

CHAPTER VI

Causes and Negligence

The day after the killer cloud struck Bhopal, Union Carbide officials at their Danbury headquarters were telling the press and public that they would require two to three weeks to determine and report upon the cause of the disaster. Ten weeks later they had provided no account of it and were carefully maintaining secrecy. Then again they promised the report in two or three weeks.

Furthermore, the Chairman of the Board said: "Our report is restricted to what happened in those tanks. Our report will not deal with how things were done in India from a managerial or a personal standpoint. I don't think you have to reconstruct what the people in India did." This is an enunciation from the foxhole of legal defense. It tells us to expect a technical report of limited scope.

In fact, the first news of the Union Carbide report reaching India on March 21 indicates that it is the kind of

technical report whose premises are concealed -- intending thereby to focus blame upon purely technical negligence and personal negligence at the Bhopal site. It is presented as the culmination of a massive research project. It hints, moreover, at the possibility of sabotage, a deliberate act in releasing water into Tank 610. It appears to reflect on-the-spot investigation after the accident; promptly government officials at Bhopal denied that the American team had been allowed entry into the pesticides unit, denied that the Indian Central Bureau of Investigations had given them any access to relevant materials, and asserted that the Union Carbide experts were not even allowed to speak to their Indian workers.

My aim here is of course broader: "to reconstruct what the people in India did" and to "deal with how things were done in India (and America) from a managerial or a personal standpoint." Probably this report will be more helpful, even for the Company.

The ultimate cause of pesticide accidents is the pest. Pests destroy crops, spread disease, and convey endless annoyances. They proliferate; under pesticide pressure, they also may change genetically to defend themselves. Means of combating pests are numerous and the most effective of them have been toxins in a form for wide dissemination, poisonous to humans as well as to pests.

Invention is a human non-genetic change; pesticides are continuously in the process of invention. As with all inventions, a time lag occurs before the adoption of new types of pesticides and techniques. The lag is brought on by dislike of losing one's investments in old techniques as well as by the time required for rendering an invention practical on a large scale.

Perhaps this needs be said because in the Bhopal case one perceives both the pressure of new pesticidal inventions and equipment and the resistance to scrapping investments in old formulas, plants, and procedures. These, too, may be termed causes of the tragedy.

As one works closer to the tragedy from such remote causes, he comes upon many a closer cause, so many that

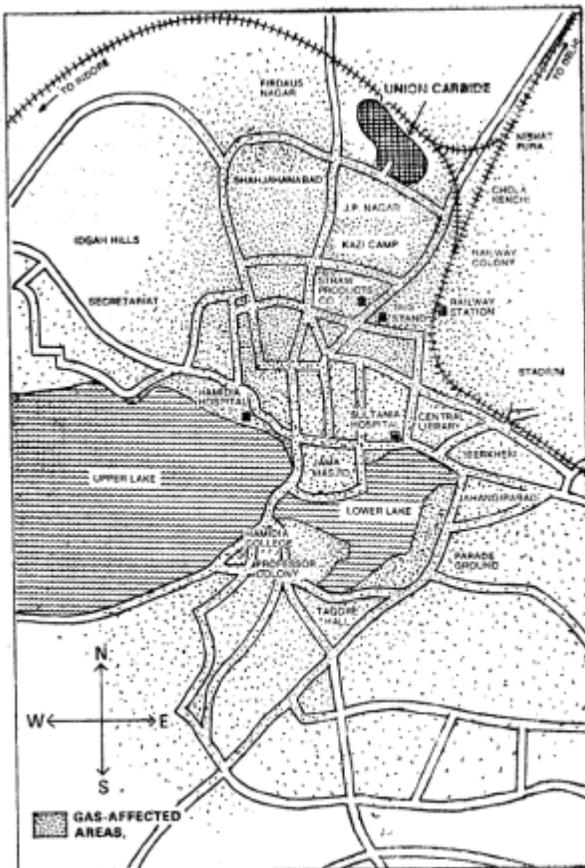
practically everyone whose behavior is mentioned in this report can, whether he wishes so or not, be placed in the network of causes with some justification. For legal and journalistic purposes, a disproportionate amount of attention is invariably to be given to the immediate cause, the "trigger-man," whoever committed the "one" act without which no gas would have escaped and the City of Bhopal would have rested in peace during the night of December 2-3, 1985.

