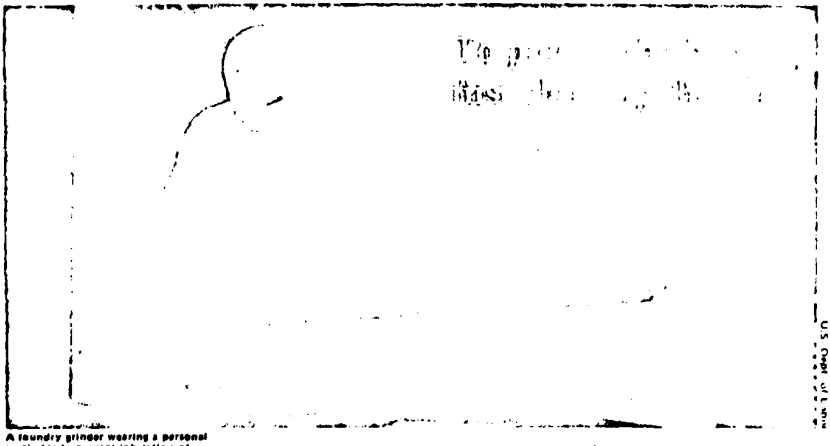
Workplace Burden

BY BARRY COMMONER



A foundry grinder wearing a personal respirator to prevent inhalation of silica dust.

AT FIRST GLANCE there appears to be a strong – but negative – relationship between the proponents of labor and the proponents of the environment. The examples are well known: Environmentalists won an important victory when the SST was abandoned, but the unions – which had joined Mr. Nixon and the aircraft industry's management in a strenuous effort to persuade Congress to approve the project – were among the defeated. When conservationists blocked the construction of a huge chemical plant at Hilton Head, South Carolina – an area much publicized for its natural beauty – their success was a defeat for the unemployed (a less-publicized feature of the area), who had looked forward to the plant as a source of jobs. In Oregon, some unions and businessmen have banded together into an organization to oppose the "environmental McCarthyism" of conservationists, who have blocked construction projects and other job-generating, but ecologically harmful activities. Management has cited environmental effects in justifying decisions to close down plants – over the understandable opposition of local labor.

These manifestations of an apparent built-in antagonism between

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labor's goals and concern for the environment are misleading. To a significant extent, the environmental crisis is an extension of problems that were once confined to the workplace to the community as a whole; likewise, the burden of these problems, which was once borne almost exclusively (and still most heavily) by the worker, is now shared by the entire population.

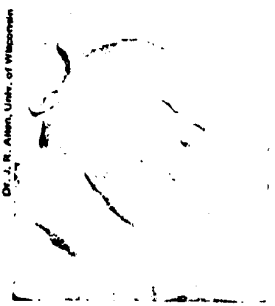
One example that clearly illustrates the divergent ways in which a single technical problem turns up first in the realm of labor and then in the realm of environmental concern is the effects of a class of widely used synthetic organic substances, polychlorinated biphenyls (PCBs).

To environmentalists, the PCB story is a typical tale of ecological misfortune. It begins in 1966 when a Swedish ecologist identified PCBs in a number of Baltic fish, in the body of an eagle, and in eagle feathers from museum specimens.[1] Only the feathers of eagles captured after 1944 contained PCBs, thus marking the date when these substances first entered the environment in significant amounts. Since this initial study, environmentalists have become concerned about the ecological effects of PCBs.

PCBs were first produced commercially in 1929 but came into large-scale use only during and after World War II, when they found numerous applications: as electrical insulators in transformers and condensers, in heat-exchange and hydraulic systems, in plastics, in tires, and in certain textiles, printers' inks and carbon papers. Being stable, they persist in the ecosystem and accumulate at the end points of food chains. PCBs, along with DDT, are present in essentially all living things everywhere in the world.[2]

Because PCBs closely resemble DDT in chemical structure, they are likely to have the same kind of biological effects in wildlife and people: interference with sex hormone activities (leading in birds to eggs which fail to develop); effects on liver enzymes, which change bodily response to certain drugs; and, on the basis of experiments with laboratory animals, a potential for inducing cancer.

