Chapter - 5 The Miike coal-mine explosion

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I. Energy-source conversion and coal-mine labour

The Miike coal mine was first developed during the Meiji Restoration of 1868 and was nationalized in 1872. After nationalization it was government policy to use prisoners to work in the mines. In 1888 there were 3,102 people engaged in mining, 2,144 or 69 per cent of whom were prisoners. In 1890 the Mitsui Coal-mining Company bought the Miike mine from the government and continued to use prisoners to mine coal. It was normal to force these people to work like beasts of burden in a system which produced a minimum of expenses and in which there was no need to advertise for labour.

In fact, after the mine had been taken over by the Mitsui Company, the number of prisoners employed began to decrease, though it continued as a prisoner-based operation until 1930. Although the mine was operated under favourable natural conditions, the treatment dispensed to the labourers was very bad. Indeed, modernization of the mine began using prisoner-based slave labour.

When the Japanese military machine invaded China in 1931, many of the labourers working in the mine were taken as cannon-fodder. The resulting shortage of labour became acute and, in order to make up the shortfall, the company used Koreans and, later, Chinese prisoners of war. In reality these people were subjected to the same harsh treatment that had been meted out to the former prisoners.

In 1945, after Japan's defeat in the Second World War, the Chinese and Korean labourers were released from servitude in the mine. Japan's production of coal in 1941 was 56,470,000 tons, decreasing to 20,38().()()0 tons in 1946, a level that was 36 per cent of the 1941 total, just one year after the close of the war. The Miike mine was no exception to this trend. and the maximum production of 4,000 tons decreased to 30() tons in 1946.

In the post-war period the coal industry faced some very difficult problems. Even though it had an important role to play in Japan's post-war economy. the occupation forces of the United States were not interested in the production of coal. Since the price of coal produced in Japan was much higher than the international price, the Japanese government had to provide supplementary aid to the industry, but in 1945, on the instructions of the occupation forces, this aid was cut. United States economic aid was invested in major industries which could expand on limited capital; aid to the coal industry was first reduced and then dropped completely after 1949. When coal prices went up as a result, the effects were felt in the electricity-generation and steel industries. The occupation forces abolished all limitations on the importation of coal and on the use of oil. With this, the fate of the coal industry in Japan was sealed.

In January 1950 the occupation forces issued a memo which allowed the importation of oil and the operation of a refinery on Japan's Pacific coast. At that time the Standard Vacuum, Caltex, Tide Water, and Shell oil companies had begun negotiations with companies in Japan for joint venture capital tie-ups. In the Middle East vast oil discoveries were being made, and the change from coal to oil as an energy source was going on all over the world.

Not only the occupation forces but Japanese economic circles welcomed the change from coal to oil. However, the coal-miners opposed the change because of a desire to preserve their jobs. The Miike coal mine became the centre of the opposition movement against this change. Between 1959 and 1960 disputes arose between the mining capitalists and the labour union, but the miners were defeated. In this instance about 1,200 miners were forced out of their jobs. After the defeat of the union movement, the switch from one energy source to the other came into effect very swiftly. Table 5.1 indicates that in 1955 coal as a primary energy source provided 50.2 per cent of energy needs, but that after the Miike dispute the level decreased, dropping to 16.4 per cent by 1975, while the use of oil increased from 20.2 to 73.3 per cent.

Through this rapid change in the energy picture, coal mines were forced to reduce prices and increase productivity in order to compete with oil as an energy source. Coal production at the Miike mine was 14 tons per labourer in June 1958, but this was increased to 44 tons per person as of October 1963. Mined coal was transported by a belt conveyor system, leading to an increase in coal production. In 1958 over 6,000 tons per day left the mine, rising to over 10,000 tons in 1962 and 13,000 tons by October 1963.