Such a "trigger-man" appears to exist. He would be the worker who fitted a water hose into a pipe that sent or leaked water into Tank 610. What the American Chairman of Union Carbide implied of himself after the accident is true of this worker as well: our problem is not solved by nailing him to the wall. However, for purposes of delineating the chain of causation, it is as well to begin with the worker. He is known to authorities and Union Carbide and has been mentioned in the press.

The complex of buildings, machines, pipes, and toxic chemicals in which our supposed "trigger-man" was to be found working that night may best be conveyed by a set of diagrams. These show the factory layout and neighboring area (Figure 2). The MIC storage tank (Figure 3) and the vent gas scrubber (Figure 4). The path of the gas cloud vented above the scrubber has already been shown (Figure 1) as it affected the City of Bhopal.

A stainless steel tank emplaced in concrete contained probably 45 tons of liquid MIC. The Union Carbide *Manual* calls MIC ($\text{CH}_3\text{N}=\text{C}=\text{O}$) "an extremely hazardous chemical.. by all means of contact" and regards it "as an oral and contact poison" even though it is not classified among poisons. It is also "extremely flammable." Most probably, water got into the tank through a pipe. The MIC, which reacts violently with water, turned into an explosive gas vapor that blew out the valves in its path. The event was a constrained explosion, not a leak, and the explosion formed a cloud which blew downwind over Bhopal. It was the simplest of occurrences: a tank of volatile liquid, a violent reaction with water, a prolonged explosion of gas through a pipe and out.

Sometime after 9:00 P.M., with the night shift due at 10:45 and not much going on, the "trigger-man" was taking a cup of tea at the company canteen. He had worked for seven years at the plant, and for reasons unknown, two months before, had been transferred into the unit that makes and stores MIC. He had less than the background and training originally required to fill his job as an operator.



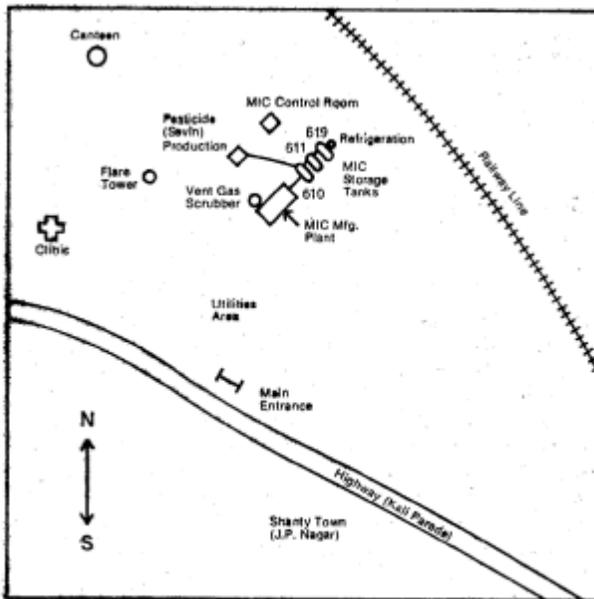
CITY OF BHOPAL SHOWING GAS AFFECTED AREAS

Figure No. 1

His supervisor telephoned him from the MIC area office to come over and clean a pipe. Cleaning the pipe in question was on the job list for the shift, possibly the only notable chore on the list. The supervisor himself had also joined the

