The first is the present reality, the second a future goal. The problem is how to develop scientific practice in such a way that this future goal is created out of the present reality.

A popular opinion on the left is that as long as political power is in the hands of the capitalist class, the development of a science that is responsive to working class needs will be impossible. At best this is simply muddy thinking, at worst it is an excuse for scientists with radical ideas to maintain the comfort of their social position as scientist while engaging in political work on the side. While it may have originated from an honest effort at a progressive political analysis, its effect is to serve the bourgeois class. How convenient to have socially conscious and highly trained scientists hamstrung so they cannot use their training to satisfy their social conscience. How conveniently debilitating to force them into a schizophrenic life where their science, if done at all, certainly does not challenge, and frequently can be used by, the ruling class, while their politics are pursued as an avocation.

To understand the origin of this predicament we must look at possible alternatives. One alternative might look something like the scenario described above. Scientists engaged in agricultural research would get together with workers so as to assess, formally and informally, the research needs of the working class. Rather than attending conferences sponsored by Campbell's Soup Co., they would attend conferences sponsored by FLOC. Rather than hobnobbing with executives of Libby-McNeill-Libby, they would hang around with grant workers. Rather than accept positions as board

members of Campbell's Soup Co., they would be staff members of FLOC. In short, the ties, formal and informal, strong and weak, that now exist between scientists and the capitalist class, could be constructed between scientists and the working class.

What are the impediments to forming such ties? First and foremost is the lack of material support for such efforts. Scientists serving the capitalist class are rewarded with grants, tenure, prestige etc. Scientists openly serving the working class will have grant proposals routinely rejected, tenure or career advancement will be obtained with considerably more difficulty, fellow scientists will scoff at their work. But no one ever said it would be easy. I merely wish to suggest that it is possible.

But perhaps the material problems are not as important as the ideological problems. Again, popular radical analysis is proving to be a stumbling block. The false position that claims science can never serve the working class when political power is in the hands of the capitalist class receives some of its rationalization from a recognition that *any* scientific advance can be utilized by the capitalist class, that no matter how politically progressive the intent, all scientific and technological advances will ultimately be taken control of by the class in power, the capitalist class. But if this analysis is correct, what can we expect when the working class comes to power? Will all scientific and technological advances ultimately come under the control of the working class? An affirmative answer to this question implies that the technocratic interpretations of earlier Marxist analysts such as Bernal were correct. Science itself is pure. Its use is determined by who holds political power.

Such an analysis is wrong and presents tremendous impediments to the development of a radical science, a science that serves the working class. The principal problem with this analysis lies in its point of origin. Given a scientific or technological advance, which class will ultimately use it? This is the origin. When one begins at this point there is only one answer. But beginning at this point ignores the dynamic nature of class struggle. We must begin the analysis with the realities of class struggle, and pursue scientific problems that are suggested by the current level of class struggle, by the classes that are involved and by their role in the system of social relations. Unquestionably the class in power will *eventually* control the technology, but what is needed is technology to aid the working class in its *present* struggle for power.

The classic military analogy is illustrative: class warfare is like conventional warfare. Science and technology in effect make weapons used in the various battles in the war. Scientists must decide for which side they are going to make weapons. Weapons provide only a temporary advantage to one side because they are eventually used by the other side also. The ultimate question may be "who will eventually control technol-

ogy?", in which case the answer must be "the class that controls political power." But the more immediate question is the important one on which we must base our actions. What technology is needed right now to advance the cause of the working class in its struggle for power? The pursuit of an answer to that question is the beginning of a practicing radical science. □