Table 5.1. Primary Energy Source Comparisons

	Oil	Hydro	Coal	Other
1955	20.2	21.2	49.2	4.0
1960	37.7	15.3	41.5	5.5
1965	38.4	11.3	27.3	3.0
1970	70.8	6.3	20.7	2.2

1975	73.3	5.8	16.4	4.5

Source: Resource and Energy Agency, *Sogo enerugii tokei.*

Table 5.2. Death and Injury Rate per 1,000 Man-days at the Miike Coal Mine

Year	Rate (persons)
1953	0.341
1954	0.424
1955	0.461
1956	0.598
1957	0.721
1958	0.810
1959	0.917
1960 November	0.406
1960 December	1.203
1961	1.403
1962	1.317
1963 August	1.415

Source: Kaneko Tsuguro, ``Rodo saigai," *Kakaku* (October 1966).

Attendant upon the increased coal production, there also came an increase in coal dust in the mine, resulting in an ever-expanding risk of mine explosions. The coal-dust problem should have been made a priority, but in fact the importance of this problem was minimized as production increased. Twelve conveyor belts were installed in the first mine rationalization, with one person assigned to each belt drive motor and five charged with spreading water and rock dust in order to contend with the coal-dust problem. This brought to 17 the number employed to control the hazard, but with the dispute between the miners and the company this was reduced to two.

The Miike coal mine was then once again on the upswing, experiencing a great increase in production. Not only was there a decrease in the number of workers used for explosion security, but the number of coal-transportation and machine-operation workers was also reduced. The number of workers employed outside the mine was also decreased so that they could be used in the mine. As a result of these factors, many accidents occurred. In 1961, 16 labourers were killed, which was a higher toll than for any other year since 1951. Also, 1,922 persons were seriously injured. Table 5.2 provides an indication of the death-rate per 1,000 man-days. In November 1960, before the reorganization of the mine following the labour dispute, the death-rate was 0.4 persons per 1,000 man-days, but after the dispute it climbed to 1.2 persons. Leading up to the worst disaster in the Miike mine, month by month and year by year these death-rate figures increased.

II. Modernization of the coal mine and labour conditions

The increases in production levels at the mine produced an intensification of labour activity; the modernization and mechanization was motivated by the strong rivalry with the oil industry. Because of the mechanization of the mining and product transportation methods, labourers suffered from ever-increasing hardships. The mechanization of the coal mine in the post-war era started in 1948 when a flat-bed-type belt conveyor was imported from the Federal Republic of Germany. If the speed of mining operations was too slow, the belt would not function properly, and this increased pressure on the labourers to speed up their extraction efforts.

In 1956, a coal planer was introduced from the Federal Republic of Germany. This equipment, which cut the bottom of the coal seam with its very sharp edges, made much deeper cuts than the equipment the miners had been using previously. Thus the coal wall, after being cut out by this new machine' would fall immediately on the conveyor belt and be carried away at once. The belt conveyor was forced up against the coal seam through the action of water pressure; then the belt conveyor with the coal planer was brought forward to the coal wall for cutting and immediate extraction. With the old method, dynamite was used to blow out the coal-seam wall, but the new system eliminated most of the intermediate mining processes.

Because of the introduction of this system, the speed at which mining took place was increased by a factor of two. The pillars that supported the ceiling of the mine had to be moved faster - water pressure was used to provide the locomotion necessary to move these supports. Also, with the use of pressurized water, the coal-seam cutter speed was increased by a factor of four. Because of this great increase in productivity all efforts had to be increased, from the coal-cutting processes to the coal-transportation systems.

With this came an increase in the activity of the miners as the pressures for increased productivity were brought ever more forcefully to the workplace. There was no room in the production schedules for the maintenance of safety or reduction of hazards. Mechanization meant that workers were forced to attend to one machine after the other in a very difficult subterranean environment. Under these circumstances, crisis conditions increased as mechanization progressed.

The working conditions in coal mines are so bad that any comparison with the worst conditions in surface factories provides no adequate understanding of the difficulties involved. The pressure on workers underground is such that they are under continual stress. When the pillars that support the roof begin to weaken, rocks fall and much injury results. There is also the risk of a sudden injection of underground water or problems produced by pockets of methane gas. Fire is the main hazard in both surface and underground mines, while rocks and water are also major sources of danger. Any crisis is magnified by the enclosed spaces that are an inherent aspect of underground operations. The transportation systems for taking out the coal and bringing in tools spread throughout the underground maze like a great spider's web, and hold the potential for even greater crises. Rocks fall on the workers, and the coal and rock dust produces any number of lung ailments.