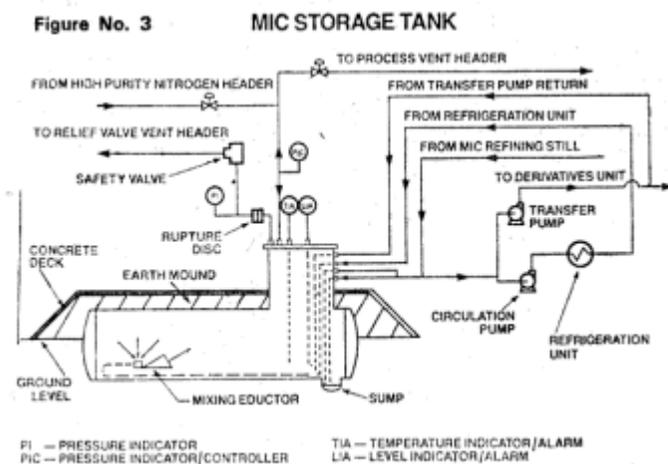
74A Cloud Over Bhopal

MIC unit two months before; his prior experience had been with the Union Carbide battery division in Calcutta. He met the operator at the MIC area and showed him a 25 foot pipe, 8 feet off the ground, that was to be washed. The pipe is said to have connected an MIC outlet from the manufacturing plant to the MIC storage tanks. The operator proceeded to open a nozzle on it, affix a water hose and flush out the inside. A drain hole in the pipe was opened to let out waste water, which then flowed onto the floor and out a floor drain. The supervisor stood by. Then the two men left the area. The water was running.



**THE MIC SETUP AT BHOPAL UC
(NOT DRAWN TO SCALE, NON-RELEVANT STRUCTURES OMITTED)**

Figure No. 2



I do not know the flow rate; it would have been heavy; in the three hours that it was running, I assume that enough water flowed to fill a large tank even while draining. Nor do I know the amount of water used ordinarily to flush a pipe of MIC residue. Nor is there any indication that either man checked to be sure that the pipe valves that blocked passage to the tanks were all closed. Could they possibly have thought that they were to clean out the "empty" tank 619? Not if the work agenda said to clean out the particular pipe. Is it conceivable that one or the other in a moment of confusion mixed up Tank 610 with Tank 619 and actually began to flush out the full tank 610? Probably not, although why so much water should have been used and let run on and on -- and forgetfully as we shall see -- is still incomprehensible.

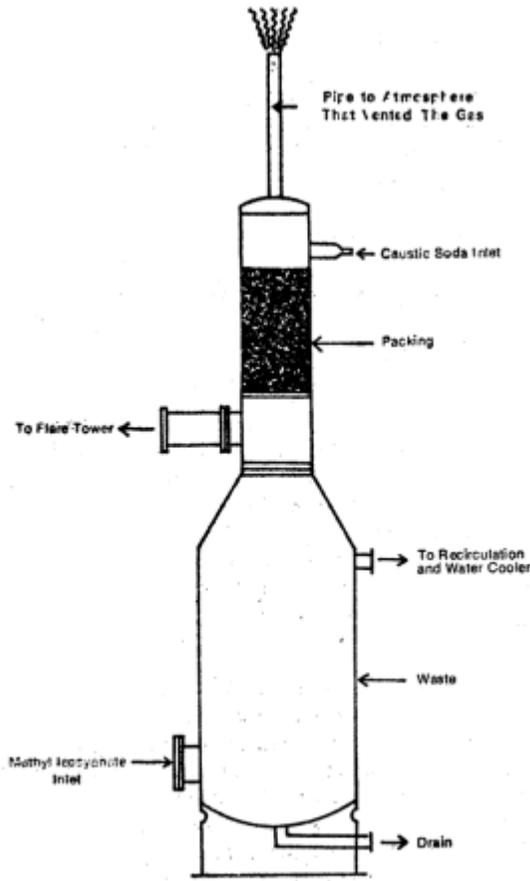
Now, more negligence and another odd fact: the overfull tank 610 had been filled around October 22, for the MIC plant had been shut down since then. That is 40 days from December 3, over twice the recommended storage time limit. This fact is damaging enough; yet it lets us also think that these men may even have forgotten what Tank 610 contained! And we know and will know more about the respect accorded records in this setting.

Thus far, the "trigger-man" is just that and acting as a

dutiful worker. He noticed that the valve leading to the MIC tanks had been sealed. (It must have been the valve to Tank 610, or that the valve to Tank 610 was open enough to receive leaked water from the first valve through a pipe common to all three storage tanks).

Then the "trigger-man" may have joined the ranks of the culpable. For he noticed that the closed valve had not been sealed by the extra metal disc, "a slip blind," that is standard and required operating procedure when contaminating substances are present in a pipe leading to any MIC storage. And he did not insert the slip blind. Now did he tell the supervisor to do so. Nor did the supervisor act on his own initiative. Or so it appears. And the truth will not be fully known until both men and several other workers testify to the events in a court of law where liable to perjury charges, if then.