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5. Some project titles clearly indicate that the funds were at least partly for tomato research (e.g. Determination of the Mycoflora associated with decomposition and toxicogenicity of selected fresh fruit) while others are not so obvious (e.g. Enzymatic synthesis and inheritance of carotenes). The determination of \$202,104 spent out of public funds is based on identifying grant funds earmarked not specifically for tomato research but for individuals known to be engaged in some form of tomato research. Those individuals do not spend 100% of their time on tomato research so the 202 thousand dollar figure is not an accurate estimate of direct public expenditure. If we presume an average fraction of 10% devoted to research relevant to tomato mechanization (I believe a conservative figure) we estimate about \$20,000 directly contributed out of public funds. Data from Financial Support for Research Purdue University Agricultural experiment Station Annual Reports for Fiscal years 1966-1970.
6. Taking a conservative estimate of \$15,000 annual salary for the 25 Purdue researchers again presuming a 10% effort, and allowing for only 20 individuals to be active at any given year (sabbaticals, transfers etc.) we find that \$30,000 (15,000 X 20 X .1) in public funds were allocated indirectly through salaries for tomato research each year. Thus over the 8-year period of 1969-1977 approximately \$240,000 in public funds had been devoted to salaries for research specifically aimed at the mechanization of the tomato industry.
7. Meyerhoff, A. Agribusiness on Campus. *The Nation*. Feb. 16 1980: 170-173 (1980).
8. Grants specifically granted to the 25 researchers amounted to \$463,395. Allowing for only a 10% effort we obtain \$46,340. Gifts are not given to individuals but rather to the University in general making it sometimes difficult to determine their purpose. At times it is obvious (e.g. a gift of \$1000 in 1975 from Saluto Foods Corporation specifically for test runs on tomato sauce and economic feasibility studies studies on these test runs), and at other times obscure (e.g. a gift of \$400 from Nor-Am Agricultural Products for Herbicide research). If we include all gifts even marginally related to tomato research for the year 1974-1975 we obtain figures of \$46,700 from 33 separate private institutions, and for the year 1975-1976, \$69,240 from 36 different interests. Taking the average of these two years and applying the 10% rule (again, believed to be a conservative procedure) we obtain

\$46,376 in gifts directly related to tomato mechanization research during the 8-year period of concern. Data from the same source as in reference 11.

9. It has been unofficially reported for example that Ohio State University receives public funds in excess of \$200,000 annually for tomato mechanization research. (Letter from Baldemar Velasquez president of FLOC, to supporters 1980).

10. That Bishopric industries contributed \$83,910 over 6 years and it is estimated that Purdue received only \$92,716 over an 8 year period that includes that 6 years, is evidence that the figures presented herein are extremely conservative. Over 90% of the estimated 8-year figure is accounted for in just 6 years by one source.

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news notes

LEAK IN RECOMBINANT DNA LAB

On a Monday morning in early September last year, a graduate student in Biology at the University of Michigan entered his office only to find his books and desk area saturated with water. A quick survey of his office revealed that the origin of the water was the ceiling and that the laboratory above his office was the source of the flood. Leaking laboratories would not necessarily be newsworthy, but this leaky laboratory was a fully certified P3-level recombinant DNA laboratory.

Apparently what had happened was that a piece of tubing attached to a faucet burst under a pressure build-up. The resulting flood leaked out of the lab into the office below. While no P3 work was going on in the lab at the time, the leak raises serious questions as to the safety of P3 labs. That lab had been certified as capable of containing dangerous organisms. Does this not include organisms that can be transported in water?

As soon as he heard news of the leak, James Cather, associate chairman of Biology, notified the biohazard committee of the University of Michigan. According to Cather they eventually

sent someone around to put some caulking in the most obvious places on the floor of the lab. Does the lab still leak? No one knows.

But that seemingly does not matter anyway. In a blatantly obvious violation of the *spirit* of the NIH guidelines, contractors are apparently allowed to ignore vertical leakage. While such precautions as negative air pressure and sophisticated sanitation equipment are required in recombinant DNA labs, evidently nothing says they can not leak. This one certainly does. How many others do? Are we perhaps seeing the beginning of the same sort of accident/coverup pattern we saw in the nuclear industry? Stay tuned, this is probably only the beginning.