On evidence such as this, the Food and Drug Administration (FDA) established acceptable limits for PCBs in foods; in 1969 Coho salmon in Lake Michigan exceeded 5 parts per million (ppm) of PCBs and were banned as food. In 1971 large amounts of animal feed were contaminated by PCBs leaking from a heat exchanger in a North Carolina plant; the contamination spread to chickens, eggs, and catfish, which were then embargoed. A general FDA survey of all types of food, initiated in 1969, found that 3,505 out of



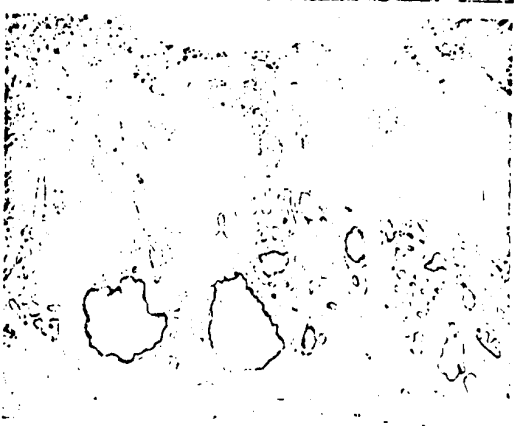
Dr. J. R. Allen, Univ. of Wisconsin

Generalized focal edema (swelling) and loss of hair developed in all monkeys within one month after receiving a diet to which 25 to 200 ppm of PCB had been added. Swollen inflamed eyelids and loss of eyelashes were observed as well as enlargement of the upper and lower lips.

Cross section from stomach wall of a control monkey.

Following PCB ingestion, hyperplastic mucosal glands of the stomach penetrate the muscularis mucosae to form numerous glands and mucous-filled cysts in the underlying submucosa.





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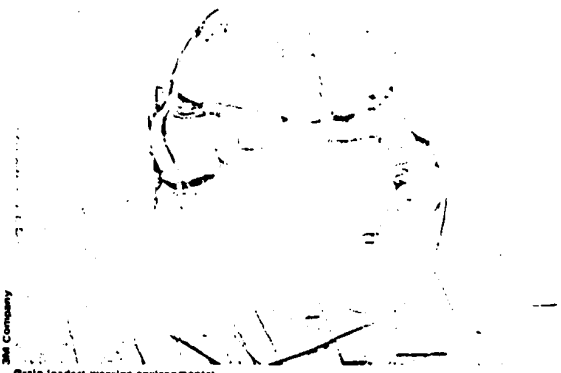
17,000 samples tested were contaminated with PCBs. Some packaged foods had particularly high levels of PCBs, stemming from the PCB content of the packaging, which had been manufactured from wastepaper containing a certain type of "carbonless" carbon paper – coated with microscopic plastic spheres containing PCBs. One researcher in a pesticide residue laboratory reports that when he was unable to obtain a sample of Aroclor (trade name for PCBs of the Monsanto Company, the only U.S. producer, accounting for about one-half the world's output) for comparison with suspected PCB residues from Coho salmon, he extracted the needed PCB from the laboratory's report forms, which were backed with "carbonless" carbon paper. Meanwhile in October 1968, over 1,000 Japanese people became seriously ill from eating rice oil contaminated with PCBs (again, originating in leaks from a heating system).

Following the first public notice of the problem (in June 1970, in an article in *Environment*, and in several newspaper stories) the Monsanto Company announced on September 1, 1970, that it had withdrawn PCBs from sale for uses which might lead to food contamination or other uncontrollable losses to the environment. U.S. sales dropped from a high of 75 million pounds in 1970 to about 35 million pounds in 1971. The company restricted the use of PCBs wholly to "confined" systems beginning in 1972. Clearly from the environmentalists' point of view, a victory has been won.



3M Company

Grain loaders wearing environmental systems designed to protect them from dust.

PCB and the Worker

Now let us look at the same problem from the worker's point of view. The industrial history of PCBs is well known. They were first manufactured in 1929; through their remarkable range of applications, they soon found a rapidly expanding market that grew particularly fast after World War II.

