Reading

6.6

Butler, J. E. (1980). Extract from Man-made disasters (pp. 58-73). Heinemann: Richmond.

ALBATROSS TWO

Colin Thiele

An extract from the book

On Thursday the first sea-bird died. It was a black cormorant. Craypot found it lying half dead on the rocks near the western headland, while he was looking for lost marker-buoys. He brought it back to the boatshed to show Tina and Link. The oil slick from Albatross Two was now a huge smudge five kilometres long and two kilometres wide. Its shoreward edge was only 1000 metres from the coast in some places, and it was spreading relentlessly like a disease. The lagoon of clear water along the shore was shrinking every day.

Indigo Ingvarsson and the directors of the Oil Company knew only too well what was happening and they were working around the clock to try to get Albatross Two by the throat and strangle her. They set up huge flood lights near the jetty so that they could work through the night. They brought in more men and equipment. But in the end only a small group of experts could actually fight the blowout and it was a long hard job. And very dangerous.

After long analysis and much discussion they decided to drill a "relief" well, as they called it, which would be controlled so carefully that it would actually meet Albatross Two down near the zone of high-pressure gas. Then heavy mud would be pumped in to seal it off. It was an enormously complex operation. And it would cost a million dollars.

Tina took the cormorant from Craypot, laid it gently on a bench in the boatshed, and started wiping its feathers with a rag. They were covered with oil. Although it was still alive it was weak and helpless and lay there without struggling; its eyes were blinking open and shut in alarm and its beak kept opening wide in a retching movement.

Tina was almost in tears. "You poor old fellow, you poor old fellow," she kept saying while she wiped and dabbed at its wings and breast. But the cormorant remained limp and listless.

Link and Craypot stood watching. . .

Craypot was strangely concerned. "I hate seeing innocent things die," he said.

"Perhaps it would help if we bathed him in warm soapy water. It would get rid of the oil."

"Maybe," answered Tina. But Link snorted. "You do that and he'll die for sure. It would take away the natural oils too."

"What would that do?"

"He wouldn't be able to float. He'd drown."

Tina and Craypot both looked so crestfallen that Link felt sorry for them. "In any case," he added, "this fellow is poisoned. Nothing much we can do for him."

"Poisoned?" Tina was horrified.

"Oil poisoning. Swallowed it while he was fishing."

"You mean it's in his stomach and everywhere?"

"Yes. Like a child that's swallowed kerosene."

"Couldn't we make him bring it up? Spit it out?"

"Don't ask me. I'm not a vet."

Air pollution types

It is difficult to avoid feeling the effects of polluted air. People who live in cities are most affected, but pollutants in the air may travel, and at worst, cause problems on a world-wide basis.

We can divide the pollutants in the air into two main groups — *gases* and *particles*. Of the gases, *carbon dioxide* and *carbon monoxide* are the pollutants found in greatest quantities. Both of these are the result of the burning of *fossil fuels;* carbon dioxide from the complete burning and carbon monoxide from incomplete burning. It may seem strange to include carbon dioxide as a pollutant, since it occurs naturally in the air, and is in fact breathed out by the human body. However, it is known that it does affect world temperature control. In the last one hundred years, the amount of carbon dioxide in the atmosphere has increased by 10%.

Carbon monoxide is mainly produced by the incomplete burning of petrol in cars. Hazardous concentrations of this gas have been found in the atmosphere near places with heavy traffic.

Some other gases, although found in much lower concentrations, are more poisonous. *Sulphur dioxide* is another by-product of the burning of coal and oil. When it mixes with water in the air, it forms *sulphuric acid* which penetrates the lungs and attacks internal parts of the body. This was one of the main killers in the 1952 London smog.

