ANNEX 7

TO MINUTES OF THE JAKARTA MEETING

MULTINATIONAL INVESTMENT, ENVIRONMENT AND DEVELOPMENT

(WCED/85/4)

WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT

SECOND MEETING
Jakarta, 27-29 March 1985

WCED/85/4

Item 5.2 of the Provisional Agenda

PAPERS ON MULTINATIONAL INVESTMENT, ENVIRONMENT AND DEVELOPMENT

SECOND MEETING
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Item 5.2 of the Provisional Agenda

Multinational Investment: Environment and Development

Note by the Secretary General

As mentioned in the annotations to the Provisional Agenda, it would be useful to have a general discussion in Jakarta on the agenda item "International Economic Relations and Environment". Apart from informing each other of our initial views on this complex question, it would also provide necessay guidance to the Secretariat in the further development of work in this area.

One point of departure for this discussion is the section on this subject on page 26 of the report on Mandate, Key Issues, Strategy and Workplan. It flags several questions: e.g. the structure of economic relations between developed and developing countries, trade, multinational investment, multilateral and bilateral aid, IMF conditionality.

It also raises the notion of an international PPP. Commissioners, however, will no doubt wish to raise many other aspects.

Attached are several papers on Multinational Investment, which can act as a further point of departure for the discussion on Multinational Investment and Environment.

The first is a survey paper on "The Environmental Aspects of the Activities of Transnational Corporations". It is being prepared by the United Nations Centre on Transnational Corporations with the financial support of UNEP. It is in the form of a next-to-final draft for publication which is planned shortly.

The second is a 1983 paper on "Multinational Enterprise and Environmental Responsibility: A Review of Key Concerns, Control Limitations and Mutilateral Options", dated October 1983. It was prepared for the OECD by Thomas N. Gladwin, Associate Professor of Management and Business Administration, New York University, and has formed the basis for recent discussions in that body. It has not been released for publication.

The third is a paper on "Improving Environmental Co-Operation: The Roles of Multinational Corporations and Developing Countries". It is a report of a Panel of business heads and other experts convened last year by the World Resources Institute of Washington, and reflects one attempt of consensus by one business community on a complex set of questions.

In addition, we have requested two short papers on the lessons of Bhopal. One is being prepared by Professor Gladwin and one through the offices of Dr. Ashok Khosla, President of Development Alternatives in New Delhi and Special Advisor to the Commission. These will be sent to you as soon as possible.

Following discussion by the Commission, it is proposed that the Secretariat puts together a paper on Multinational Investment and the Environment, for consideration at a future meeting of the Commission. Such a paper may best be referred to a Panel or Working Group for consideration.

WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT

SECOND MEETING
Jakarta, 27-29 March 1985

WCED/85/4 Add.1

Item 5.2 of the Provisional Agenda

PAPERS ON MULTINATIONAL INVESTMENT

ENVIRONMENT AND DEVELOPMENT

1. "LESSONS OF BHOPAL", THOMAS GLADWIN
2. "MYTHS AND REALITY ON THE BHOPAL TRAGEDY" PAUL SHIVASTAVA

draft

LESSONS OF BHOPAL:
CYCLES OF CORPORATE AND GOVERNMENTAL FAILURE

a paper submitted to the:

WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT

by

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March 1, 1985

"The worst industrial accident in history"..."The seminal environmental event of the decade"..."The chemical industry's Three Mile Island"(1). Each has been used to describe the tragedy which occurred in the central Indian city of Bhopal during the early morning hours of December 3, 1984. That is when some 40 tons of vaporized methyl isocyanate (MIC)--a highly"reactive, toxic, volatile and flammable" substance--calamitously leaked from a storage tank at a pesticide plant 50.9%-owned by Union Carbide. The gas cloud enveloped half of the city, killing more than 2,500people (by some estimates more than 5,000) and injuring about 200,000, mainly with lung and eye damage(2). The tidal wave of human suffering, apparently caused by a runaway chemical reaction that the plant's safety systems couldn't contain, stunned both India and the entire world. "Could it happen here?" became a question on the mind of millions.

The Bhopal catastrophe variously triggered import bans, national investigations, regulatory hearings, legislative proposals, and widespread "chemophobia" in dozens of nations(3). Union Carbide experienced a precipitous 25% fall in its market value, a downgrading of it debt ratings, an intense spotlight placed on its global operations, and as of early March 1985, an accumulation of more than 50 lawsuits filed against the company in the U.S. and India on behalf of victims and shareholders--collectively asking for hundreds of billions of dollars in compensation and punitive damages. Beyond Carbide, the accident confronted the entire chemical industry with some of the most profound ethical, legal, social and technical questions ever encountered.

The effort here represents a tentative search for lessons of the Bhopal disaster--necessarily tentative because official reports from

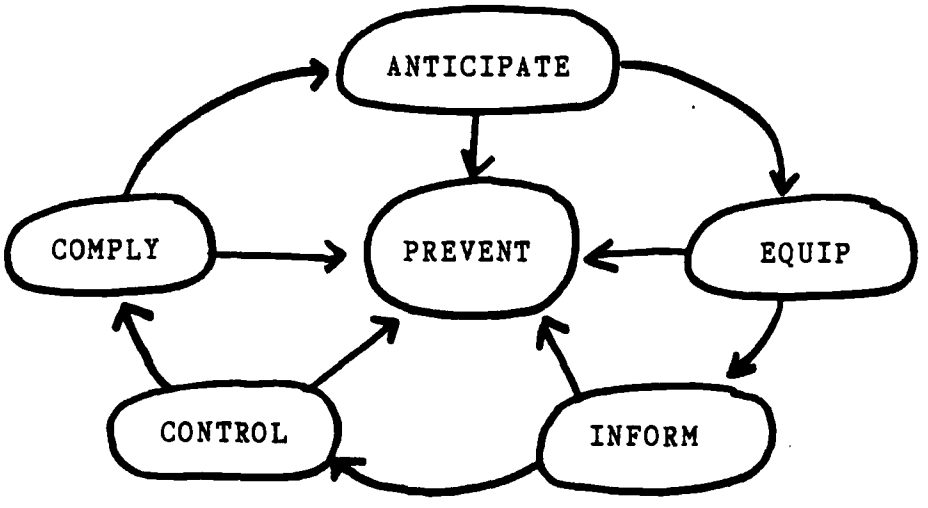
the Indian Government and Union carbide had not been made public at the time of this writing. Based on a distillation of the massive local and international press coverage of the tragedy (it was the second most important news story of the year according to the Associated Press) along with selected interviews of people intimately involved in the case, as well as analogous reference to previous industrial disasters (e.g., explosion of the PEMEX liquefied petroleum gas storage terminal in Mexico city in November 1984 that killed 500 and injured 4000 or explosion of a chemical plant of a Hoffmann-La Roche subsidiary near Seveso, Italy on July 10, 1976 that exposed thousands of area residents to dioxin)(4), an attempt has been made to specify some key hypotheses that interdependently might explain why the tragedy was not prevented. A few of these are bound to be officially confirmed or disconfirmed as the result of investigations and judicial proceedings become known. Sadly, however, because of the intervention of legal and political forces, it will be months, if not years, before a truly definitive account emerges as to exactly why and how the gassing occurred. The search for lessons of the tragedy, however, must get started now.

A CYCLE OF MANAGEMENT FAILURES

As shown in Figure 1, our reading of the available evidence strongly indicates an interconnected set of management failures on the part of Union Carbide, at different levels of the firm, that may have contributed to the disaster. As noted by the arrows, the overall hypothesis is that the failure to prevent the accident can be attributed to management failures to adequately anticipate, equip, inform, control and comply--with these assorted failures both

FIGURE 1

Management Actions Bearing Upon Accident Prevention



independently and collectively influencing the probability of accident prevention.

The closed loop system portrayed in Figure 1 (we'll be expanding, opening and controlling the system later on in this paper) is what a systems analyst would call a "deviation amplifying mutual causal process." That's a mouthful, but all it means is that a change in any of the variables in the outside ring would amplify through the system bringing about changes in the same direction for all the variables involved, including feeding back onto itself. A reduction in the level of risk anticipation, for example, would tend to reduce the extent to which managers and workers were adequately equipped to deal with risks, which in turn, would decrease the extent to which a company informed its workers and the surrounding community about the risks, and on and on through the system. Let's now examine these interdependent failures.

FAILURES TO ANTICIPATE

The available evidence bearing upon the question of whether Carbide failed to anticipate the potential risks and health/environmental consequences of its MIC operations at Bhopal is mixed. It appears, for example, that a chemical was being produced for which very little was known about its health effects, particularly with regard to the long term effects on human health of large scale exposures--which a company spokesman had to admit were "beyond our experience"(5). The issue of storing large quantities of MIC in huge tanks at Bhopal was apparently disputed within Carbide during the early 1970s, with local management reportedly arguing against it for both "economic and safety considerations"(6). A 1982 safety study of the plant uncovered problems that presented "serious potential for

sizeable releases of toxic materials" in the phosgene/MIC unit and storage areas, "either due to equipment failure, operating problems or maintenance problems"(7). Carbide's manual on methyl isocyanate issued in 1976 warned that it could "undergo a runaway reaction if contaminated"(8). In September of 1984 an internal report regarding the company's MIC unit in Institute, West Virginia, further warned that a "runaway reaction" in the tank containing the substance was possible if it were contaminated by water from a cooling system or catalytic materials from a flare system, and could have "catastrophic" consequences. Corrective actions were taken at Institute, but the company never forwarded the warnings to engineers at the sister plant in Bhopal because "there was no reason to share," given differences in the cooling systems employed, according to a Carbide spokesman(9).

Thus it appears that risks associated with large scale storage, runaway chemical reactions and toxic gas releases had been identified and specified, at least within the U.S. operations of Union Carbide. The failure of anticipation, therefore, may lie more with assessments of whether those risks could be effectively managed or mitigated. Consider the following list of factors operating in the Bhopal and Indian environment that may have augmented the probability of an accident or the severity of adverse consequence if such an accident occurred:

- encroachment of densely populated shanty towns composed of poor, illiterate people right up to the border of the plant;
- absence of a highly educated pool of workers and high turnover among hired workers;
- weak enforcement of relatively lax health, safety and environmental laws;

- close ties and nepotism operating between plant management and local politicians;
- import controls that could block or delay the procurement of key parts and equipment;
- absence of a deep commitment among workers to the importance of preventive maintenance;
- regulations mandating labor intensive rather than capital intensive operations, making safety dependent on proactive manual rather than passive mechanical actions;
- regulations requiring significant participation of local owners and partners whose regard for safety and environmental protection could be different than that of the foreign enterprise;
- regulations constraining the firm's ability to lay off workers and close down operations, even after they become uneconomic; and
- public transportation, communication, health and safety systems of the sort that could inhibit proper emergency evacuation and relief efforts.