Increased productivity is bought at the cost of workers" health and safety. It was inevitable that the mechanization of the coal mine should result in a vast increase in the number of crisis situations.

Table 5.3. On-the-job Injury Rates for Different Industrial Sectors

Year	Mining	Construction	Iron and steel	Metallurgy	Machinery	Chemical	Transport and communications
1955	76.67	47.28	20.98	34.00	23.12	14.21	17.83
1960	83.92	27.88	13.21	22.04	65.57	7.00	13.96
1965	104.14	16.24	8.25	14.85	10.70	6.31	12.14
1970	79.22	15.44	11.31	15.71	12.44	5.66	14.56
1975	25.42	8.12	5.60	10.09	7.64	3.78	6.36

a. Injury rate = (Deaths and injuries)/(Man-hours x 1,000,000)

Source: *Rodo tokei yoran* (Labour Statistics).

During 1959, the labour union at the Miike coal mine was very active in the safety movement. Among the 11,711 persons in the union, there was one death, 1,190 serious injuries, and 1,753 slight injuries: thus injury and death were at a 25 per cent level. After the dispute between the union and the company in 1961, there were 10,946 union members and the injury and death rate went up to 38 per cent of the membership, or 4,230 persons.

The death and injury rate was higher for coal and other mineral mining than for any other industry, as is clearly seen from table 5.3.

The most dangerous hazard in any type of mining is that of coal-dust explosions. At the end of the nineteenth and into the beginning of the twentieth century, in confluence with the rapid worldwide growth of the mining sector, mine explosions occurred with ever-increasing frequency and scale in Europe, the United States of America, and Japan. In 1906, the Curie mine in France experienced a massive explosion which killed 1,000 people. From that time on, the mechanisms of mine explosions were clarified and their number decreased. However, in Japan alone there was no reduction in coal-mine explosions. The lessons learned by the international community on this score were not applied in Japan.

As was indicated earlier, safety personnel at the Miike mine had been greatly reduced in number in order that more people could be placed on the production lines. In a word, the mine was being operated with almost no attention to safety and explosion prevention. On 9 November 1963, an explosion occurred in the Mikawa area of the Miike mine, as a result of which 458 persons were killed and 839 suffered from carbon monoxide poisoning. It is clear that this tragedy occurred as a result of the neglect of mining safety.

III. The worst of the coal-dust-related mine explosions

In relation to coal mines, and also to other large-scale plants like petrochemical complexes, the most important aspects of plant planning and construction are the preparations for possible worst-case accidents. In the case of coal-mining, coal dust represents the greatest hazard.

In the first place, the scale of coal-mine explosions is considerable. Explosions can be sparked by methane gas filling certain areas that are not properly ventilated. Coal-dust explosions, however, present a particular problem, because coal dust is something that is produced at every point in the mining process and accumulates, through the movement of air and the transportation of coal, on the floors, walls, and ceilings of the mine, all the way from the mine entrance to the deepest shafts. Therefore, when a small explosion occurs somewhere in the mine, it is followed by a chain reaction fuelled by the coal dust, and the resulting explosion envelops the entire mine infrastructure.

In the second place, coal-dust explosions are the worst type of explosion because there is a great amount of carbon monoxide produced. As a result of this, many mine workers continue to suffer from the long-term after-effects of carbon monoxide poisoning even if they are lucky enough to be rescued alive. Methane gas explosions create carbon monoxide when the density of the gas is high, but if there is not much gas it is more often than not dispersed in the air. However, in coal-dust explosions the story is a very different one. Coal dust, being a solid rather than a gas, does not burn completely, and high-density coal-dust clouds can be formed. This prevents adequate air circulation, contributing to the production of carbon monoxide. Even if a coal-dust explosion does not spread throughout the length and breadth of the mine, the resulting carbon monoxide gas does in fact spread in this way and all the workers are poisoned. The Miike mine explosion of 1963 was a good example of this.