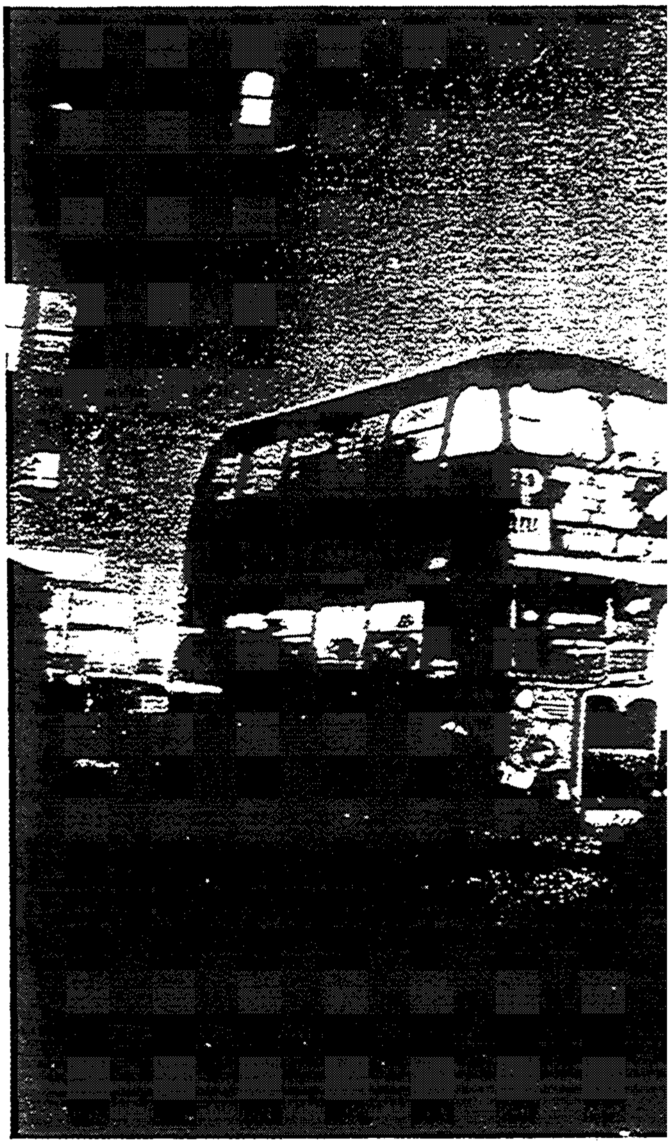
Oxides of nitrogen make up another group of gas pollutants. The car is the main source of *nitric oxide*, which is often converted into *nitrogen dioxide*, a more dangerous gas. Nitrogen dioxide is coloured and can restrict visibility. If the nitrogen oxides react with organic substances on sunny days, a gas called *ozone* is formed. This causes *photochemical smog* which will be described later.

Particles of all kinds are always present in the atmosphere. Dust is an ever present nuisance but is not usually a serious pollutant. Soot is also common, and more dangerous. The *hydrocarbons* carried with soot are suspected of causing cancer in certain circumstances.

A different kind of particle is one that is formed in the atmosphere, as a result of *photochemical smog*. The concentration of these particles can become dense enough to significantly reduce visibility. In high concentrations it can also cause serious eye irritations.

Two other kinds of pollutants, not only confined to the air, are discussed later in this book. They are the *poisons* (herbicides and pesticides) and *radio-active material.*

The killer smog of London



It is now well known that smoke and other pollutants in the atmosphere can be dangerous to our health. Breathing polluted air, over a long period, can affect the lungs. Fortunately it is very rare for the pollution of the atmosphere to be so bad that it causes chaos and death within a short time.

However, one of these rare instances occurred in London in December, 1952. London was noted for its pea-soup fogs. It had experienced these periodically since the mid-nineteenth century. As the city grew with the industrial revolution, the amount of coal burned in houses and factories increased. The coal-smoke mixed with the water particles in the winter atmosphere and often created thick smog. Londoners were accustomed to the smog in winter but usually wind would clear the smog fairly quickly.

However, in early December, 1952 due to the stability of the atmosphere over London, a wind did not come. The smoke pouring into the air just stayed over the city. Throughout December 5 the smog became thicker and visibility decreased. Soon people could not see more than a few metres in front of them. Even in cinemas the view of the screen from the back seats was obscured.