—John Vandermeer
University of Michigan

EPA COVERUP OF LOVE CANAL DAMAGE

As a result of the Love Canal disaster, the EPA initiated a study of possible chromosome damage to the residents of the Love Canal area. This study was contracted to the Biogenics Corporation, with Dante Picciano as senior member of the research team. When the

report came out, Picciano reported that indeed there were chromosome abnormalities in the Love Canal population. On June 13, 1980, *Science* reported that the EPA panel which reviewed the Biogenics study had found that the chromosome abnormalities "... exist only in the mind of Picciano." The panel also charged that Biogenics had not used a control group to provide comparisons, so there was no basis to conclude anything from Picciano's study.

But in the next issue of *Science*, Margery W. Shaw from the Medical Genetics Center of the University of Texas Health Sciences Center wrote to confirm, through her own review, that many of Picciano's serious claims were true. Picciano also wrote to explain his version of the events. He explained that he requested a control group from the EPA, which the EPA promised to provide him with. The EPA failed to provide him with that control group. He claimed that the chromosome abnormalities he had observed "... now exist in the minds of seven geneticists, including the chief of Genetic Toxicology for EPA." He went on to explain how the EPA went out of its way to exclude his team's recommendations for appointments to the review panel, and that at

least one member had a potential conflict of interest. The EPA review was made without the panel visiting Picciano's laboratory.

What is the EPA protecting, the environment or the Hooker Chemical Company?

EL SALVADOR ALERT

On October 15, 1979, a group of young officers initiated a coup which ousted General Romero from the presidency. During the decade prior to this coup, concomitant with the worsening economic conditions, fraudulent elections and increasing repression, the popular military and mass organizations grew in strength tremendously.

During the following two and one half months over 1,000 people were killed compared to approximately 600 in the first ten months of 1979. The armed forces and right-wing paramilitary organizations increased the violence and repression to unprecedented levels. As a result, in the beginning of January, the civilian junta members and almost all cabinet officials, composed of all the liberal reformist sectors, resigned. The new government has been composed of Christian Democrats and the military.

On January 10, all the popular organizations formed the Revolutionary Mass Coordinator (CRM). On January 22, over 250,000 people celebrated this event with a demonstration in San Salvador. Government security forces fired upon them, killing over 40.

In the beginning of March an Agrarian Reform was announced and a state of siege imposed. This marked a tremendous escalation of repression which culminated on March 24 with the assassination of Archbishop Oscar Romero. As a result of these events, one junta member and several cabinet members resigned.

In March, the U.S. sent a Mobile Training Team of 36 military advisers to El Salvador.

On April 16, 80% of the ex-members of the Christian Democrats, plus the Social Democrats, professionals and all the democratic reformist sectors joined with the CRM to form the Democratic Revolutionary Front (FDR).

On May 14-15, in a coordinated action between the Salvadorean and

Honduran armies, over 600 elderly people, women and children were massacred at the Sumpul River.

On June 24-25, in a general strike called by the FDR, participation was over 95%. On June 26, the Government security forces invaded the National University (which has been occupied ever since) and fired on students from the ground and from helicopters. Over 130 people were killed during those three days.

In the end of July, a large-scale military operation was carried out in the northeastern region. Over 1,500 troops participated and suffered heavy losses from the popular army. In early August, in similar actions, there were reports of the death in combat of five U.S. military advisers.

On August 13-15, during a general strike called by the FDR, the people practiced self-defence and preparation for general insurrection.

On September 1, most of the young reformist officers who had initiated the coup were sent abroad in what marked the complete control of the armed forces by the most reactionary sectors.

On October 10, all the political military organizations joined to create the Farabundo Marti Front for National Liberation (FMLN), with the DRU as its political military leadership. This marked a tremendous advance in the unity and strength of the popular struggle.

On October 15, the government launched its largest military offensive against the popular organizations, mainly in Morazan. Over 5,000 troops participated in the 20 day offensive which ended with the defeat of the army. Over 300 troops were killed. Thus, Morazan was reconfirmed as a liberated zone. In the following three weeks, some of the major garrisons were captured by FMLN forces.

On October 29, the Rector of the National University, Felix Ulloa was killed by members of a right-wing death squad.

On November 27, six leaders of the FDR were murdered by government troops.