In April 1930, "O.D.," a 26-year-old man in Georgia joined the work force at the first U.S. PCB manufacturing plant. Three years later he developed a severe skin disease, chloracne, which covered his body with pustules. By October 1933, 23 of the 24 men in the plant suffered from chloracne.[3] It was also reported that the PCBs were so stable that, carried home on workers' clothes, they frequently caused chloracne among the workers' wives and children.[4]

During World War II, outbreaks of chloracne occurred among workers handling electrical equipment (especially cables) containing PCBs and the related chlorinated napthalenes.[5] By the end of the war, it was well established from *the workers' experience* that PCBs were so toxic that industrial techniques ought to be controlled to avoid exposure. It was also known that PCBs seriously affect the functions of the liver – an organ which is the seat of enzymatic processes that play pervasive roles in a great many living things. It was known, as well, that PCBs are so stable, and so toxic in minute amounts, that they can spread, in hazardous amounts, from the factory to the workers' homes on their clothes. Here, then, was a warning of a serious environmental hazard. For twenty years or more it was ignored.

Following World War II, the production and use of PCBs expanded rapidly. Despite the 1943 admonition by the director of the Division of Industrial Hygiene of the New York Department of Labor,[6] "... to see that such exposures are controlled insofar as humanly possible," PCBs were sold for use in fabrics, carbon papers, inks, and plastics – materials which come in contact with large numbers of people in a wide variety of ways. Even PCBs in sealed electrical components cannot be regarded as "controlled" in the sense of avoiding human exposure. Such components – for example, the condensers used in common fluorescent lighting fixtures – are eventually discarded as junk. They are then often incinerated – at temperatures which are usually high enough to destroy the container and vaporize the PCBs, but which are not high enough to destroy the latter. Result: exposure of refuse workers – and to a lesser extent the rest of us – to PCB vapors. A recent study showed that 81 percent of refuse workers had PCBs in their blood plasma, while this was true of only 11 percent of a control group.[7] Thus, even apart from accidents in which PCBs escape from "closed systems," PCBs are released into the environment and come into contact with people.

Contrasts

These contrasts between our approach to PCBs in the workplace and in the general environment are illuminating. Although the hazard from PCB was first discovered in the workplace in 1933, the problem was given relatively little scientific attention (beyond clinical description of chloracne and its asso-

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tion with PCBs) until 30 years later, when it was first recognized as an *environmental hazard*. As a result, we seem to be better informed about the detailed biological effects of PCBs on quail and minnows than we are about their effects on human beings.

Understandably, an industrial hygienist might reflect with some bitterness on the fact that while there is (to my knowledge) no monograph or comprehensive collection of papers on the effects of PCBs on workers, in April 1972, an entire issue of the journal *Environmental Health Perspectives* was devoted to various aspects of PCB ecology. A worker once exposed to PCBs might be, understandably, angered to discover from articles published in this special issue that: "The discovery of polychlorinated bi-phenyl (PCBs) in fish from the Baltic Sea in 1966 attracted widespread attention among scientists,"[7] while the discovery 30 years earlier that PCBs cause chloracne, did not.

The impact of *environmental* concern about PCBs on both scientific interest (as indicated by the number of scientific papers published on the biological effects of PCBs) and on the production of PCBs is shown in Figure 1. Relatively few papers were published until after 1966, when the widespread distribution of PCBs in the environment was first discovered. Since then, the number of papers published annually has risen sharply. The general public first learned about the problem in 1970 – and in that same year PCB production in the U.S. began its sharp decline.

There is much irony – and tragedy – in the PCB story, for it shows that had the scientific community given enough attention to its earlier effects on workers, the present ecological hazard could have been avoided and the long-term effects of industrial exposures would now be much better understood. Had industry heeded the 1943 warning to *prevent* contact between PCBs and people, we might have avoided a situation in which, according to a recent estimate, 1,500 to 2,000 tons of PCBs per year are "lost" to the air, 4,000 to 5,000 tons per year to fresh and coastal waters, and 18,000 tons per year to dumps and landfills.[8]

Particularly ironic is the fact that early attention to the effects of PCBs on workers could have provided advance warning that their chemical cousins – DDT and other insecticides based on chlorinated hydrocarbons – which were first manufactured some ten years *after* the first commercial production of PCBs are also too toxic to be openly disseminated in the environment. In effect, proper attention to the fate of worker "D.D." stricken with PCB-induced chloracne in Georgia in 1933, and the