There is very little methane gas in the coal seams of the Miike mine. Thus, the possibility of a gas explosion is relatively low and, even if such an explosion came about, the possibility of its initiating a coal-dust explosion is likewise low. Therefore, in the case of the Miike mine, it is clear that some factor caused the dispersal of the coal dust throughout the mine and some ignition source produced the explosion. There are two possible locations where the conditions for starting an explosion are ideal; one is at the seam working face, and the other on the mining slope.

The Miike mine owners were very careless in relation to coal-dust prevention procedures during mining operations. In order to prevent coal-dust explosions it is necessary to keep the dust out of the air by continuously sprinkling the area with water. Alternatively, rock dust, which is incombustible, can be mixed with the coal dust to prevent a chain reaction.

However, on the first mining slope, there were absolutely no preventative measures taken in relation to the problem. According to the testimony of mine workers at the Fukuoka Prosecutor's Office, one to two centimetres of coal dust had accumulated even at the location of the switch-box for the high-voltage system in the mine, and the walls were black with dust. The Fukuoka Mine Safety Department required that coal dust be cleaned away once a week, but, in locations where cleaning was difficult because of the height of the walls and ceiling, no such cleaning had taken place. Thus, the risk of a large dust explosion was inherent in the coal-mining operation, especially when conditions existed that could provide the initial detonation.

IV. The Miike coal-mine explosion of 9 November 1963

At 3.12 p.m. on 9 November 1963, a thunderous explosion took place. At the bottom of the first mining level, ten of the four-wheeled carts filled with coal were being hauled to the surface. One of the lower three carts derailed and, because of the tension thereby created, the chain of the third cart broke. At 1,180 metres from the entrance, eight cars began a free-fall run to the bottom of the mine. They ran free for about 360 metres, increasing their speed by 33 metres per second, the momentum breaking archway support frames in the mine. Then all of the carts were derailed and turned over. At this point the explosion took place.

The rapid air displacement caused by the high-speed carts created air cur rents which caused the settled coal dust to mix with the surrounding air. It is possible that the friction caused by the carts turning over produced the spark that ignited the coal dust; alternatively, the crashing carts could have damaged the high-voltage cables, and this could have been the ignition point for the explosion. The compression caused by the explosion moved toward the mine entrance, and, 100 metres from the first explosion, a powerful second explosion was created. It has been estimated that the wind created by this second explosion was probably travelling at a rate of 1,000 metres per second. The compression from the second explosion, as it headed toward the bottom of the mine, fortunately did not touch off another explosion, but the carbon monoxide that was created by the two explosions spread throughout the entire mine, creating a disastrous poisoning situation.

At that time the second shift of workers (2 to 10 p.m.) had just started entering the mine, and some of the first-shift workers (6 a.m. to 2 p.m.) were in the process of leaving. Twenty people were killed by the direct effects of the explosions, but 438 died from acute carbon monoxide poisoning, and 839 suffered the after-effects of poisoning. 1,197 of the 1,403 workers in the mine at the time were either killed by the explosions or suffered from carbon monoxide poisoning. There is to date no other coal-mine accident in the world that has produced such a large number of casualties.

Amazingly, the Mitsui Coal Mine Company management had no knowledge of the coal-dust explosion problem. Most labourers believed that coal-dust explosions were caused by methane gas explosions and therefore were not open to ignition from other causes. Since the coal mine contained almost no methane gas it was believed that coal-dust explosions there were an impossibility. This explosion was to dislodge that myth very effectively. If management had shown a greater sense of responsibility toward the potential for coal-dust explosions, appropriate methods of avoiding such disasters would have been taken, cutting down the damage done and minimizing the danger to life and health.