The point of the above list is that a hazardous chemical operation may be manageable in one location, but not so in another. What Carbide may have done was to site a hazardous operation in a rather hazard-prone environment, perhaps thus exponentially raising the probability of disaster. As one prominent Indian observer recently noted about the tragedy, "Western technology came to this country, but not the infrastructure for that technology"(10). The technological reach, in other words, may have exceeded the managerial, cultural and institutional grasp.

A more ominous interpretation could be that the risks of both the technology and the environment were generally understood, and that the perceived interaction of these risks (conceptualized in terms of economic costs and benefits) was deemed <u>acceptable</u>, both on the part of the company and the government. Such would be consistent with the frequent recent admissions by Indian scientists and industrialists

of gross complacency regarding human safety(11). And as V.P. Gokhale, Chief Operating Officer of Union Carbide India Ltd. told The New York Times, "there were no indications of problems....we had no reason to believe there were any grounds for such an accident"(12). Following from a brilliant new analysis of the generic problem by sociologist Charles Perrow (Normal Accidents: Living With High Risk Technologies, New York: Basic Books, 1984), perhaps what we had in Bhopal was merely a "normal accident," that is, one that should have been expected given the apparent widespread acceptance of living with a complex high-risk technological system that could operate and indeed "go out of control," in ways beyond the comprehension of those who designed, managed, operated, monitored, and chose to live next door to that system.

FAILURES TO EQUIP

No matter what the final judgments turn out to be regarding risk anticipation and perception, it appears from the efforts of investigative reporters that Union Carbide clearly failed to equip its workers, its management, its community and the plant itself at Bhopal with adequate safety "software and hardware" commensurate with any rational assessment of the objective risks involved. A seven-week inquiry by reporters of The New York Times, for example, concluded that the disaster "resulted from operating errors, design flaws, maintenance failures, training deficiencies and economy measures that endangered safety"(13).

In December 1984, after the accident, a Carbide spokesman at headquarters stated that the company "regards safety as a top priority. We take great steps to insure that the plants of our affiliates, as well as our own plants, are properly equipped with

safeguards and that employees are properly trained"(14). This statement sadly dosen't mesh very well with testimony of workers at, and inspectors of, the Bhopal plant. The general secretary of the union at the plant, along with other workers, for example, reported that plant management had drastically reduced staffing levels at the MIC unit, had cut back on training programs, had lowered the qualifications required for supervisors, and had not induced much in the way of safety-mindedness--"internal leaks never bothered us" is how one employee put it(15). The 1982 safety audit of the plant by U.S.-based Carbide inspectors, found that training comprised "rote memorization" without "a basic understanding of the reasoning behind procedures" or much in the way of "what if" thinking; that maintenance people had been signing work permits they could not read; that there was a high turnover rate; and that "personnel were being released for independent operation without having gained sufficient understanding of safe operating procedures." As a result of such deficiencies, the report concluded that "the plant represented either a higher potential for a serious accident or more serious consequences if an accident should occur"(16). Carbide has reported that most of the defects discovered in 1982 had supposedly been put right by June 1984, but no on-site inspection to confirm the corrections was over carried out.

Numerous press reports in India have questioned the competence of the Bhopal factory managers on issues of health and safety, and pointed out that virtually nothing had been done to properly equip the local authorities and community for dealing with an emergency evacuation situation(17).

The most damning allegations on this "equip" hypothesis relate to

the plant's hardware. Investigators for India Today have reported that at least five elaborate fail-safe systems precisely designed to prevent or contain the type of gas leak that occurred all failed just when they were most needed(18). This report, which has been substantially corroborated by statements of government investigators, union officials and even some Carbide managers, alleged that: 1) the vent gas scrubber, which was supposed to spray caustic soda on escaping vapors to neutralize them, had been shut down for maintenance for more than a month; 2) the flare tower that could have harmlessly burnt toxic gases high in the air was also down for maintenance because of a corroded pipe; 3) the water curtain that could have shot up into the air and knocked down the vapor didn't reach high enough to blanket the escaping gas (the 1982 safety audit had recommended the installation of more powerful water spray system); 4) the refrigeration system designed to keep the MIC cool and nonreactive in the storage tanks had been shut off for sometime; and 5) the spare tank that might have absorbed some of the pressure and liquid was available but in the confusion the valves to it weren't opened. As India Today concluded, "Had the systems been working, had the employees kept their wits about them and reacted the way they have been taught in emergency drills, most of the methyl isocyanate escaping into the air could have been rendered harmless"(19).

What explains this reported pattern of multiple system failures and neglect of safety, maintenance and training? We'll explore the role of lax worker, public, and governmental pressure later in this paper. But another painful hypothesis must also be raised here. This is that some of these lapses and inadequacies may have been consciously ordered or condoned by plant management as part of a cost-

cutting program. The Bhopal plant had reportedly not been making any profit since 1981 and had lately been running at only 30% of capacity and losing on the order of $4 million a year for the company due to drought and competition-induced declines in demand for Carbide's pesticides in India(20). As a former project engineer at the Bhopal plant told The New York Times "The whole industrial culture of Union Carbide at Bhopal went down the drain....The plant was losing money, and top management decided that saving money was more important than safety. Maintenance practices become poor, and things generally got sloppy. The plant didn't seem to have a future, and a lot of skilled people become depressed and left as a result"(21).

FAILURES TO INFORM

Given the reported failures of anticipation and equipment described above, it's not hard to comprehend that Union Carbide also apparently failed to adequately warn its workers, the authorities and its neighbors in Bhopal about the hazardous nature of MIC and its storage. Interviews with current and former plant employees indicate that most workers did know that the substance was dangerous, but did not appreciate that it could be so toxic. The New York Times investigation has reported that due to rapid turnover and reduced training, a majority of the plant's workers had "neither read nor understood" the company's technical manual for MIC(22).

Many government officials at the local, state and national levels in India have vigorously asserted that they were completely unaware of the risks. The Mayor of Bhopal, for example, has charged that the local Carbide management kept "everything secret"(23). Most government agencies, according to their own admissions, were unprepared to cope

with the disaster. As noted by the Chairman of the Central Water and Air Pollution Board, "we had no inkling of what kind of emergency steps should be taken" in such a situation(24). No evidence has emerged that either the company or the local government had drawn up any contingency plans to handle a potential gas leak at the plant. And a shocking lack of coordination evidenced itself during the actual accident--the police superintendent was not informed, for example, and rescue workers didn't arrive on the scene, until about four hour after the leak began. Many lives might of been saved if evacuation efforts had gotten underway during those critical early hours.

As for the community, almost all reports indicate that virtually no one in the shantytowns surrounding the plant fully understood the hazards posed by the plant. Neither the company nor the government had made an effort to educate the public as to what to do in the event of an emergency. Even during the accident there were no effective public warning of the disaster--the factory's emergency alarm evidently sounded two hours after the leak began but could not be differentiated from other sirens that sounded for a variety of reasons many times during a typical week. The extent of community ignorance is summed up by the fact that even a few days after the accident, many Bhopal residents still didn't understand what had hit them. As one of Mother Theresa's Missionaries of Charity put it at the time, "These are poor, illiterate people. They don't understand what happened. Many are still asking me to explain what came in the night and blinded them and killed their families"(25).

FAILURES TO CONTROL

The world's cartoonists have had a field day with the Bhopal

tragedy. One cartoon that has received wide print circulation shows an Indian woman with a dead child in her arms confronting a line-up outside the Carbide Bhopal plant of what are apparently supposed to be various people that could presumably be held responsible for the accident(26). At one end of the line-up are fat-cat American executives smoking cigars; at the other end are low-level Indian factory workers holding brooms; in between are various Indian managers (and presumably governmental bureaucrats) lined up in a descending order of seniority. Each member of the line-up, in response to the woman's protestations, is pictured pointing a finger to the next guy down the line.

Part of the explanation for all the "passing the blame" behavior since the accident can be traced to what appear to have been woefully inadequate control systems in operation all the way down the chain of responsibility. For cost-cutting reasons, the amount of supervision had been reduced at the Bhopal plant. Whereas the MIC unit had reportedly in earlier years been staffed by a dozen operators, three supervisors and one superintendent on each shift, at the time of the accident the number had been cut to six operators on each shift with one supervisor(27). Going a bit further up the line, we should note that the head of Union Carbide India Ltd. (UCIL) stated in a recent interview that the Bhopal plant was responsible for its own safety, with little in the way of outside scrutiny(28). At its headquarters in Bombay, UCIL had only one safety officer, whose job was not that of monitoring the safety of the plants in India, but rather simply keeping the safety manuals supposedly to be used in those plants up-to-date.

The most controversial question regarding control has centered on the relationship between the parent corporation in the U.S. and its

50.9%-owned Indian affiliate. Although posturing for the sake of legal and public relations reasons has clouded the issue, most of the available evidence appears to indicate that although Carbide U.S.A. possessed the legal right to closely control matters of plant safety and environmental protection in its Indian operations, it essentially chose not to. As will be explained shortly, it appears that a variety of factors conjoined to reduce the parent Union Carbide's motivation and/or capacity to ensure adequate industrial and environmental safety at its Bhopal plant.

Evidence of the weak authority links between parent and subsidiary in regard to safety takes many forms. To many observers during the first two weeks after the accident, for example, it was clear that executives at Carbide headquarters had little substantive knowledge of what was really going on in India. No detailed knowledge of the safety standards, safety systems, or evacuation plans in existence at the Bhopal plant, or even blueprints of the facility, could apparently be found at Carbide headquarters(29). The Bhopal plant had gone totally indigenous after 1982 following the departure of the last American supervisor. Local management determined the frequency of safety audits, and the last "operational safety survey" conducted by parent auditors had been conducted two and a half years prior to the accident. That survey had found ten "major" deficiencies, but Carbide has admitted that no safety experts from the parent company even returned to Bhopal to follow up on the critical 1982 study. All of this seems to reflect a pattern of "local adaptation," in which Union Carbide India Ltd. apparently was allowed to follow its own course, without much in the way of active and coherent headquarters intervention, monitoring,

control and sanctioning on matter of plant safety and environmental protection(30).