In recent months, eight U.S. Navy ships have been patrolling the Pacific Coast of El Salvador with over 2,000 marines aboard. A growing number of reports have indicated the participation of North Americans in combat actions. Most dangerously, the U.S. has had a direct role in guiding and coordinating

the security forces of Guatemala, Honduras and Venezuela, and conducting military training in Panama. These measures have been in preparation for a massive intervention in El Salvador.

Since the above summary was prepared by Casa El Salvador in San Francisco, three American Nuns and one lay worker were killed on December 2nd and two American advisers to the land reform program were killed on January 4. Both killings were carried out by right wing squads.

Meanwhile, the launching of a final offensive against the military-civilian Junta is rumored. The revolutionary forces are making an effort to overthrow the Junta before Reagan takes office. The Reagan administration is going to confront an arrangement of forces in Central America entirely different from what past U.S. Administrations had to confront. It is hard to predict now what Reagan's policy towards the region will be considering the broad opposition to direct U.S. military intervention.

Human rights and religious organizations are pressuring Carter and Reagan to stop all military and economic aid to El Salvador. The State Department, however, has not changed its position. The coming months will be critical; *solidarity efforts must be increased.*

For more information about how to get involved with the solidarity movement contact CISPES (Committee in Solidarity with the People of El Salvador):

CISPES-Chicago Sub-Reg.
3411 W. Diversity Rm. 1
Chicago, IL 60647
(312) 227-1632

CISPES-East Coast Reg.
P.O. Box 12056
Washington, D.C. 20005
(202) 887-5019

CISPES-Austin Sub-Reg.
P.O. Box 8407
University of Texas Sta.
Austin, TX 78712

Science for the People recently endorsed a statement which condemned the repressive activities of the El Salvador Junta and called on the U.S. government to cut all economic and military aid to El Salvador. For a copy of the resolution, and suggestions for how scientists and health care workers can get involved, contact: SftP, 897 Main St., Cambridge, MA 02139, #(617) 547-0370.

breakthroughs

PHOTOCOPIES CAUSE MUTATIONS?

In the near future an insidious occupational hazard may be added to the already voluminous list. Using the Ames test, researchers investigated eleven models of photocopying machines manufactured by seven companies. Extracts of photocopies from seven models (from five of the companies) were capable of causing mutations.

The human health hazard suggested by these results is impossible to assess at the present time. In the Ames test the substance to be tested is added to a bacterial culture, which is then examined for mutations. Of known, tested carcinogens, 85% give a positive Ames test result, while less than 10% of presumed non-carcinogens do, so the test is a rapid, inexpensive screening procedure.

It is as yet unknown to what degree the mutagenic substances in photocopies may enter workers through volatility, skin adhesion, or the use of paper products made from recycled photocopies; moreover, some processes are not implicated at all. Further research is clearly warranted since workers in all walks of life are increasingly in contact with photocopied material.

Source: *Science*, Vol. 209, pp. 1037-1039, 1980.

GENETIC BASIS FOR RACE ELUSIVE

Certain obvious differences exist in the physical appearance of different groups of human beings, depending on geographical origins. Asians tend to have a yellowish cast to the skin while Europeans tend to have lighter skin. Africans usually have thick lips while Australian aborigines have thin lips. These and other physical differences are commonly assumed to be under genetic control, a not unwarranted assumption. Furthermore, some groups are known to have unusually high frequencies of certain genes, such as the sickle-cell gene in Blacks.

Based largely on these physical differences we have defined different groups as races. Races then are thought to have

a genetic base since they are defined by characteristics that we all agree are mainly genetic.

It is a seemingly small step from that position to generalize that many other genetic differences must also exist among races. But that small step is a gigantic step in its effect. It seems to provide a basis for any claim that a racial difference is genetic. While it is true that such claims would be highly suspicious *even if* there were many genetic differences between races, they nevertheless seem to gather great currency if it is assumed that race is essentially a biological concept, that many genetic differences exist among the various races.