V. Increased numbers of gas-poisoning victims due to a lack of education

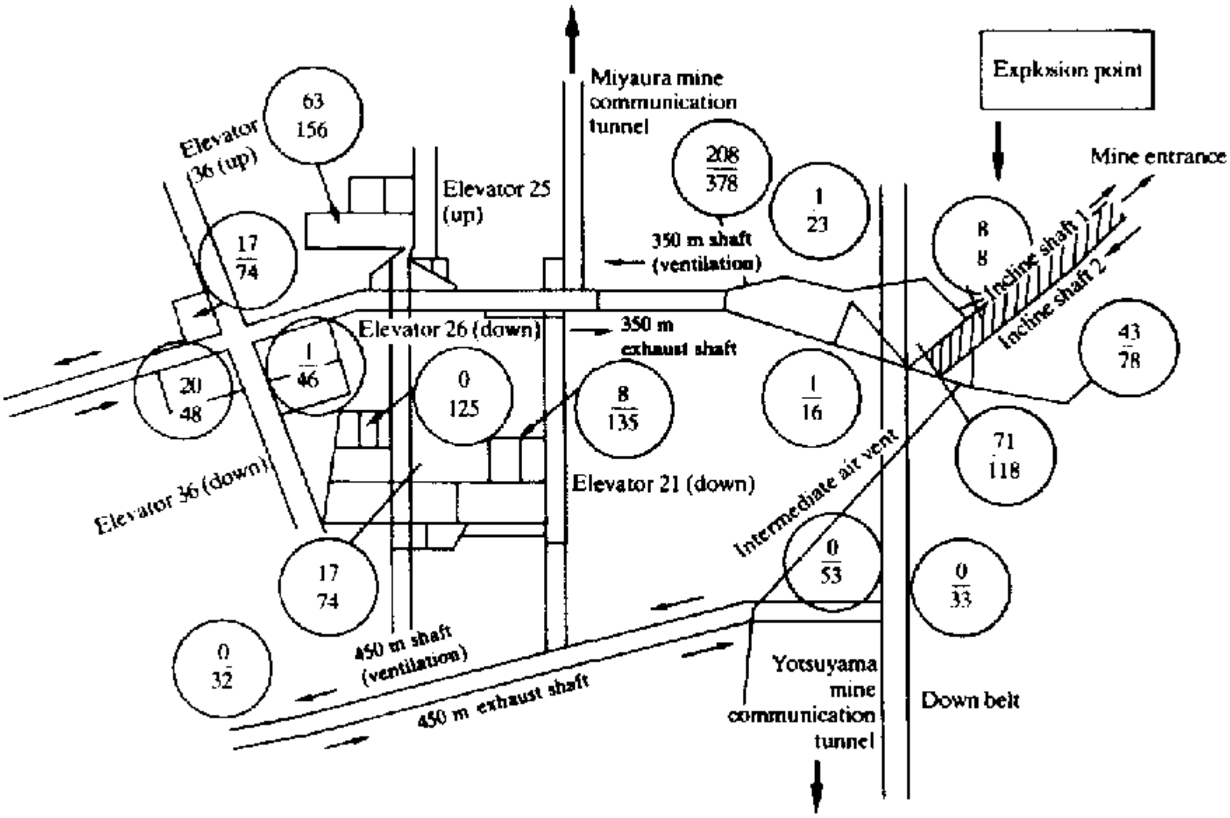
The number of deaths and injuries resulting from the explosions was greatly increased by the carbon monoxide problem. In other words, had the carbon monoxide and other poison gases generated by the explosions been isolated in the immediate area, the amount of death and injury could have been kept to a minimum. However, the mining company did not make any efforts to provide for such eventualities. Moreover, it would seem that the company neglected to educate its workers in relation to the potential for gas poisoning. Indeed, it provided misinformation by spreading the "myth" that coal-dust explosions were impossible in the Miike mine.

If the company was unaware of the relationship between dust explosions and the generation of poison gases, then it can only be said that it was irresponsible in the extreme. In most cases the explosion victims were not injured in a physical manner, and many of the corpses recovered from the mine showed no scars or scratches at all, since they were victims of monoxide poisoning. Many of those rescued alive showed very severe symptoms of monoxide poisoning.