FAILURES TO COMPLY

Given the possibly faulty anticipation, insufficient equipment, scant information disclosure and rather loose control described above, it probably comes as no surprise that numerous reports have also charged that Union Carbide's operations at Bhopal failed to comply with important safety standards, particularly its own internal standards. The in-depth investigation by The New York Times, for instance, produced evidence of at least ten violations of the company's own standard procedures as prescribed in Carbide's technical manual covering the manufacture, storage and transportation of MIC(31). Some of the violations of standard procedures occurred before the day of the accident, while others occurred during the accident itself. Examples of such reported violations include shutting down the refrigeration unit for the MIC tanks, utilizing insufficiently trained workers to perform sensitive tasks, overfilling the tank that leaked beyond recommended levels, keeping the vent gas scrubber down for maintenance for two months, not keeping the spare tank empty as required, and relying on tears in the eyes of workers to detect leaks.

Evidence has also emerged that the safety standards at work in the Bhopal plant were somewhat different from those in operation at its sister plant in Institute, West Virginia. A few days after the disaster, Carbide headquarters issued a news release claiming that the two facilities were "essentially the same" and that "safety precautions for working with methyl isocyanate at both facilities are the same"(32). Carbide has since then been forced to retreat from this original notion of equivalence. It became known, for example, that

a computerized data-logging/early warning system to detect irregularities in temperature or pressure in storage tanks had been installed at Institute, but not in Bhopal. It was then disclosed that there were fewer control instruments in general at the Bhopal plant and that devices to clean and burn off escaping MIC at Institute were automatic, but in Bhopal were manually operated. Later it was admitted that some of the safety stems, such as the cooling system, involved different technologies. One member of the Carbide team that had performed the 1982 operational safety survey at Bhopal admitted to the press that the safety systems of the Indian plant had not been "up to American standards... it is an entirely different set up...the demand is on the human out there"(33).

Is Bhopal a case of a multinational exploiting "double standards" on human health and safety? Little evidence has yet emerged that it was not. The safety criteria established for Institute and Bhopal may have been identical, but it's clear that the extent to which they were honored and enforced differed tremendously. The "safety hardware" appears to have been more automated and sophisticated at Institute than in Bhopal, but judgments as to the "functional equivalence" of the safety equipment in place at the two sites cannot yet be made. But one final judgment probably can. This is that the "safety software" (i.e., worker training and skill qualifications, safety and maintenance consciousness, contingency planning for emergencies, etc.) at work in Bhopal was radically deficient as compared to the U.S. plant.

WHY THIS CYCLE OF FAILURES?

We have in Union Carbide a company that has been lauded by workers,

environmentalists and regulators in the U.S. as being one of the most "health and safety conscious" in its industry in recent times. Even in India, its reputation for safety was among the best in the country. So why the long list of apparently life-threatening and life-taking management failures reported above?

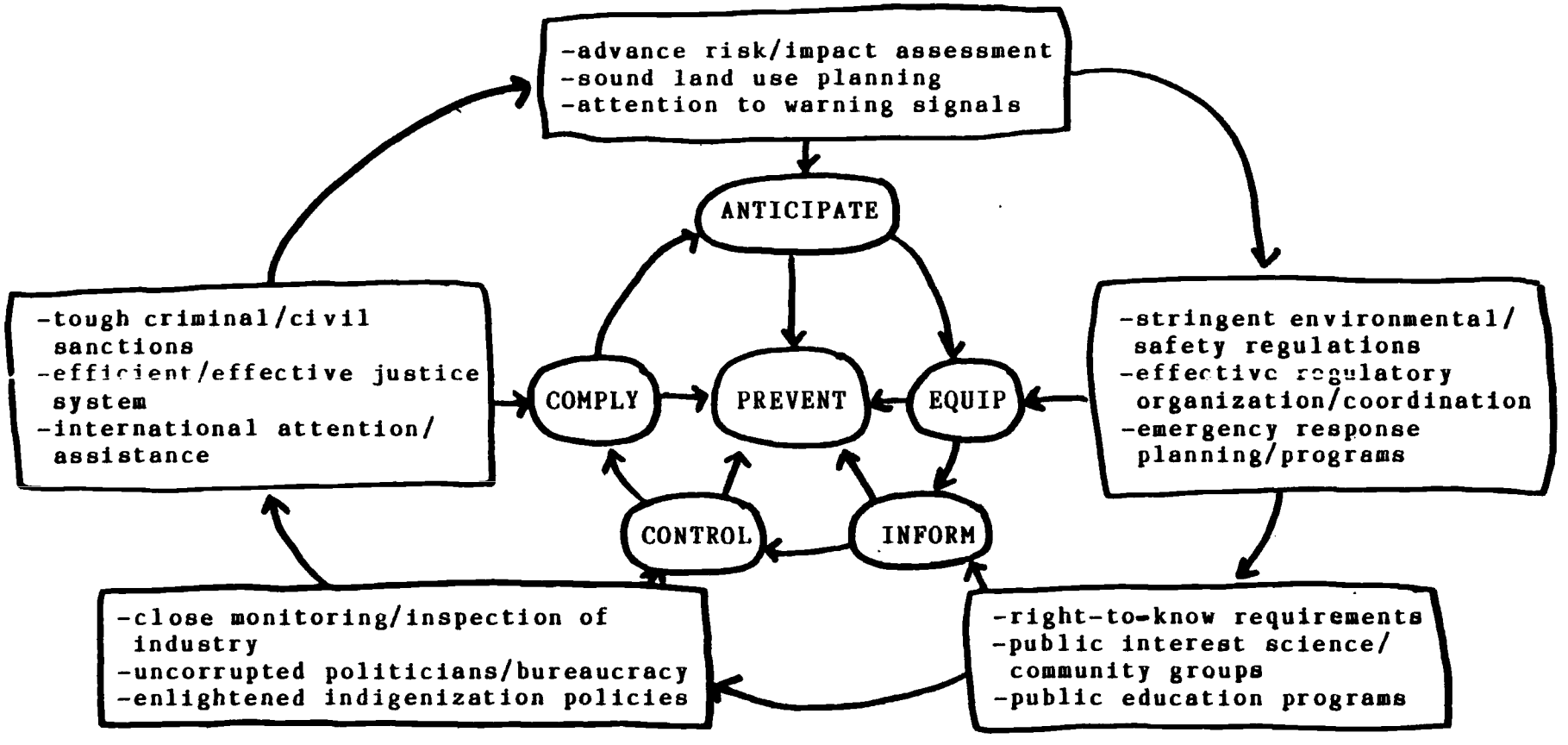
Our major focus so far has mainly been on the internal Carbide setting, noting how failures to adequately anticipate, equip, inform, control and comply may have directly or indirectly raised the probability of the disaster occurring. We have also pinpointed various potential internal causes of those failures (e.g., cost-cutting necessitated by financial loses, high turnover of workers, etc.). But this assessment only takes us so far. In order to more fully attempt to explain the failure cycle it is essential to turn to the external setting in which Union Carbide was operating.

Accident prevention can be viewed as a joint function of the motivation to prevent, the strength of obstacles working against prevention, and the availability of resources for overcoming such obstacles. These motivations, obstacles and resources are surely partly internally based, but are probably more powerfully shaped by forces in the external political, social, regulatory and technological environment(34). Figure 2 shows a number of such forces or variables grouped in relation to the five management actions bearing upon accident prevention. These variables or public policy leverage points, in the end, may represent the really important determinants of industrial safety.

The painful hypothesis we have to propose is that none--yes, none--of these external leverage points were effectively in place or in operation so as to be working in the direction of accident prevention.

Figure 2

Public Policy Variables Bearing Upon Corporate Accident Prevention



the external policy environment, in short, had been working to reduce both Union Carbide's motivation and its capacity to ensure adequate safety at its Bhopal plant. Union Carbide had simply adapted to the incentive system, compliance structure or web of external control in which it was operating. To put it very bluntly, a "normal accident" of a catastrophic nature is something that should have been expected and was certainly made more likely by the public policy context at work in this case. Let's take a quick tour of that accident-facilitating context.

The Context of Anticipation. It has been reported that the depth of scrutiny given by Indian officials to the potential hazards of Carbide's pesticide production facility during the formal governmental approval process was "shallow and superficial", with the decision apparently being made only on employment, foreign exchange and self-reliance grounds(35). During operation of the plant, it is clear that hazard anticipation was given short shrift by local and state politicians (and obviously by Carbide itself) in allowing a densely-populated squatter's colony to be built right up to the plant's borders. Prime Minister Rajiv Gandhi has acknowledged this by explaining the disaster as "result of planning in an uncontrolled manner"(36).

We must also note that the motivation of a firm to anticipate the risks and consequences of its operations is not likely to be fostered by a track record of regulatory/political inattention to warning signals. An attempt by a local official to get the pesticide plant moved beyond city limits in 1975 due to safety concerns was apparently squelched by higher governmental officials(37). A governmental inquiry report into a death of a worker at the plant in 1981 was submitted to

the Labor Department but no one acted on it(38). At least three significant accidents concerning leaking chemicals and gases occurred at the plant during 1982-83. A local journalist published articles at this time variously entitled, "Save, please save this city," "Bhopal on the mouth of a volcanoe," and "If you don't understand, you will be wiped out"(39). All of this lead a news bureau chief in Bhopal after the accident to conclude, "It is the bureaucrats who are responsible for all this"(40).

The Context of Equipment. The massive "fail-safe failure" described earlier becomes easier to understand when one acknowledges the very low standards of the Indian government's poorly financed and staffed regulatory apparatus for health, safety and environmental protection. It's not that India is not without occupational health, safety and environmental laws, but rather, as according to an Industry Ministry official, "where things go wrong is in the implementation of the laws"(41). Carbide's Bhopal plant, in fact, had been granted an "environmental clearance certificate" by the state pollution control board just a few weeks prior to the accident. The problem is that the certificate was granted on the basis of "terribly outdated" laws and procedures. As admitted by the Chief Minister of the State government, "Most of these rules were framed quite a long way back...they certainly need updating in view of new processes".(42) It is a telling statement when we also learn that the pollution control board possessed few instrument to measure air pollution. And no regulations or enforcement of any kind was in existence with regard to the storage of highly toxic substances. In sum, India does not appear to have worked out an environmental ethic applying to hazardous production processes.

As indicated by the absence of automated safety systems at the plant and emergency response systems in the community, the reality of environmental safety as Carbide probably perceived it, was that environmental safety in the setting of Bhopal was a discretionary "luxury good."