A recent article by the Australian geneticist B.D.H. Latter presents data which challenge this basic assumption. Conceptually, Latter followed the earlier work of others (including Science for the People member Dick Lewontin) and asked: if two individual humans are chosen at random and we could look at their genes, to what extent might we be able to say whether or not the two came from the same race? In other words, if we could look at all the genes (and not only those that determine skin color or lip thickness, etc.) to what extent would those genes define groups of individuals as the races that we currently recognize? The answer is, hardly at all.

Using 18 genetic systems (10 blood groups, 3 serum proteins, and 5 soluble enzymes all told including 38 alleles) populations were sampled from six geographic groups (Europe, Africa, Near East and India, East Asia, America, and Oceania). Each geographic group was subdivided into regions (e.g. Jews, Arabs, and Indian regions for Near East and India) and populations were sampled within those regions. The data show that approximately 84% of the genetic diversity originates *within* populations, 4% between populations within regions, 2% between regions within groups and 10% between groups. Put another way, comparing two Jews we might find 20 out of 100 genes to be different between the two. Comparing a Jew to an Arab we might find 20.4 out of 100 genes to be different, and comparing

a Jew to an African we might find 22.7 out of 100 genes to be different. Defining races based on genetic factors would thus be next to an impossible task, unless we took arbitrary genes and made our definitions based on them. The "black race" makes as much biological sense as the "red-haired freckled-faced race."

This work corresponds almost exactly with the earlier work of Lewontin, and places severe doubt on the widely held assumption that many genetic differences exist among races. The concept of race seems to be a cultural and political concept more than a biological one.

Sources: Latter, B.D.H., *American Naturalist*, Vol. 116, pp. 220-237, 1980; Lewontin, R., *Evol. Biol.*, Vol. 6, pp. 381-389, 1972.

EFFECT OF RADIATION FURTHER JEOPARDIZES THE SEARCH FOR NUCLEAR WASTE DISPOSAL

One of the most recent proposals for the permanent storage of nuclear waste is to enclose it in huge glass or glass-like blocks. Recent experiments have shown that materials which contain alkali metals of alkaline earths — as would the large glass blocks — while themselves highly resistant to either breakdown from normal atmospheric exposure or radiation bombardment, are somehow changed so that they are broken down rapidly by atmospheric moisture after having been exposed to radiation. To quote from the report:

It would seem prudent to investigate these and related problems fully before we embark on the irreversible step of large-scale storage of nuclear waste in vitreous materials.

Once again, it's back to the drawing board for the nuclear engineers. Repeated announcements that the nuclear waste disposal problem has been solved are subsequently met with revelations like this one. Some say the problem will never be solved.

Sources: Hall, A.R.; J.T. Dalton; B. Hudson; J.A.C. Marples, *Management of Radioactive Wastes from the Nuclear Fuel Cycle*. (Int. Atomic Energy Agency, Vienna), Vol. 2, pp. 3-14, 1976; Hirsch, E.H., *Science*, Vol. 209, pp. 1520-1522, 1980.

CORPORATIONS TAKE CONTROL OVER PHOTOVOLTAICS

Recent advances in photovoltaic solar cell technology and the growing market for solar cells have increased the attractiveness of solar research to corporate investors.

The modern photovoltaic solar cell was first developed by the Bell Telephone Labs in 1954 as an outgrowth of their semiconductor research. When it was determined that the solar cell had no military applications, research almost stopped, except for that concerned with power sources for space satellites. In 1970 the federal government first began to study the terrestrial uses of solar power and it began funding research in 1972.

Most modern photovoltaic solar cells are based on silicon semiconductor crystals. The electrical properties of the semiconductor result from what is called a "p/n junction." This junction is the interface between two regions, each containing a small amount of a different impurity, which enables the semiconductor to readily conduct electric current in one direction. The electrical qualities of the p-region are determined by small concentrations of an element with a chemical valence one less than silicon, e.g., boron or gallium, in the crystal. The electrical qualities of the n-region are determined by small concentrations of an element whose chemical valence is one greater than silicon, e.g., phosphorus or arsenic. Electric current flows more readily from the n-region, which has a slight "excess" of negative charge, to the p-region than in the other direction. The impurities are added when the silicon is molten so that the p/n junction can only be destroyed by melting the crystal.