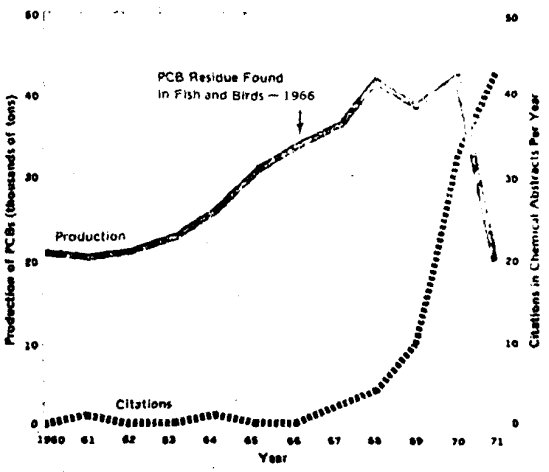

FIGURE 1
MEASURE OF PCB CONCERN
Decline in PCB production (top curve) began only after the chemical was found widely in the environment. The number of scientific articles on PCBs (bottom curve) also rose sharply after this discovery. PCBs were discovered to cause the skin disease chloracne in industrial workers in 1933.

workers who followed him, might have warned us in time to avoid the great DDT debacle.

Environment on the Job

Precise links between problems of the environment and of the workplace emerge when one considers the effects of specific pollutants, such as sulfur dioxide, nitrogen oxides, and carcinogenic (cancer-causing) hydrocarbons. Except when they are so concentrated as to have immediate toxic effects on the worker, the influence of such substances on health is not regarded as reportable "work injuries" at present. Nevertheless, these pollutants – which, it will be recalled, are the cause of major concerns in the general environment – are responsible for serious health effects among workers exposed to them on the job.

A recent study of smelter workers by the National Institute of Occupational Health and Safety (NIOSH) shows that the incidence of lung cancer among smelter workers is 229 percent higher than that expected in a similar nearby population of nonsmelter workers. The incidence of tuberculosis is 41 percent greater than expected, and the incidence of heart disease is 18 percent greater than expected.[9] All of these effects are readily understandable from the known effects of sulfur dioxide on the lungs: it attacks the lung cells that help to remove toxic substances from the air passages.

Another detailed NIOSH study of disease among steel workers reveals that workers heavily exposed to the fumes of coking plants (which contain the carcinogen, benzopyrene) exhibit a cancer incidence 104 percent greater than expected.[10] Other studies show that workers exposed to asbestos – now also recognized as an important pollutant of the general environment – experience a significantly elevated incidence of lung cancer. Similarly, uranium miners and mill workers experience an excessive rate of lung cancer, due to elevated radiation levels.

The point at issue here is this: If, in the environmental arena we find reason to be concerned about the exposure of the general population to pollutants such as sulfur dioxide, carcinogenic hydrocarbons, asbestos, and radioactivity, and if we recognize that, to a considerable degree, these pollutants originate from industrial operations, then there is

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– or ought to be – a community of interest between the industrial worker and the citizen generally. Clearly it will be the industrial worker who is exposed to the highest levels of the pollutants that trouble all of us in the environment; equally clearly the most direct way to prevent environmental dissemination is to clean up the plant.

NIOSH scientists have recently reported a notorious example of how poor plant conditions generate hazards not only for the worker, but in the environment outside the plant. In a recent investigation of an asbestos insulation plant in Tyler, Texas, they found that because of grossly inadequate precautions, nearly all of the workers in the plant were exposed to concentrations of asbestos in the air considerably in excess of the standard.[11] A number of the workers showed evidence of asbestos-related disease. One cause of trouble was the practice of emptying the sacks in which asbestos was shipped to the plant by hand – with enough vigorous shaking to scatter a good deal of asbestos dust in the air. The NIOSH investigators also discovered that poor housekeeping extended this hazard from the plant to the neighborhood: Waste asbestos was dumped in several open heaps outside the plant from which it was scattered by the wind. Finally, as its ultimate contribution to environmental quality, the plant management sold the empty asbestos bags to the numerous rose nurseries in Tyler ("The Rose Capital of the World"), and tests showed that the hapless gardeners who received plants packed in these sacks almost certainly received an unacceptable dose of asbestos with their rose bushes.