The Context of Information. The failure of Carbide to fully share information on the hazards of its pesticide operation with its own workers, with local officials and the general Bhopal community can probably be simply traced to the fact that the notion of "right-to-know" has not yet emerged as a popular notion or demand in India, or likewise in most other nations. The power balance in most developing nations is still such that workers and plant neighbors have not formally or informally acquired the right to know the risks to which they are being exposed. Environmental pressure groups and independent public interest science organizations are in a very early stage of their evolution in societies such as India. General public education on technology, health and environment is likewise just beginning. As explained to The New York Times by Rashmi Mayur, a founder of the Urban Development Institute in India, "Three-quarters of the population of India doesn't know what ecology means and has no understanding of the concept of hazardous chemicals. There is no continuum of intelligence, as in the United States. There are only two layers: a thin veneer of highly skilled people at the top and hundreds of millions of people who don't have a basic understanding of industrialization at the bottom"(43).

The Context of Control. What motivation can there be to carefully control your own operation when virtually no one else is monitoring what you do or do not do? As the Director of the Delhi Science Forum summed it up, "inspection in India is a farce"(44). Factory inspectors in the State of Madhya Pradesh in which Bhopal is located numbered only 15 and this small group of poorly paid people had 8,000 plants to cover during 1984 in this largest state of the nation. And this had to be done without the benefit of such basics as department vehicles, telephones, chemical hazards training, or much in the way of status(45). It's not clear when the last in-depth government inspection of the Bhopal plant took place. The Chief Inspector of Factories, however, stands accused of having renewed the Carbide factory license annually without considering earlier safety lapses. The Secretary of the Indian National Trade Union Congress told the press that inspections of the plant by local official were rather irregular and superficial, with the consequence that "complicity of government officers," in the tragedy is a distinct possibility(46). The Indian press has also been full of allegations of corruption in the factory inspectorate, with the acceptance of payoffs in exchange for permits, licenses and clearances apparently being a fairly standard practice (47). Going beyond the inspectorate, other reports have noted a pattern of apparent cronyism between Union Carbide and the local political establishment, with some key posts going to relatives of local politicians (48). We can also note that an opposition political leader has called for a formal investigation into possible role of nepotism (i.e., hiring on the basis of family ties or friendship, rather than solely merit) in the Bhopal plant management (40).

Along with lax monitoring, one must also examine the possibility that governmental regulations driven by nationalism may have reduced Union Carbide's motivation and/or capacity to ensure adequate environmental and industrial safety at its Bhopal plant, largely by diluting the degree of parent control and reducing the flow of relevant expertise into that 50.9%owned affiliate. Carbide was reportedly required by Indian foreign investment laws to design, engineer, build, operate and maintain its Bhopal plant with local labor, materials, equipment and staff, unless it could prove to the authorities that needed resources were unavailable locally. At the time of the accident, the plant was totally managed by Indian nationals; the last U.S. technician had departed from the scene in 1982. When control over an affiliate is diluted (due to forced local participation requirements), and rewards from the activities of that affiliate are depressed, fewer resources are typically committed by the parent company. As recently noted in The Wall Street Journal , "Intangible assets, such as proprietary technology, are less likely to be shared with a local partner, given the reduced flexibility of the venture and its limited responsiveness to the needs of the larger corporate structure. The multinational is less likely to fully include such a venture in its global information/expertise network in the presence of the "free-riding " local partners. It is more likely to be held at arms length"(50).

The Context of Compliance. The reported noncompliance with standards detailed above becomes much easier to understand if one buys the argument that prior to the accident, the expected penalties associated with noncompliance perceived by Carbide managers may have been rather small. As one Chief Inspector of Factories and Boilers in India told

the press, "The fines are so low that managements smilingly pay them and go back and commit the same offence"(51). Along with weak civil/ criminal sanctions, it's not likely that local Carbide managers were very worried about negligence suits and liability laws in the pre-accident Indian setting. The existing Indian legal system, involving long delays before trial, upfront filing fees (where a claimant is often required to pay ten percent of the sum requested in the suit), a paucity of tort precedent, no system of punitive damages, no arrangements for contingency fees to compensate lawyers out of money recovered, and the susceptibility of district court officials to bribery--was surely seen as being strongly biased against speedy, effective adjudication of liability cases(52). And even if plaintiffs did choose to traverse thi long and difficult legal maze and proved successful, damage awards would likely be tolerable for the company in that they are based on expected lifetime earnings--and the frequently cited average annual income of residents near the Bhopal plant was just $200. Furthermore, given the insurance covering pollution liability possessed by Carbide, these awards would be coming out of the coffers of insurance companies rather than the firm itself(53).

We must recall that global "ambulance-chasing" on the part of plaintiff's lawyers (typically pictured in editorial cartoons as a flock of legal vultures descending on Bhopal) had never been witnessed on such a scale before. As one of these American lawyers told the press, "If you hit them in the pocketbook, they will change...if you don't, they won't change"(54). Given limits on parent company liability, barriers to piercing the "corporate veil," and other impediments to cross-border adjudication, it is unlikely that Union Carbide ever

expected to be confronting the distinct possibility of having to litigate damages for Indian deaths and injuries caused by its Bhopal operation in U.S. courts.

"Out-of-sight, out-of-mind," is how the old saying goes. Along with traditionally being out-of-sight of home nation lawyers, juries and courts, its important to also note that the hazardous operations of multinationals in developing nations, including Carbide's at Bhopal, have rarely attracted any significant international attention from the world's media, from environmental groups, from insurance underwriters, from home governments, or from international governmental organizations. No one else was carefully looking or meaningfully assisting; India and Carbide were very alone in this tragic affair.

Where From Here?

There are no simple solutions or "quick fixes" for the interconnected set of apparent corporation and governmental failures described above. As noted by Carbide Chairman Warren M. Anderson before a U.S. Congressional hearing ten days after the disaster, "We're going to have to reevaluate everything"(55).

Dozens of lessons of a specific nature pour out of the Bhopal tragedy, but needn't be listed here since they generally take the form of the obverse of all of the failures considered so far (i.e., thou should anticipate, etc.). The central summary lesson, however, bears restating. This is that for the sake of sustainable development, we need to get all organizations employing high risk technologies--whether they be public or private, small or large, north or south, national or multinational--adequately anticipating, equipping, informing, controlling, complying, and hopefully thus preventing life-threatening and taking accidents. The corollary, as displayed in Figure 2, is that

this is likely to happen only if the external web of social control properly motivates and facilitates the working of the anticipation-prevention action cycle among the designers, managers and operators of high-risk technologies.

A tour around the outer "context" ring in Figure 2 signals the need for adjustment at local, national and international levels, involving a wide variety of actors, e.g., labor unions, environmental groups, insurance underwriters, judicial bodies, industry associations, governmental legislatures and agencies, international organizations such as the United Nations Environment Programme (UNEP) and the Organization for Economic Cooperation and Development (OECD), and so on. It's obvious that changing the dominant mind set on this Earth of "react and cure" over to "anticipate and prevent" will not happen quickly or easily, especially as it involves multinationals operating in developing nations.

It's also clear that independent or unilateral adjustment alone will not be sufficient(56). Although Bhopal should demonstrate that occupational and environmental safety makes good business sense, we probably shouldn't expect too much from purely altruistic behavior on the part of multinationals given the short time horizons, competitive realities and financial pressures under which they operate. Although the home governments of multinationals could usefully help to ensure that their enterprises do not cause health or environmental harm abroad, the likelihood of any significant extraterritorial safety regulation is likely to remain rather low given concerns about "environmental imperialism" and putting enterprises at a disadvantage vis-a-vis firms home-based in other nations whose governments do not

enact and enforce similar regulation. And given that host nation governments are likely to remain the primary locus of real power over the health and safety practices of corporations into the indefinite future, it is important to also acknowledge that many such governments, given pressing problems of poverty and underdevelopment, are likely to remain poorly equipped for effective occupational safety and environmental protection. And even when nations become well-equiped, they will still remain vulnerable to a bargaining process in which multinational enterprises often have greater leverage given their advantages of mobility, scale, and information.

These limitations on unilateral action suggests a useful role and need for coordination and harmonization at the international level. Multilateral options that could help to prevent future Bhopals include intergovernmental information exchange schemes on hazardous products and technologies, safety review procedures by international financial institutions, U.N. programs to train developing nation officials about occupational and environmental safety, and creation of an international advisory service which nations could call upon for assistance in appraising and auditing hazardous facilities.

Another multilateral option that could usefully support and complement unilateral action by catalyzing awareness,, clarifying baseline expectations, and inspiring changes in corporate and governmental policy, is that of an international code of conduct on environmental and plant safety that governments would ask enterprises to observe. One such set of quidelines calling for firms to asses the environmental consequences of their activities, properly educate and train their employees on safety matters, use best available technologies and practices, prepare contingency plans, adequately

equip their component entities, provide timely information to authorities, and so forth is currently before the O.E.C.D. in Paris. The effort to add such recommendations to the existing O.E.C.D. "Guidelines for Multinational Enterprises" has been underway for over two years now, but progress has been slow mainly to opposition from the U.S. Government. Let's hope that Bhopal changes things, and that as a result, the 24 member nations of the O.E.C.D. (i.e., the home nations of 95% of the world's multinationals) later this year jointly and forcefully call upon enterprises in all of their activities to better protect human health and the environment. Let's hope, in general, that the victims of Bhopal will not have died or suffered in vain.

FOOTNOTES

1. See: "Union Carbide Fights for Its Life," Business Week (Dec. 24, 1984), pp. 52-61; Stuart Diamond, "Doing Business in the Third World: Chemical Leak Prompts Debate," The New York Times (Dec. 16, 1984), p. 1; and Philip Shabecoff, "Officials Tell a House Hearing that Plant in West Virginia is Safe," The New York Times (Dec. 13, 1984), p. 10.

2. For general surveys of the tragedy see: "Bhopal: City of Death," India Today (Dec. 31, 1984), pp. 4-25; Richard I. Kirkland, Jr., "Union Carbide: Coping with Catastrophe," Fortune (Jan. 7, 1985), pp. 50-53; "Indian Tragedy Raises Big Questions," Not Man Apart (Jan. 1985), p. 1; "It Was Like Breathing Fire," Newsweek (Dec. 17, 1984), pp. 26-44; "India's Bhopal Disaster: Chemical Mishap Raises Thorny Issues," Chemical and Engineering News (Dec. 17, 1984), pp. 22-24; "Gassed in Bhopal," The Economist (Dec. 15, 1984), pp. 12-14; "Home Truths About Bhopal," New Scientist (Dec. 13, 1984), p. 2; "India's Bhopal Distaster Raises Important Issues for MNCs, Governments," Business Asia (Dec. 14, 1984), pp. 393-394; Robert D. McFadden, "India Disaster: Chronicle of a Disaster," The New York Times (Dec. 10, 1984), pp. 1 and 6; "Bhopal Report," Chemical and Engineering News (Feb. 11, 1985), pp. 16-65; and Stuart Diamond, "The Disaster in Bhopal: Lessons for the Future," The New York Times (Feb. 3, 1985), pp. 1 and 8.