The Mitsui Coal Mining Company was aware of these facts but made no attempts to rescue the workers. It indicated that, because of the breakdown of electricity and telephone communications in the mine after the explosions, conditions inside were unclear, and therefore it was too risky to send in rescue crews. One must infer from these statements that management was willing for the 1,400 workers trapped inside the mine to be subjected to the possibility of pervasive monoxide poisoning, with no hope of rescue.

The miners of Miike were angered by the situation, feeling that responsible persons should go immediately into the mine with oxygen tanks. While management was safe from the problem, there were workers in the mine who were at 350- to 450-metre depths and 8 kilometres from the entrance in tunnels. These workers did not know about the explosions and were forced to remain below ground without electricity or telephones. Figure 5.1 is a sectional layout of the mine where the explosion took place. The encircled numbers above the line indicate those who died because of the explosions, and those below the line indicate those workers present when the explosions took place.

Fig. 5.1. Manning Chart at the Time of Explosion (after Miike Roso, "(s.38. 11.g mikawako daibakuhatsu) shozoku rosobetsu hisai basho hyo," *Miike karano hokoku dan 3 shuu*).



Note: Circled figures indicate the number of miners assigned (figure below the line) and the number of deaths (figure above the line) at each station.

The workers who knew about the explosion numbered approximately 200, who were located close to the bottom of a neighbouring mine shaft. About SO who were close to the site of the explosions died as a direct result of the conflagration or from the poison gas generated by the sudden combustion. Another 150 workers heard the explosion at a location where they were waiting for the lift out of the mine. They were told by officers not to move but to wait. These people lost their chance to Bet away from the destruction and died as a result of monoxide poisoning. Therefore, of the 200 people who knew about the explosion, none of them were able to go and tell the other workers of the seriousness of the problem. Figure S. 1 indicates that at a depth of 450 metres there were 120 workers, none of whom died. At 350 metres more workers died. It is said that at 450 metres there was air circulation from the Mitsui Company's Yotsuyama mine, whereas at the 350-metre level there were no provisions for isolating the poison gases and a ventilation fan worked to increase the rate at which the gas filled the area. The workers who were at this level knew nothing of the explosion and, believing that clean air was being brought into their area, died while on their way to the lift.

Instead of stopping the air-circulation fan, management continued its operation, thereby ensuring a more rapid spread of the poisons. The workers did not know about the gas problem and followed directions to use the passage that was normally used for ventilation; however, this was already filled with poisonous gas.

As a result of these management blunders, 438 persons lost their lives unnecessarily. There were 939 workers saved, but 839 of these suffered from serious carbon monoxide poisoning. Many more might have been saved if the company had taken immediate emergency action or had made preparations beforehand for such eventualities.

VI. Almost complete absence of a security policy

The rules for rescuing carbon monoxide victims are as follows:

1. If a person looks well and is running out of the problem area, his stage of poisoning is probably well advanced.

2. Poisoning victims should not walk.

3. Poisoning victims should be carried out of the problem area into fresh air for treatment as soon as possible.

These three rules were laid down in 1936 by a medical doctor who had experienced many explosion accidents and had treated many patients at Mitsui Mining's Yamano Mine Hospital. However, the Mitsui Mining Company did not follow these rules.

In the first instance, it took more than two hours after the explosion for a rescue team to be formed with the participation of workers outside the mine and from other mines. When the first crew of 22 workers reached the 350-metre depth it was already 6 p.m.' and the poisoning victims had already been breathing poisons for about three hours. The situation was such that victims could in no way be carried out into the fresh air as soon as possible, since the rescue operations had been considerably delayed.

The Mitsui Mining Company must have been aware that the explosion took place at 3.12 p.m. and that 30 minutes after the explosion the gas victims were already suffering in the mine. Some victims escaped to the entrances to the Yotsuyama and Miyaura mines through connecting tunnels (fig. 5. 1), and through this the Mitsui Mining Company headquarters most likely received a report on the poisoning problem. By 4 p.m. at the latest company headquarters had received news of conditions at the three locations (350, 450, and 520 metres) from which workers had been evacuated. In spite of this, rescue teams were sent into the mine two hours after these reports had been received. During this two-hour period, workers trapped in the mine were suffering from gas poisoning and were trying to help each other find safe areas in the darkness. During this same period also, many workers died.