In conjunction with the renewed interest in photovoltaics, the cost of the most common cells fell from \$500/peak watt in 1970 to \$10/peak watt in 1980 (the cost/peak watt is the cost of the number of cells necessary to produce one watt of electricity when exposed to full sunlight at sea level). This was largely due to an increase in market demand and a forty-

fold increase in production. A study by the Department of Energy reports that if the cost of commercial cells can be reduced to less than \$2/peak watt, or if it can be held to \$10/peak watt while raising efficiencies to 25-30%, the market for solar cells would expand yet further.

There are several ways to increase efficiency. The theoretical limit of the efficiency of a single photovoltaic cell is 25%; the highest efficiency reported for a single cell to date is 22%, but most commercial cells operate at about 10%. If cells are put in tandem, for example, the theoretical efficiency is 40-50% (i.e., a tandem cell is an array built of individual cells which have peak sensitivities to different parts of the solar spectrum). If mirrors are added to concentrate light onto cells the efficiency can be increased to 60%, but such a system requires tracking mechanisms to keep it pointed directly at the sun and it operates only under clear skies, while conventional photovoltaic systems produce electricity even under cloudy skies.

The relative indestructibility of photovoltaic cells is one of the reasons they are an attractive power source. They convert sunlight directly into energy; they cannot wear out, since they have no moving parts; and they operate silently. They do not create waste products and, since they operate at the same temperature as their surroundings, they cannot produce thermal pollution.

The prospect of a rapid expansion in the market for photovoltaic solar cells, which is directly related to the strength of the environmental and anti-nuclear movements and the costs of fossil fuels, has led some of the energy giants to sharply increase their investments in solar energy. In 1970 only two companies manufactured photovoltaic solar cells and both were part of the semiconductor industry. In 1980 there are ten manufacturers. The three largest are Solarex (affiliated with Standard Oil of Indiana), Solar Power Corp. (owned by Exxon), and Arco Solar (owned by Arco). Under capitalism, large corporations are the only entities with the capabilities for large-scale production, which reduces unit costs. The immense profits of the energy conglomerates during the last decade have given them the financial resources to dominate the solar power industry; just as they earlier moved into coal and uranium, so they will profit from whatever energy choice is made. In addition, energy and aero-

space companies are coming to dominate the production of solar heating and cooling devices. Since even rooftop solar collectors usually have to be connected to a central power grid to provide both energy back-up and an outlet for excess power (otherwise they would be unreliable and uneconomical), it appears that solar technology is not incompatible with capitalism, nor even monopolies.

It is likely that solar corporations will achieve the goal of reducing the cost of commercial photovoltaic cells to \$2/peak watt. Even at that, electricity from photovoltaic cells would still cost four times as much as that now supplied by utility power grids. Photovoltaic cells would thus probably be used where utility grids are inappropriate, such as for rooftop collectors on isolated buildings, for water pumping in arid regions, and for village power in developing countries.

Many people have argued that solar technology is a way for developing countries to supply more of their people's needs, by spreading the availability of electricity, and to break the ties of dependency to the North Atlantic nations. Solar technology can supply a large part of a nation's electricity; however, it can not substitute for conventional power plants in many industrial uses. Moreover, a reliance on solar technology for energy production would leave these nations dependent on multinational corporations not only for photovoltaic cells, the technology of which is not simple, but for most other industrial products as well, enabling development of little besides tourist and service industries. An integrated development program using solar technology and conventional power plants may still be a sound development strategy, but solar technology alone cannot meet the power needs of the industrial base necessary for development.

Solar technology will not, of itself, overturn capitalism or international economic relations. Capitalist investment in solar technology, private and state, is a response to popular protests in both industrialized and nonindustrialized countries. It is, however, a capitalist response, for capitalism under pressure is adaptable.

Sources: Loferski, J.J., *The Sciences*, Vol. 20, p. 6; *Dollars & Sense*, No. 58; *St. Louis Post Dispatch*, Aug. 18, 1980; Graham, B.J., *Solar Age*, Nov. 1979.

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