3. See: "Spurred by Bhopal, Florio Readies a Batch of Bills," Chemical Week (Jan. 30, 1985), p. 82; "Bhopal: Legislative Fallout in the U.S.," Chemical Week (Feb. 6, 1985), pp. 26-28; and "Bhopal: A Less Frenzied Legislative Pace Abroad," Chemical Week (Feb. 6, 1985), pp. 29-30.

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5. "Union Carbide Starts Inspecting Two U.S. Plants," The Wall Street Journal (Dec. 5, 1985), p. 4.

6. Barry Meier, "Union Carbide Wanted Large Amounts of Chemical at Bhopal, Ex-Aide Asserts," The Wall Street Journal (Feb. 4, 1985), p. 2.

7. Ron Winslow, "Union Carbide Confirms That Problems With Tanks in India Were Found in 1982," The Wall Street Journal (Dec. 11, 1984), p. 3; Thomas J. Lueck, "1982 Report Cited Safety Problems at Plant in India," The New York Times (Dec. 11, 1984), pp. 1 and 8.

8. Stuart Diamond, "The Disaster in Bhopal: Workers Recall Horror," The New York Times (Jan.30, 1985), pp. 1 and 6.

9. Philip Shabecoff, "Union Carbide Had Been Told of Leak Danger," The New York Times" (Jan. 26, 1985), pp. 1 and 42; and Christopher Joyce, "Bhopal's Engineers Not Told of Safety Fears," New Scientist (Jan. 31, 1985), p. 4.

10. Stuart Diamond, "The Disaster in Bhopal: Lessons For The Future," The New York Times (Feb. 3, 1985), p. 1. Also see: Cathy Frost, "Danger Zone: Chemical Plant Safety is Still Just Developing in Developing Nations," The Wall Street Journal (Dec. 13, 1984), pp. 1 and 24.

11. "Belated Awakening," India Today (Jan. 31, 1985), pp. 62-62.

12. Stuart Diamond, "The Bhopal Disaster: How It Happened," The New York Times (Jan. 28, 1985), p. 6.

13. Ibid., p. 1.

14. Ibid., p. 6. Also see: Inderjit Badhwar, "Exporting Hazards, India Today (Jan. 15, 1985), pp. 54-57.

15. Ibid., p. 1. Also see: Barry Newman, "Death in Bhopal: Compensation Seems Not Quite the Point," The Wall Street Journal (Dec. 19, 1984) and Sanjoy Hazarika, "An Indian Union Leader Blames Both State and Managers For Leak," The New York Times (Dec. 17, 1984), p. 8.

16. Stuart Diamond, "1982 Inspector Says Indian Plant Was Below U.S. Safety Standards," The New York Times (Dec. 12, 1983), pp. 1 and 8.

17. William K. Stevens, "In Bhopal, Signs of Tragedy Are Everywhere," The New York Times (Dec. 10, 1984), p. 7.

18. "Bhopal: City of Death," India Today (Dec. 31, 1984), pp. 4-25.

19. Ibid., pp. 9-10.

20. "Publication Says Carbide Tried to Sell Bhopal Plant," The Wall Street Journal (Dec. 17, 1984); "India Frees 2 Carbide Officials," The New York Times (Dec. 15, 1984), p. 4; "Carbide Did Not Know of Plant Details," The Financial Times (Dec. 12, 1984), p. 9; Robert Reinhold, "Disaster in Bhopal: Where Does Blame Lie?," The New York Times (Jan. 31, 1985), pp. 1 and 8; and "Pesticide Plant Started as a Showpiece but Ran Into Troubles," The New York Times (Feb. 3, 1985), p. 8.

21. Stuart Diamond, "The Bhopal Disaster: How It Happened," The New York Times (Jan. 28, 1985), p. 6.

22. Stuart Diamond, "The Disaster in Bhopal: Workers Recall Horror," The New York Times (Jan. 30, 1985), p. 6.

23. Wil Lepkowshi, "People of India Struggle Toward Appropriate Response to Tragedy," Chemical and Engineering News (Feb. 11, 1985), p. 19.

24. William K. Stevens, "Workers At Site of Leak Described as Unskilled," The New York Times (Dec. 6, 1984), p. 10.

25. "Indian Tragedy Raises Big Questions," Not Man Apart (Jan. 1985), p. 1.

26. Cartoon by Moir originally in the Sydney Morning Herald, reprinted in World Press Review (Feb. 1985), p. 44.

27. "Bhopal: City of Death," India Today (Dec. 31, 1984), p. 10.

28. Stuart Diamond, "The Bhopal Disaster: How It Happened," The New York Times (Jan. 28, 1985), p. 6.

29. "Carbide Did Not Know of Plant Details," Financial Times (Dec. 12, 1984), pp. 1 and 14; "Union Carbide: The Safety Factor," The Economist (Dec. 22, 1984), p. 72; and "Carbide's Search For Answers," Chemical Week (Dec. 19, 1984).

30. See: Thomas N. Gladwin and Ingo Walter, "Bhopal and the Multinational," The Wall Street Journal (Jan. 16, 1985) p. 28. "Local adaptation" is a rather common pattern for MNCs in the environmental area. See: Thomas N. Gladwin and Ingo Walter, Multinationals Under Fire: Lessons in the Management of Conflict (New York: John Wiley, 1980), Chapter 12.

31. Stuart Diamond, "The Bhopal Disaster: How It Happened," The New York Times (Jan. 28, 1985), pp. 1 and 7.

32. Ron Winslow, "Union Carbide Moved to Ban Accident at U.S. Plant Before Bhopal Tragedy," The Wall Street Journal (Jan. 28, 1985), p. 6 and Barry Meier and Ron Winslow, "Union Carbide Faces a Different Challenge Even Without Bhopal," The Wall Street Journal (Dec. 27, 1984), pp. 1 and 6.

33. Stuart Diamond, "1982 Inspector Says, Indian Plant was Below U.S. Safety Standards," The New York Times (Dec. 12, 1984), pp. 1 and 8.

34. Previous studies have shown this. See, e.g., Thomas N. Gladwin, Environment, Planning and the Multinational Corporation (Greenwich, Conn: JAI Press, 1977).

35. Robert Reinhold, "Disaster in Bhopal: Where Does Blame Lie?," The New York Times (Jan. 31, 1985), pp. 1 and 8.

36. "Gas Deaths in India Exceed 1,000, with Thousands Hurt; Gandhi Seeks Compensation," The New York Times (Dec. 5, 1984), pp. 1 and 12.

37. "It Was Like Breathing Fire," Newsweek (Dec. 17, 1984), p. 30.

38. "The Legal Damage," India Today (Jan. 15, 1985), pp. 60-63.

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40. "Bhopal: City of Death," India Today (Dec. 31, 1984), p. 23.

41. "Belated Awakening," India Today (Jan. 31, 1985), p. 62.

42. Robert Reinhold, "Disaster in Bhopal: Where Does Blame Lie?," The New York Times (Jan. 31, 1985), p. 8.

43. Stuart Diamond, "Doing Business in Third World: Chemical Leak Prompts Debate," The New York Times (Dec. 16, 1984), p. 1.

44. Barry Newman, "Death in Bhopal: Compensation Seems Not Quite the Point," The Wall Street Journal (Dec. 19, 1984) and "Bhopal: City of Death," India Today (Dec. 31, 1984), p. 23.

45. "The Legal Damage," India Today (Jan. 15, 1985), p. 62 and Stuart Diamond, "The Disaster in Bhopal: Lessons for the Future," The New York Times (Feb. 3, 1985), p. 8.

46. Sanjoy Hazarika, in "Indian Union Leader Blames Both State and Managers For Leak," The New York Times (Dec. 17, 1984), p. 8.

47. "Belated Awakening," India Today (Jan. 31, 1985), p. 63. Also see: Cathy Trost, "Danger Zone: Chemical Plant Safety is Still Just Developing in Developing Nations," The Wall Street Journal (Dec. 13, 1984), pp. 1 and 24.

48. "Gassed in Bhopal," The Economist (Dec. 15, 1984), pp. 12-14; and "India's Bhopal Disaster Raises Important Issues for MNCs, Governments," Business Asia (Dec. 14, 1984), pp. 393-394.

49. William K. Stevens, "In Bhopal, Signs of Tragedy Are Everywhere," The New York Times (Dec. 10, 1984), p. 7; and William K. Stevens, "Workers at Site of Leak Described as Unskilled," The New York Times (Dec. 6, 1984), p. 10.

50. Thomas N. Gladwin and Ingo Walter, "Bhopal and the Multinational," The Wall Street Journal (Jan. 16, 1985), p. 28.

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Myths and Reality in the Bhopal Tragedy

by

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Abstract

Crises caused by industrial/technological accidents are becoming a major social problem. Accident at the Three Mile Island Nuclear Power Plant and the propane gas explosion in Mexico City that killed over 450 people, are examples of the types of crisis that technology based accidents can create. The magnitude of these crises is best illustrated by the recent leakage of Methyl Isocyanate (MIC) gas from the Union Carbide plant in Bhopal. This accident killed over 2500 people, injured another 167,000, killed 1100 animals, disrupted the social, economic and cultural life of the city, and caused unknown damage to the environment. Management of such crisis involves preventive measures as well as relief and resettlement measures.

Crisis prevention requires identification of technological/industrial hazards, assessment of their risks, understanding their causes and making adquate safety provisions. Post-crisis management involves assessment of damages, prevention of further damage, rescue and relief of victims, inquiries into causes of the accident, management of long term consequences, and management of normalization processes.

This study will examine causes and consequences of the Bhopal crisis with the aim of developing a theory of crisis management. It will document crisis management activities, and assess the city's capacity to cope with crises of this type. It will identify business and industrial policy actions necessary to prevent future crises.

Myths and Reality in the Bhopal Tragedy

Myth: an ill-founded belief held uncritically especially by an interested group. (Webster's New Collegiate Dictionary, 1981).