That toxic substances carried into the home from the workplace may also accumulate in house dust (where it can readily come in contact with a crawling baby) is shown by another recent report. Investigators found that vacuum cleaner sweepings from the house of a worker occupationally exposed to PCBs contained 180 ppm of that material.[12] Selikoff and co-workers have already shown that asbestos workers often carry significant concentrations of this material into their homes. These few instances suggest how important it would be to make a systematic study of the transport of hazardous substances from the workplace to the home, where not only the worker is at risk, but also his family.

Environment at Work and in General

These considerations raise serious questions about the relationship between the environmental standards that have been adopted for the workplace and those which are applied in the general environment. It is now widely accepted that in the latter – for example, the Environmental Protection Agency (EPA) standards for pollutants in urban air – a judgment must be made of the relative value of the benefits derived from the pollution-producing activity and of the hazards to environmental quality that result from it. Thus, the environmental standard adopted for, let us say, sulfur dioxide, reflects a judgment (made by the EPA, hopefully in response to general public desire) of the relative benefit to society of the electric power produced by the plants that emit sulfur dioxide and the relative social cost of the resultant disease and physical damage caused by this pollutant.

Against this background it is illuminating to compare such environmental standards adopted in industry for acceptable in-plant exposure to the same hazard. This is shown in Table I. The contrast is striking: in every case the exposure allowable in the workplace is some 10 to 100 times greater than that allowable in the general environment.

How should we interpret this disparity between acceptable environmental standards in the workplace and in the outside air? It might be argued, of course, that since the occupational standards are for an 8-hour-per-day exposure and the common environmental standard (which governs the acceptable annual arithmetic mean level) is for continuous, 24-hour-per-day exposure, the latter should, logically, be lower. However, this approach would only call for approximately a 3-fold difference between the two standards rather than the actual 10- to 100-fold differences. The reality of the discrepancies between the two types of standards is evident when the workplace standards are compared with the environmental standards for *intermittent* exposure. Thus, while the workplace standard for sulfur dioxide permits daily eight-hour exposure to 5 ppm, the environmental standard is exceeded if the level rises above 0.5 ppm for three hours once a year. Similar discrepancies are evident for the other pollutants tabulated in Table I.

It would appear, then, that in absolute terms the two sets of standards *require that the worker accept an environmental insult which is not tolerated outside the workplace.*

The extra burden of pollutants im-

TABLE I

ENVIRONMENTAL VERSUS OCCUPATIONAL STANDARDS

Pollutant	Environmental Standard (EPA)		Occupational Standard (OSHA)	
Sulfur dioxide (in parts per million)*	annual arithmetic mean	0.03		5
	maximum 24 hr. once/year*	0.14		
	maximum 3 hr. once/year*	0.50		
Carbon monoxide (in parts per million)	maximum 8 hr. once/year*	9		50
	maximum 1 hr. once/year*	35		
Nitrogen dioxide (in parts per million)	annual arithmetic mean	0.5		5
Particulates (in milligrams per cubic meter)	annual geometric mean	0.075	respirable fraction	5
	maximum 24 hr. once/year*	0.26	total dust	15
Lead (in micrograms per cubic meter)		0.7 (USSR)		10 (USSR)

* Ambient air standards are given several values for short-term concentrations: that is, "maximum *n*-hour concentration not to be exceeded more than once per year. . . ." All in-plant exposures are presumably for an eight-hour day.

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posed on the worker is usually justified by a biological argument – originally offered to support the difference between occupational and environmental standards for ionizing radiation. It is argued that since the general population, unlike the working population, includes significant numbers of children, pregnant women, the aged, and others who are especially vulnerable to the effects of a health hazard, they ought to be given the extra protection of the more strict standard. However, the new evidence, cited earlier, that chemical pollutants may be carried home by the worker, where they can become a hazard to the more vulnerable members of his family argues that, on these very grounds, the industrial standards may be too lenient.