The second problem lay with the fact that the rescue teams made a miscalculation in that they were concerned only with rescuing those who looked most seriously ill. In other words, they carried out only those who had lost consciousness, while those who looked as though they were still able to move or who looked well were required to walk to the mine entrance. Some whose legs below the knees were completely numb still had to walk out of the mine supported by others. The rules for handling carbon monoxide victims are, first of all, those who look most well are most probably very seriously sick, and, secondly, victims should not be allowed to walk. Neither of these rules were followed in any way.

The third problem lay in the fact that those who were monoxide poisoning victims had to help rescue other workers. Those same poisoned workers who looked unharmed went back into the mine as rescue workers. Information gleaned after the accident indicates that 227 workers who were already poisoning victims were employed to help those who could not walk out of the mine. Furthermore, those who had been initially involved in rescue work should not have been made to go back into the mine a second time for further rescue efforts. Table 5.4 compares the number of workers who appeared to be well after coming out of the mine with the small number of those same workers who were able to work afterwards.

There is no other explanation but that the original intention of the company was to use the poison gas victims as rescue crews in order to minimize the labour force losses that would have followed an increase in the number of workers involved in the rescue operations. If the company had been concerned with the health of workers, the instituted measures would have been very different. Rescue crews should have gone into the mine at once and safety provisions should have been made for the rescue workers. But neither of these measures were taken. The company knew that rescue crew members would suffer from monoxide poisoning after entering the mine, and the measures taken to deal with this problem were as poor as those taken to rescue workers from the mine. As a matter of fact, of the 800 people assigned to rescue work only 323 were brought in from the Mitsui Company's Myaura and Yotsuyama mines, leaving the rest of the workers at these other mines unaware of and uninvolved in the rescue of 1,400 of their endangered fellow-workers.

Table 5.4. Physical Condition of Miners Engaged in Rescue Work after Suffering Monoxide Poisoning

		Condition of consciousness at the time of mobilization				Post-incident condition			
Location	**Number mobilized**	**Unconscious**	**Regained consciousness prior to mobilization**	**Dizziness**	**Relatively normal**	**Hospitalized**	**Resting at home**	**Working**	**Notes**
Elevator 21 (down)	91	1	0	12	78	10	61	18	Retired 2
Elevator 26 (up)	105	1	1	13	90	4	67	27	Retired 7
Elevator 36 (up)	31	0	0	3	28	3	12	14	Dead 1
	-			-	-	-	-	-	Unknown 1
									-
Total	227	2	1	28	196	17	140	59	11

Source: Kyoto Kenkyuukai Hen, *Kyuuen dankai ni okeru mitsui kozan no fuho sekinin no tsuikyuu,* p. 58.

As was indicated previously, rescue crews went into the mine without knowing anything about the carbon monoxide problem and without any protection against it and the other poison gases present. Not only that, the company gave no explanation to the rescue crews as to the nature of the accident or the purpose of the rescue mission, and many of the crew members were sent into the mine reluctantly. After reaching the problem area they saw at once that the problem derived from a coal-dust explosion that resulted in poison gases. They were told to hold hands with each other as they went into the rescue area, and were also ordered to bring out first only those who were still breathing. This was done without oxygen tanks and in an area that was filled with poison gas.

Besides the rescue crew members, who had no protection from or knowledge of the nature of the problem and the poisons involved, there was a group of people in white uniforms and with oxygen tanks whose business it was to determine the density of the carbon monoxide using special instruments. But these people were sent into the mine not to help with the rescue operation but to determine the damage done and to replace the telephone lines and other equipment items in order that the mine could be reopened as soon as possible. In contrast to the rescue workers, they were very well equipped, which indicates that management was not serious about rescuing the victims of the explosion. Therefore, because the company showed so little concern for rescue operations and followed none of the rules for saving carbon monoxide poisoning victims, the Mitsui Miike explosion resulted in the largest coal-mine disaster in the history of mining.