The Bhopal accident has serious consequences for Union Carbide, multinational corporations in developing countries, and the Indian Government. Hence, information on the accident from these sources is scarce. Moreover, because it resulted in chaos leading to a breakdown in the community's normal information systems, rumors about it abound and it is difficult to obtain accurate information. To help make sense of events several myths about what happened have emerged.

Myths represent partisan views of reality. They are coherrent stylized descriptions of reality. They help observers cope with tragedies by providing a partial understanding of bizarre events and by rationalizing disturbing facts about it, and about related aspects of society? Myths also serve to protect partisan interest groups culpable for tragedies. They do so by conveniently recasting issues about causes and responsiblities for the tragedy in relatively neutral terms.

I have reconstructed myths about the Bhopal tragedy and juxtaposed them with the reality that I have uncovered in an ongoing study of the event. The reality that emerges from perusing innumerable government and Union Carbide documents, and

interviewing over a hundred people, including victims, Union Carbide personnel, government officials and social workers in Bhopal, is very different from reports by the press and from the perceptions of American people (1). Below I examine seven myths and realities of the Bhopal tragedy.

1. The "It Can't Happen Here" Myth

Perhaps most relevant to examine here is the myth that people in the United States are immune from a tragedy like that of Bhopal. This myth has two parts. First, that an accident of this type cannot happen in an American plant. Second, that even if such an accident were to occur, we would be able to cope with it. It is argued that in general we possess better technology and better operators and have better risk management at a national scale, that can jointly prevent catastrophic accidents. More specifically, Union Carbide has reassured the American public that the accident that happened in Bhopal cannot occur at their West Virginia plant which manufactures and stores Methyl Isocyanate (MIC). This assurance is based on paradoxical claims. On the one hand, Union Carbide claims that its W. Va. is safe because of better technology and operators. On the other hand, it has stated that it does not have double standards in safety for its plants here and in developing countries, and that the technology used in Bhopal is the same as in W. Va.

Technological accidents are caused by multiple failures that interact in unknown (and unknowable) ways. In Bhopal, the accident was caused by a series of independent equipment,

operator, and procedural failures which led to an unstoppable runaway trimerization reaction. Five safety provisions (refrigeration system, flare tower, safety valve, gas scrubber and water curtain) designed to contain gas leakage simultaneously failed to operate (Diamond, 1985; Shrivastava, 1985(b)). Storage tanks, (generally less well monitored than the operating parts of any plant) at West Virginia and Bhopal are monitored in essentially the same way. The only difference is that the W. Va. plant has a computerized data logger for recording data. However, the accident was caused not because of lack of data on what was going on in the tank, but because of misinterpretation of the data, which a computer cannot prevent. So what happened in Bhopal is certainly a possibility in West Virginia.

Claims regarding better operators in W. Va. may be true, but they have never been substantiated. Claims about the general technical superiority of operators in industrialized countries compared to developing countries may be true as statistical averages, but they do not preclude the possibility of some poorly trained, incompetent operators working at hazardous technology plants in industrialized countries.

Operator errors, lean staffing in night shifts, relaxed (even inattentive) attitude of operators during plant shut off periods, are some features of the Bhopal accident. Unfortunately these are quite common in plants all over the world and not unique to either Union Carbide or Bhopal. There is ample evidence to suggest that accidents in high tech systems are

"normal" and can happen anywhere (Perrow, 1984). Hence, to believe that U.S. communities, with their 6,000 hazardous chemical plants and over 10,000 hazardous chemical waste dumps, are immune to a catastrophic accident is simply naive.

The empirical facts are that 28 MIC gas leaks have occured in the past five years from the Union Carbide plant in West Virginia (Whitehouse, 1985).2. They were caused by equipment failure and human errors. One leak incident on November 1,, 1984 involved a loss of 14,000 lbs. of a MIC/CHD3 mixture, released 840 lbs. of MIC, and was caused by a break in a feed line (EPA, 1985). In fact, leaks and releases of toxic chemicals into the environment are routine in the chemical industry. A study by the Congressional Research Service lists seven companies (including Union Carbide) that routinely released toxic substances into the environment under permits that had expired (Shabecoff, 1985).

One major reason for public complacency is that people believe risk management is being efficiently done by some central authority. Guardians of public health like, OSHA, EPA, CPSC, FDA, NTSA and the media, purportedly manage technological risks in a centralized manner (Kates and Kasperson, 1983). They are supposed to act as screening mechanisms to eliminate undesirable technological risks facing communities. Individual communities have therefore refrained from developing local risk management capabilities. (Fischoff et. al., 1982; Meyer and Solomon, 1984). This belief in adequate protection should be considered a myth because of several reasons.

1. Risk analysis and management is a new area of study and professional practice. It's risk estimates are not entirely reliable. Over confidence, cognitive limits, and social and cultural norms distort risk perceptions of experts and the public. Moreover, experts' perceptions and estimates of risk systematically differ from those of people who actually bear and experience risks (Schwing and Albers, 1980).

2. Risk-benefit analyses are flawed in some fundamental ways. They attempt to judge risks and benefits of technology to the "society" as a whole. "Societal risk" is a mystifying concept because invariably those who bear most of the risks are not the same people who obtain most of the benefits. The question of equity in sharing risks across social and economic classes and geographic regions is ignored by risk analysts. Thus, they are often not concerned that a disproportionately large amount of technological risks are borne by the lower economic classes. Moreover, risk assessments usually emphasize scientific and technological sources of risk, ignoring its social and cultural aspects, thereby giving distorted risk estimates and contributing to the further denial of the fundamentally human concerns that should dominate discussions. (Douglas and Wildavsky, 1982).

3. Risk in technological systems is not stable. Rather, it changes with time and with changing environmental conditions. What is considered acceptably safe today may not be so tommorow, or in a few years, or if the weather changes. The centralized risk management system that we have in the U.S., is inadequate for

identifying changes in risk levels because this requires close monitoring of technological systems within individual communities. Such monitoring is best done in a decentralized manner by local authorities who know changing local conditions well. Local authorities in communities across U.S.A. are just not equipped to do this (Lawless, 1977; Meyer and Solomon, 1983).

4. Data on toxicity of chemicals and industrial products is not available. For example, complete health hazard asessments are possible only for 10% of Pesticides, 18% of Drugs, and 5% of food additives. Not only is there a paucity of data, but we don't even know how to test most of the chemicals on the market. Of the 664 toxicity tests evaluated by a recent study only 27% were judged acceptable (National Toxicology Program, 1984).

The second aspect of this myth is based on claims of adequate capacity to cope with industrial accidents when they do happen. Government agencies in charge of managing disaster emergencies and rescue and relief operations, claim that U.S. communities possess better infrastructural facilities than Bhopal, to evacuate and rescue people and thus cope with accidents of this type without huge damages (Shabecoff, 1984).

While it is true that we possess better resources and capabilities for damage control, it is not certain that these resources can be mobilized into action within short periods of time (30 to 90 minutes following the accident) in which catastrophic damage occurs. Evacuation of people from affected areas is often considered to be one important remedy in

isasters. But people living in large cities will realize the bility (or lack of it) of their city's transportation nfrastructure to handle even normal traffic.

Senator Lautenberg's recent hearings on the Bhopal accident howed that people living in New Jersey communities with hundreds f chemical plants did not know about the hazards surrounding hem. They could not tell the difference between a lunch siren nd an evacuation siren. Companies that routinely release hemicals into the environment, typically do not maintain ontingency plans with information on evacuation procedures, afety precautions or medical treatment that may be needed in ase of disasters (Shabecoff, 1985).

2. The "Medical Treatment and Medical Effects" Myth

In a series of articles in The New York Times, The Times of India nd The Madhya Pradesh Chronicle, it has been suggested that, (a) the edical system in Bhopal swiftly and intelligently treated the oisoned patients, and managed to cope very well with the emergency, b) there are minimal or no after effects of exposure to MIC, pecifically there is no danger of permanent blindness (Boffey, 1984; tevens, 1984).

The reality of the situation is that for days after the accident he medical system in Bhopal remained incomprehensibly overloaded and ervice delivery was in chaos.3. The medical facilities simply id not have the resources or organizational capacity to deal ith a disaster of such magnitude. Bhopal, a city of about

800,000 people, has four government hospitals with less than 1300 beds and 300 doctors. In addition, Union Carbide has a small clinic in its plant with one doctor.

Immediately following the accident, a tremendous amount of medical help was acquired from surrounding districts, and experts were called in from Delhi, Bombay and America. Medicines and supplies were flown in from areas outside Bhopal. But, mobilization of resources takes time, and the utilization of these resources requires organization and human interaction that can surmount panic and chaos. Locally, experts were not equipped with testing facilities, good data, or appropriate medicines. Despite the willingness of many to provide medical supplies swiftly, only simple first aid and symptomatic treatment was delivered. This is partly because antidotes to MIC are not known. The "fill-in" medicines used included standard antibiotics, antialergics, bronchodialators, diuretics, and lung and heart stimulants.5. The result was that the free 24-hour clinics, later established by the government and voluntary relief organizations, provided no additional treatment beyond that available immediately following the tragedy.

Due to lack of resources, there were no systematic investigations into potential long term treatments for victims. OSHA's occupational health guidelines for MIC suggest basic medical procedures for persons exposed to potentially hazardous levels. These include, a complete medical history and physical examination to establish a baseline for future health monitoring

with special emphasis on eyes, skin and respiratory tract; 14" x 17" roentgenogram; pulmonary functions tests (FVC and FEV, 1 Sec); and periodic survaillance (OSHA, 1978).

This information was initially not available in Bhopal. When it was received, it could not be used because facilities for providing even these procedures were not available . Immediately following the accident hospitals did not have space to store the dead bodies, which had to be piled up in temporary shelters. Hundreds of dead bodies went unrecorded and were buried without autopsy to reduce the risk of disease, as there was insufficient staff to write out death certificates. Professional medical attention was concentrated on helping critically injured victims. Thousands of seriously affected persons were discharged after receiving first aid from non-medical volunteer workers.

There is also a myth about minimal after-effects of exposure to MIC. This reassuring myth stems from early assessments by scientists in India and abroad. Several contradictory statements regarding the short term and long-term effects of the gas on people and the environment have been made. Some claim that survivors will suffer few if any lasting effects (Boffey, 1984 (b)). Others identify life long damages to lung tissues, eye sight and even genetic defects in newborn infants (Sullivan, 1984).