It should be noted, as well, that industrial standards of exposure to chemicals are usually based on estimates of their direct, immediate toxicity rather than on the possible long-term effects, such as cancer or birth defects. However, it is known that substances which have relatively low, direct toxic effects, may exert powerful long-term effects. Thus, certain phthalates which are relatively low in direct toxicity have drastic disruptive effects on embryonic development, because they act much more strongly on dividing cells (as in an embryo) than on nondividing ones. (Thus when female rats are exposed to a concentration of a phthalate derivative which has no direct toxic effects on them, nevertheless 93 percent of the fetuses which they bear show skeletal abnormalities.)[13] It was this disparity that led to the thalidomide tragedy. Again, because of the possibility of inadvertently transporting an industrial hazard into the worker's home, it would appear that industrial standards should be strict enough not only to protect the worker against immediate toxicity, but also to protect the worker and the more vulnerable members of his family, against long-term effects.

Labor and Environmentalists

Given these considerations, it seems to me that despite their superficial conflict there are deep and powerful reasons for a community of interest between labor and environmentalists. From the evidence cited earlier it should be clear how much environmental concerns can benefit from close links with the problems of the work place simply because the workers' occupational diseases often serve as a kind of early warning system of broader environmental problems to come.

The value to the worker of support from the environmental scientist is equally evident. From the PCB story it is clear, for example, that environmental concerns, by eliminating some of the more obviously thoughtless industrial use of PCBs (such as carbon paper) are, thereby, reducing the PCB hazard to workers in those industries. (A Japanese study shows that PCB adheres to the fingers of those handling "carbonless" carbon papers and that the contaminant does not readily wash off.)[14] Beyond such direct benefits is the indirect but, I believe, important benefit of the growing appreciation of the ecological principles of occupational health. Thus workers, aware of the ecological law that "everything has to go somewhere," are now asking management to account fully for the deliveries to the plant of hazardous substances, such as mercury. How much of what is delivered is not shipped out in the product, but is "lost" – to the work environment, to the outside environment, to the workers' bodies, or to their homes?

Perhaps the most basic reason for the community of interest between the worker and the environmentalist is that both the condition of the workplace and the quality of the environment appear to be, in a fundamental sense, external to the marketplace economy. It is, after all, the hoped-for, short-term gain that governs the design of most productive technologies, not their impact on the environment or the workplace. Both environmental pollution and the hazards of the workplace are economic "externalities." There is considerable reason to believe that in both the workpisce and the environment, efforts made to improve conditions are likely to become costs which are not reflected in increased production – and which therefore lower productivity.

Thus, an important link between the work place and the environment lies in the area of economics. It is now widely recognized that environmental degradation represents an unpaid cost of production. In a country such as the U.S., where production is governed by private enterprise and produces private gain, the savings represented by unmet environmental costs benefit the producer, while the costs – in the form of a degraded environment and all its harmful effects – are directed elsewhere. The most intense burden from industrial pollution is borne by the industrial worker – who is, after all, exposed to the pollutant before it escapes from the plant and is diluted as it spreads into the environment. Then, a less intense but more widespread burden of pollutants is borne by the population at large. Thus, uncontrolled environmental pollution represents a savings for the producer and a cost borne by the worker and society at large. Inevitably, then, if the cost of environmental degradation is to be met it will involve a redistribution of the costs and benefits of production between the individual entrepreneur and society as a whole. This is, of course, a long-standing – and in a country such as the U.S., still unresolved – issue of social justice, as between the workers and the profits of the entrepreneur, or indeed, as between the justice of permitting a private entrepreneur to gain, preferentially, from the use of resources – including the environment – which are, in fact, public property.

These are some of the reasons why labor has a vital stake in the quality of the environment, and why environmental quality cannot be achieved without the help of labor. Workers know a great deal about pollution problems because they are, literally, so close to them. Environmentalists are informed about the workplace, because it is the origin of so many environmental problems.

The need for a new alliance is clear. Neither worker nor environmentalist can reach their separate goals without joining in a common one: to reconstruct the nation's productive system so that it conforms to the imperatives of the environment which supports it, meets the needs of the workers who operate it, and secures the future of the people who have built it.

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