The "trigger-man" asserted to Stuart Diamond of the *New York Times* that "it was not my job," those fatal words so painful to the ears of managers, leaders, and theologians. It would be psychologically of interest to probe further how this utterance emerges from this particular man, interrupted while drinking tea by an inexperienced new supervisor, and called to a chore shortly before a change of shift, himself poorly trained and unafraid of MIC except as an irritant (he said), himself new to this unit (was it a demotion, was he being paid less than the job specified?) and having heard the common expression that "valves around here are leaking all the time," and being party to a general decline in morale at the plant. Cause after cause: perhaps something so small as a supervisor who may not have ordered a subordinate about in the right tone of voice.



VENT GAS SCRUBBER

Figure No. 4

In any event, by 9 : 45 P.M. the water was running.

As the work shift prepared to retire, almost an hour later, the gauge in the control room for Tank 610 registered two pounds per square inch (2 psi) and was so logged. This was considered normal tank pressure. Temperatures were not recorded in practice; so this critical measure was and is unavailable. Ordinarily the temperature of the tanks hovered around 20 deg.C (68 deg.F), well above the recommended

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storage temperature of 5 deg.C (41 deg.F). (The Union Carbide *Manual* says: "Maintain a tank's temperature below 15 deg.C (about 60 deg.F) and preferably at about 0 deg.C (32 deg.F). Equip a storage tank with dual temperature indicators that will sound an alarm and flash warning lights if the temperature of the stored material rises abnormally."

The night shift came on at 10:45 P.M. At 10:00 hours, the control room operator noticed that the pressure on Tank 610 registered 10 psi, up by a factor of five from the 2 psi logged earlier.

The supervisor noted the rise also a half-hour later but thought the original reading might have been faulty. The men also thought that the pressure might be up as part of an expected pressure rise occurring in a sister tank, 611, where they believed that nitrogen gas was being used to push the MIC liquid into the mixer in preparation for the manufacture of pesticide. (This implies that they regarded such a "backlash" as not uncommon.) Now it was 11:30.

Between 11:30 and 12:00 employees in the utility area sensed a gaseous irritation of their eyes. They regarded it as some tiny leak, not rare. However, by midnight the leak is sensed generally around the MIC unit and the supervisor is told the news.

The workers begin to look around for leaks. One of them spots a drip high on the MIC plant wall with a whitish gas exuding from it. He reports it to the night shift supervisor, who may believe it to be water, and the supervisor is reported to say that he would examine it after the 12:15 tea break. This leak would seem to have been a true MIC condensation and spume, backed up through the pipe being purged and through the leaky valve, which by now would have had a heavy reverse pressure moving against it from the gas in Tank 610.

The operator in the MIC control room now reports that the pressure and temperature in Tank 610 has risen much higher. The supervisor and an operator go over to Tank 610 and find that the rupture disc has exceeded its bursting point and has blown; in addition, the safety valve backing up the

rupture disc has popped out. The temperature is well over 39 deg.C (102.4 deg.F, the vapor point of MIC) and pressure well over 40 psi.

Thinking now desperately of what might be the source of the trouble, they turn off the water washing the tubes. It is about 12:45 A.M. a few seconds or minutes later, a vapor plume emerges from the nozzle of the vent pipe some yards away and 100 feet up, and the men know that an accidental discharge is occurring and can only hope that it is limited and somehow will lose itself high in the air. A worker turned on the scrubber which was intended to neutralize the gas with a caustic soda solution. A loud alarm was sounded for several minutes to warn the public beyond the factory walls, followed by and reduced to a muted alarm to warn the factory workers.

By this time, too, large cracks had been seen and heard to appear in the heavy concrete housing of the almost totally encased MIC tanks, and the prospect of an imminent explosion of the tank itself must have entered the workers' minds. Several had donned gas masks. Water was poured on the tanks. Hydrants and hoses could not reach up to the gas cloud itself, where it was escaping from the vent pipe. There seemed to be nothing to turn on or off that would help. Most fled upwind. The supervisor's gas mask was lost or used by someone else; he was gassed and then injured in climbing over the fence. No one else was hurt.