OSHA's health guideline for MIC states that it is known to cause destruction of tissue and may cause permanent eye damage. Recent studies have identified many irreversible effects of MIC

on eye tissues, lungs and pulmonary functions (Brown and Allerie, 1985). The facts from my survey of victims are that there was visible damage done to eyes and lungs of thousands of people. Many people suffering from eye ailments before exposure to MIC were blinded by the exposure. In addition, damage to soil, plants, vegetables and crops was apparent even to the casual observer and was reported by the local press.

No serious studies have determined the exact extent of the long-term health and environmental effects of large scale MIC exposures. Government agencies have initiated studies and surveys of the after effects of the gas, and the extent of damage caused by the accident. However, the Madhya Pradesh government has already sued Union Carbide for the damages it is now attempting to substantiate through these studies, hence their results are likely to be viewed as partisan.

3. The Death Toll Myth

The number of people who died in the Bhopal tragedy has been an evolving myth. The press has used phrases like "at least 2000" or " more than 2000", acknowledging the uncertainty about the true numbers. Some press reports have quoted figures of 3000 and 8000 dead. The government of Madhya Pradesh issued a list of 1460 dead persons. Approximately 150 of these were unidentified bodies.6.

The death toll is difficult to determine because there are no accurate records of how many people lived in the worst affected

slum areas. The government reported numbers of dead came from government morgues and registered burial/cremation grounds. It added the deaths reported from hospitals in the surrounding areas. It did not include unofficial burial or cremation of bodies. The press took its figures from the government, and estimated them upwards based on the on-the-scene assessments by reporters.

The government is now conducting a house-to-house survey to verify the death toll. It is estimated by social workers involved in the relief operations and by professional statisticans that seven to ten thousand people are still missing. They have not yet returned to their homes in the worst affected neighborhoods. Urbanization experts agree that many people may never return because of the fear of another accident. These "missing" persons, some of whom are assuredly dead, make death toll estimates permanently uncertain.

This myth also gives the impression that the deaths occured over a period of two weeks, during which new and larger numbers of dead were reported. For example, the death toll reported in the New York Times went from 410 (Dec.4), to 1000 (Dec. 5), to 1200 (Dec. 6), to 2000 (Dec. 7), to 2100 (Dec 8), to 2250 (Dec. 9), to 2500 (Dec.11). In reality, 80% of the deaths occurred very soon after the gas leakage. It was the counting of the dead that took time to organize and verify. By releasing death toll figures slowly, over a one week period, the nature of the tragedy was distorted and its impact was reduced. The figure of 410

eaths quoted on December 4, 1984, was close enough to the figure of the 450 dead reported, in the November 1984 propane gas explosion in Mexico City. In fact, several news reports compared the Bhopal Tragedy with the Mexico City accident, implying their death tolls and scope were similar.

The next three myths deal with the causes of and responsibility for the accident. Jointly, they attempt to distance Union Carbide Corporation, New York, from its Indian subsidiary Union Carbide (India) Ltd. They also try to portray Union Carbide Corporation as a neutral, and to some extent a helpless agent, limited by its environmental circumstances to prevent the accident.

4. The "Indian Technology and Operations" Myth

Press reports have examined the role of technology and its operation in the Bhopal plant. They have suggested that the plant was designed, engineered, built, operated, and maintained with local labor, materials, equipment and staff (Diamond, 1985). They have emphasized that the Indian authorities would not permit Union Carbide (I) Ltd. (UC(I)L), to import materials or equipment unless they were unavailable locally, and at the time of the accident, the plant was totally managed by Indian nationals (Gladwin and Walter, 1985). These data are usually used to argue that responsibility for technological failures and human errors (if any) should be attributed to UC(I)L, the Indian subsidiary. This creates the mythical impression that the parent Union Carbide Corporation (UCC) had little to do with the technology or

operation of the plant.

The reality is that the technology was not only supplied by the parent Union Carbide company, but the subsidiary UC(I)L paid royalty and technical service fees for it to the parent company. The parent company supplied technical process designs which were modified by consultants (Humphreys and Glasgow Consultants Ltd.) for use in the Indian plant. Parent company supervisory personnel were physically present in Bhopal during plant construction.

The parent company provided facilities for training Bhopal plant personnel in its other foriegn subsidiaries and plants in the USA. In fact, the Works Manager of the plant, Mr. J. Mukund (the number one person at the plant), was trained and worked at a similar Union Carbide Corporation plant in Institute, West Virginia, for several years before taking charge of the Bhopal unit. Therefore, the technical designs, the construction of the plant, the top management, and service arrangements were under direct control of the parent company.

The day-to-day operations were largely under the supervision of local staff, nevertheless Union Carbide Corporation had direct involvement in crucial safety aspects of plant operations. For example, it periodically conducted operational safety surveys which were guided and monitored by executives in UC Eastern and UCC. A May, 1982, safety survey done by the UCC staff Members. Poulson, Kail, and Tyson, and the action plans based on it, were distributed to management personnel in UC(I)L India, UC Eastern,

long Kong, UC Agricultural Products Division, North Carolina, UCC plant in Institute, West Virginia, and the UCC Technical Center, Charleston, West Virginia (Union Carbide Corporation, 1982). This report pointed out ten serious safety problems in the plant, which included faulty equipment and lack of adequate operator training.

Production of MIC based pesticides involves a complex and sophisticated high technology system. It is implausible to believe that such a system could be designed, engineered, built, operated, and maintained entirely from local resources without the continued and active involvement of the parent company. In fact, UC(I)L Annual Reports of 1978 and 1979, acknowledge the involvement of UCC in providing the technology, and take credit for bringing the world's most sophisticated pesticide technology to India. In light of this data the claim that the Bhopal plant was designed, engineered, built operated and managed entirely by the Indian subsidiary, with Indian materials and labor is simply not true.

5. The "Corporate Veil" Myth

Another myth is that UC(I)L was an independent autonomous subsidiary not under direct control of UCC. A "corporate veil" it is claimed, prevents executives at headquarters of multinational corporations from knowing about and exercising effective control over subsidiary operations. For a variety of economic, managerial, and regulatory reasons, local managements

gain autonomy over local operations, which allows them to function relatively independently of headquarter control. This veil has been used in the past by parent companies to disown responsibility for the actions of their subsidiaries.

Union Carbide Corporation executives have claimed that no direct link was effectively in place between headquarters and the Indian subsidiary (Gladwin and Walter, 1985). They say that UC(I)L was managed autonomously and without supervision from the parent company. The implications are that the parent company is not liable for the actions of the independent subsidiary.

The reality of the situation is that Union Carbide Corporation of Danbury, CT. owns 50.9% of the Indian subsidiary, just enough to have complete control. The remaining shares are held by individual investors and financial institutions. This high percentage (by Indian standards) of ownership was justified by Union Carbide on grounds that UCC needed effective control over UC(I)L operations to enable it to manage the sophisticated technologies in its plants. Otherwise, Indian law permits only 33% ownership of shares by any foriegn partner.

Local managers are hired workers, trained, approved, held accountable and replaceable at the discretion of headquarters management. In fact, there have been instances when technical and managerial personnel from the parent company have been posted in senior positions at UC(I)L. For example, from May 1980 to the end of 1982, Mr. W. Woomer of UCC was the Works Manager of the Bhopal plant.

While day to day management was under the control of local anagement, long term planning and strategic decisions involved -nd were guided by the parent company. Strategic plans, capital expenditures over a certain limit, and resource allocations for ajor programs all had to be approved by headquarters. For example, the construction of the MIC production plant in Bhopal as the result of a strategic decision to backward integrate, rom the earlier production strategy of formulating pesticides from purchased raw material. This backward integration strategy as approved by the parent company.

Additional links between the parent and the subsidiary companies exist in the areas of R&D and technical services. The R&D labs in Bhopal do research projects by contract for the parent company. The 1983 Annual Report of UC(I)L states, "We have recently entered into a collaboration agreement with Union Carbide Corporation, USA to conduct experiments to synthesize new molecules, test them on tropical pests at Bhopal and supply the research data for an annual fee of US$300,000 in foreign exchange". In a reciprocal arrangement the parent company provides (and charges for) technical services to UC(I)L.

6. The Restrictive Indian Laws Myth

Indian foreign investment laws limit foreign parent companies' role in local operations is a myth. It is created by a misunderstanding among analysts about the complex Indian legal framework, and the implementation of laws. The following quote

illustrates this situation.

> "Restrictive Indian foreign -investment regulations that mandate significant local participation and sourcing, alongside self-sufficiency policies, may have reduced Union Carbide's motivation and/or capacity to ensure adequate environmental and industrial safety at its Bhopal plant,largely by diluting the degree of parent control and reducing the flow of relevant expertise to that 50.9% Carbide owned affiliate. Indeed regulations driven by nationalism may lie at the core of any in-depth explanation of Bhopal's tragedy." (Gladwin and Walter, 1985).

Regulations in India (and most other developing countries) are woefully inadequate, and much less restrictive than legal systems in industrialized countries. Moreover, due to lack of resources, the government's capacity to implement laws and monitor performance is very low. Indian laws regulating chemical industries and environmental pollution are so weak and weakly implemented that the country now faces an unprecedented urban pollution crisis. The lack of restrictive regulations has made developing countries attractive venues for pollutive industries. By operating in these countries, companies avoid high pollution control costs which have to be incurred in the US or Europe (Castleman, 1979; Norris, 1982).

The restrictiveness of Indian laws irrelevant in explaining the Bhopal tragedy. Most Indian laws that govern foreign investment and pesticide production (Indian Factories Act, 1948, Foreign Exchange Regulations Act, 1973, Monopolies and Restrictive Trade Practices Act, 1969, Workmen's Compensation Act, 1923, Indian Insecticides Act, 1968, etc.), were in effect before UC(I)L began manufacturing MIC based pesticides in Bhopal.

The company knew the nature of the legal framework in India. It accepted this framework and prospered within its constraints for over 50 years.

7. "Carbide's Financial Capacity to Cope" Myth

A tremendous financial liability has been created by the accident for Union Carbide Corporation. It is a myth to believe that the corporation can cope with this liability without severe damage to its position. Over forty law suits, claiming billions of dollars in damages, have been filed in US courts against the company by lawyers representing victims, and by the government of Madhya Pradesh. Suits have also been filed against UC(I)L by victims in India. In addition, stockholders have sued the company for not adequately informing them of the risks of its business (Business Week, 1985). The legal issues are complex and unlikely to be resolved soon. Union Carbide has persistently claimed that it possesses the financial wherewithal to weather any likely damage settlements resulting from these suits.

The reality beneath this myth can be examined in two ways. First, best estimating the likely settlements with the victims and the Government of India. Second, by examining indirect financial consequences of the accident. Calculations by hopeful analysts have estimated settlements as low as $120 million (Barron's, 1984). These were based on unrealistic assumptions and early data (around Dec 17, 1984). More recent calculations on Wall Street approximate settlement to be around $1 billion. These calculations are based on an estimate of 30,000 victims, 10

to 50 thousand dollars per victim, and assume no punitive damages.

The actual number of persons hurt and treated in Bhopal for poisoning by the MIC gas is more than five times the number presumed in this calculation. Moreover, this estimate does not include any compensation for loss of animals, damage to property, and the disruption of economic and social life in Bhopal. Another figure, suggested by legal experts who represent the perspective of the government of India, is $15 Billion to be paid out over a thirty year period. That a final settlement figure could run into several billion dollars is no longer unrealistic.

Union Carbide has accident insurance coverage of about $200 to $300 million. However, if inquiries into the accident show that the company was negligent, then insurance companies would not pay for damages. These calculations are on the conservative side. There is always the possibility of cases being tried in US courts and juries awarding much larger compensations. In any case, the financial liabilities created by the accident could potentially be large enough to threaten Union Carbide's solvency.

The indirect financial effects of the accident on Union Carbide are deterioration of its credit worthiness and a decline in its market value. Standard and Poor's Corp. downgraded UCC debt rating to the lowest investment grade. The large unsettled law suits were a reason for their decision. Similarly, KMG Main Hurdman, outside auditors of Union Carbide, are under pressure to qualify their opinion of the company's 1984 financial statement.

Other companies, for example, the Manville Corporation and United Airlines Ltd. have received qualified statements for far smaller unsettled liability claims (Broder,1985).

Union Carbide's strategic growth plans are also getting thwarted by public's reaction to the Bhopal accident. For example, in September 1984 the Scottish Development Agency welcomed Carbide's plan to build a $6.6 Million plant in Silcon Glen to produce gases used in chip manufacturing. After the Bhopal accident the project plans were frozen and now the Union Carbide offer has been rejected by the community. In Breziers, France, where another Union Carbide MIC manufacturing plant is located, the community is petitioning for shutting down the plant. The picture that emerges casts doubt on Union Carbide's financial capacity to cope with their liabilities from the accident.

The Victims Reality and a Possible Solution

Having examined the myths about the Bhopal tragedy it is time to examine one unassailable reality. It deals with the suffering of victims. Most people affected by the accident were extremely impoverished slum dwellers, living under inhuman deprivation even by Indian standards. They represent the poorest, most disenfranchised part of the society, with no resources nor voice to make the legal system work for them.

American and Indian lawyers descended on Bhopal and acquired rights to represent victims in legal suits. The apalling insensitivity with which this was done, has made these victims

realize that they are merely convenient pawns in a legal battle to be fought in a foreign country. They also lack faith in the government's ability to address their plight.

From the perspective of victims quick compensation is the most important objective. A compassionate, just and prompt settlement can be negotiated between Union Carbide Corpration and the Government of India, but public pressure must be exerted to bring them to the negotiating table. Any plan for resettlement of victims should include the following elements.

1) A 6 to 12 month time horizon for reaching a settlement and beginning implementation.

2) Affected victims be divided into three compensation categories
   - -families of dead persons
   - -seriously injured persons
   - -persons with minor injuries

3) Compensation for each category should be negotiated between contesting parties.

4) Form of compensation should be resettlement assets such as a house and a monthly income stream from investments. This will avoid exploitation of victims who are unable to manage large amounts of cash.

5) Indirect victims like the residents of Bhopal should be compensated by building up Bhopal's infrastructural capacity to cope with industrial accidents.

The myths and reality contrasted here show that the suffering of powerless victims is displaced in debates that are of importance to powerful stakeholders. These myths help observers rationalize tragedies. However, if an early settlement is not reached on the compensation issue, then our cherished concepts of justice, fairness, and humanism are themselves likely to become myths.

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Footnotes

(1) A Methodological Note:

Empirical research in the social sciences generally uses three types of data. First, the phenomenon under study may be directly observed and described by the researchers. Second, perceptions of subjects may be directly tapped by the researcher through structured and unstructured interviews. And finally, the researcher may use secondary data prepared by some other research agency like, census data, stock market data, case studies, etc. These three sources of data are referred to as first party (researcher) reports, second party (subject) reports and third party (observers) reports.

In crisis situations like the Bhopal tragedy each of these three sources of data were systematically distorted and inadequate for several reasons.

(a) First party reports alone are inadequate because besides the usual problem of subjective bias of the observer, crises phenomenon under study are simply too large for a single observer to examine. Cruises are constituted of a large number of discrete events (technical, social, financial, medical, legal, etc.) happening in rapid succession or even simultaneously, in geographically dispersed area (from Danbury, Connecticut to Bhopal, India). Hence, it is virtually impossible for one or even a group of observers to directly observe all aspects of a crises.

mechanism for its contruction are inactive, or worse-reactive, a social struggle to shape reality ensues. Myths and realities are consequences of this struggle.

(2) Union Carbide Corporation later announced that 197 gas leaks occurred in the same five year period. The discrepancy between EPA and UCC figures is due to differences in the way they defined a 'leak', and the limited data available to EPA.

(3) A telling example of the extent of chaos is provided in the horrifying story of a person who was set on a mass funeral pyre for cremation, and walked off the burning stakes. Apparently medical workers at the hospital had mistakenly placed his uncionscious body with a stack of dead bodies which were taken for cremation en mass .

(4) The city lacks other infrastructural facilities as well. For example, nearly 40% of its population does not have tap water in their homes. Water is available in taps for only two to three hours per day on the average. There are less than 10,000 telephones in the city, with only 37 being public telephones. It has such widely fluctuating voltage in its electric power supply that all home appliances have to be equipped with a voltage stablizer.

(5) The list of medicines used by the various government hospitals included the following,

(6) The discrepancies in these numbers is explainable only by rumours which I heard in Bhopal. These rumours started on the day of the

accident itself and have been consistently voiced ever since. They claim that thousands of dead bodies were disposed off en mass without being registered with any authority. The conspiracy version of this rumour accuses government of a coverup operation, and provides cogent argument about why it was done. The benign version of the roumour just blames that general chaos and disorganization as the reason for the unregistered mass disposal of bodies.

Project Statement

Technological production systems are becoming progressively more sophisticated and pervasive. Accidents associated with such systems can cause damages and crises of unprecedented magnitude. Living with such systems requires that society learn about their crisis potential, and enhance the capacity of communities to cope with them. Existing knowledge in the fields of safety engineering, emergency management, hazard management, industrial/business policy and organization theory need to be combined to fully understand crisis management in industrial accidents. This study aims at developing a grounded theory of crisis management through an in depth examination of the Bhopal tragedy.

Present state of knowledge: The Union Carbide Bhopal accident was the worst industrial accident in history. The scope of the crisis it created, and the unique problems that it has raised go beyond the present state of knowledge in the social and management sciences. While some attempts have been made to explain such crises, very little is known about managing them effectively.

Past relevant research on has focused on identifcation of technological and industrial hazards, assessment of their risks, and policy making to minimize their harmful effects. Technological hazard identification involves recognizing dangerous technologies and materials, determining their threat to human life

and the environment, and monitoring their existence and growth. This is a gigantic task in a world that now has over 3.6 million chemical compounds increasing by 240 thousand per annum, in addition to thousands of related technologies and systems (Kates,1977). Assessing and managing risks associated with industrial hazards involves determining their harmful impacts and the likely frequency of disasters caused by them. Risk assessments rest on scientific extrapolation from past experiences and analog events, using decision theory models, quantified subjective probability estimates, and systems models (Lave, 1982; Munn,1975). They are limited by the assumptions made by risk estimators and by human cognitive processes (Tversky and Kahneman, 1974; Slovic, Fischoff, and Lichtenstein, 1976).

Social policies for preventing and limiting damages caused by industrial/technological hazards involves societal choice of technologies for industrialization, regulation of industries to make them safe, and commensurate policies of economic development, urbanization, and socio-cultural change. These policies are based on cost benefit tradeoffs, availability of resources and political processes (Shills, Wolf and Shelanski,1982).

Studies of industrial accidents usually focus on technical failures and the role of operators in causing the accident. Their aim is to understand sources of failure in technological systems in order to design safer systems. Recently researchers have turned to examining organizational, social and cultural factors that contribute to industrial hazards and risks (Douglas

and Wildavsky,1982). Accidents in high risk technological systems may even be normal occurences because of the complexity, high interdependence, and interaction among subsystems inherrent in these technologies (Perrow,1984). If accidents are a normal aspect of technological systems, and these systems are becoming increasingly more complex and dangerous, it is imperative that we learn to manage crises associated with such systems.

The study of crisis management proposed here is built around in-depth field research on the Bhopal tragedy. A tentative research model shown in Figure 1 identifies variables of importance to the study. This model will be refined through a synthesis of relevant research. Data on variables will be collected primarily through personal interviews with key informants associated with the crisis. Additional, data will be collected from secondary sources including government documents and inquiry commission reports.

Data analysis will involve thematic analysis, historical analysis and quantitative analysis (Miles and Huberman, 1984). It will make policy recommendation to developing and industrialized countries for dealing with hazardous technologies and for developing community capacity to cope with crisis. It will also analyse business policy implications of the accident for multinational corporations dealing with hazardous technologies.

The proposed study explores a problem likely to become very important in a rapidly industrializing world. Crisis management is an emerging area of

research with few established external funding sources. However, several funding agencies are being contacted for additional funding to support a research assistant and teaching time release for the investigator.

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Available Facilities

The author conducted a pilot study of the crisis during Dec. 1984 and Jan. 1985. It involved interviews with over 50 people including, victims, UC(I)L employees, government officials, social workers and local politicians in Bhopal, and observers and analysts in USA.

The author lived in Bhopal for 23 years and has excellent contacts with Bhopal authorities and UC(I)L. Personal contacts are critical here because data on the event is sensitive and legal liability for the accident has not yet been established. Senior government officials and UC(I)L managers have agreed to discuss relevant issues with the author.

The author has access to the library and faculty of the Bhopal School of Social Sciences, which has invited him to be a research associate at the school. Access to other local colleges and research institutions is also available to the author.

Figure 1

Crisis Management in Industrial Catastrophes

Research Model