Around 1:00 A.M., through a patrolling inspector, the city police learned that something serious was up. The police control room was affected by the gas, and telephoned Union Carbide only to be told that nothing of importance was occurring. The Police Chief had two men trying to call the plant. Between 1:25 and 2:10, he got through three times. Twice he was told : everything is O.K.; then, that they didn't know what was happening. This was reported by Praful Bidwai in *The Times of India*.

A district magistrate heard of the action and called the Union Carbide Plant Manager, at 1:45 A.M. The Manager drove to the plant sensing the gaseous air *en route*, but could do nothing upon arrival. He himself thought for a while that the

leak had been plugged, and said so.

Ever since the disaster, other ideas have contended with the leaky valve theory. One argues that metallic or other substances might have contaminated the liquid of Tank 610. Tests have now discovered traces of iron, lye, water, and phosgene in the empty tank. The head government scientist in charge of the conversion of the remaining MIC to pesticide in "Operation Faith" pointed out that phosgene, when combined with water would produce chloride ions that would corrode the steel of the tank, producing iron, which would accelerate a reaction with the MIC. However, the trace measures in parts per million are not yet available, and nothing argues for the presence of more than the smallest amount of iron, and all phosgene other than a minuscule fraction to stabilize the MIC is denied. Anyhow it is doubtful that a tank which had been standing quiet but whose pressure rose from normal (2 psi) to a valve-bursting point of above 40 psi in two hours would have done so on the basis of a water/iron-phosgene-chloride-iron-MIC sequence in so brief a time, especially since the phosgene was probably available in only minute amounts. It is more reasonable to theorize that the iron and chloride ions were generated almost wholly in those fatal couple of hours.

As for the lye, *The Hindustan Times* heard initially that workers had used lye in a cleanup of the area around Tank 610 the day before, but there is no evidence that lye entered the tank and in any case the reaction time would have taken too long and the gas created would have been too voluminous. The surmise is hardly tenable.

Another idea is that Tank 610 contained some new chemical diabolically conceived in the Research Laboratory and this substance either went out of control or was used to experiment on the poor people of the area. Naturally the CIA has been mentioned in this connection, and I would suppose that this suggestion ought to be ignored or else become the subject of a legislative or other public hearing in which one might at least put the allegation to rest and discover who are the public paranoiacs in the setting.

A favored idea among the chemical cognoscenti is that MIC might begin to transform from simple to giant molecules, that is, to polymerize, under favorable conditions of heat and temperature. Perhaps the chief obstacle to this idea's progressing is that water was definitely in the picture in quantity, and that the time elapsed between a normal and an explosive temperature was too short for the process to occur. Such molecules were reported discovered in the analysis of the tank residue, but these were probably formed under the heat and pressure of the total reaction.

I have already mentioned the incredible idea that the blunder made was stupendous, that the supervisor and operator somehow confused Tank 610 with "empty" Tank 619 and thought they should wash out "empty" tank 610. But then several items contradict this: the pipe drain was allegedly opened, the MIC valve was allegedly closed, the water was running so long accidentally, and so on. If any item makes this notion plausible, it is the long three hours that the hose was running, and the large amount of water that got mixed up with Tank 610. Otherwise, the idea has small merit.

But an estimate that at least 1.5 tons (450 gallons) of water was needed to gasify 45 tons (13,000 gallons) of MIC, is troubling. Few can believe that the valve in question could be so faulty. Still, the water would have entered the liquid from above. The main reaction would be occurring near the top of the overfull tank. Shortly after the rise in pressure, the newly formed gas might bring pressure against the leaky valve -- not enough to push back the water leak, itself being hosed under pressure, but enough to create a path in reverse through the valve. Somehow, we recall, gas backed into a pipe and was emitted and condensed high on the wall of the MIC plant.

The reverse gas pressure would strain the faulty valve. The valve would admit water at a faster rate. Soon it would be pouring at a rate easily capable of supplying the necessary 450 gallons within an hour's time. A concentration of MIC gas beyond all experiment and experience was primed for release.

Let us now put ourselves in the position of those designing a plant to make MIC and to convert it into the