At first the smog was just an inconvenience, causing traffic chaos and personal delays. But soon there were major disruptions to ambulance, fire-brigade and bus services. It became impossible to answer emergency services in time.

At Westham, the fire brigade was unable to get to a burning factory in time to save it, even though it was only 400 metres away. Because it was so difficult to negotiate the fog, people abandoned their cars. This made it even harder for others to find their way about. By evening, buses, taxis and trains were forced to stop their services. Heathrow Airport was closed and planes were forced to use the small airport at Bournemouth.

Crime increased during the Great Smog, in particular, violent crime. Fortunately, the smog, which gave cover to criminals, also made escaping difficult. By the third day supplies to shops became short. Dockers could not find their way to work to unload ships, and truck drivers could not find their destinations. People were afraid to go to shops in case they lost their way.

However, the most disastrous effects of the great smog was on human life. For old people, babies under one year and anyone suffering from heart or lung complaints it was a time of extreme risk. 4,000 people died from an attack of acute bronchitis.

The reason for the fatalities was the combination of the *soot particles* and *sulphur dioxide* in the air. The sulphur dioxide came from the burning coal and oil. When combined with water it makes *sulphuric acid*. People were breathing a mixture of acid and soot! An official committee set up to investigate the disaster confirmed this combination of pollutants was one of the main causes of deaths.

There were proposals from various people and organisations to evacuate people with weak lungs and hearts out of London. One member of Parliament proposed that 10,000 people should be moved out of the city for four or five days. However, these plans were not acted on by the Government.

After four days of the terrifying smog, a wind slowly began to clear the air over London. The visibility increased, people were able to go out of their houses and find their way about, and business resumed.

Those Londoners who had suffered through the four days were determined that such an event should not happen again. In analysing the event and its causes, they realised that December, 1952 was only the last step in a long progression towards such a disaster. Therefore, in 1956 the Clean Air Act was made a law by Parliament. This allowed local governments to control the burning of coal and production of smoke within their local areas. In London these new laws were very quickly used to create smoke-free areas. Because this happened during the same period that natural gas was being used more widely, it is impossible for such a disaster as the 1952 smog to happen again.

It is interesting to note that most other cities of the world did not have laws governing air pollution until the 1960s. It was the 1952 event, the worst of a whole series of such smogs, which prompted Londoners to support legislation which otherwise would not have been very popular. In a climate of long winters, restrictions on the burning of coal would not have been supported, except for the knowledge of the greater evil of effects on health. The 1952 Smog is another example of the way that important and beneficial laws can be introduced as the result of a major disaster.

Fig. 4.1 This is the early stage of a London smog.

Photochemical smog

The type of smog that used to choke London was caused mainly by the burning of coal, together with the moisture in the atmosphere. Since controls on the burning of coal were introduced, the problem has almost been overcome.

Another type of smog which is much harder to control is called *photochemical* smog. It occurs in most Australian cities and other places with plenty of sunlight. Photochemical smog only occurs in sunlight and is caused by chemical reactions. (Hence the name "photo" being derived from the Greek word for light.)

The nature of the chemical reactions is very complex but it is known that the major components are *nitrogen oxides* and *hydrocarbons*. These two substances reach the atmosphere primarily from car exhausts. Nitrogen oxides are by-products of combustion in the car engine. Hydrocarbons are emitted when there is incomplete combustion of petrol.

One of the main products of the chemical reactions which are stimulated by sunlight is *ozone*, a gas which is extremely toxic. The level of ozone in the air is used to measure the level of photochemical smog. There are other products of the chemical reactions, and some of these are in the form of tiny particles. It is these which limit visibility and cause a grey haze over cities.

The effects of photochemical smog are not fully known. What is known is that people experience breathing difficulties and eye irritations as a result of it, and that certain crops are affected.

There is much research being done by the C.S.I.R.O. in Australia and also by similar organisations elsewhere. Los Angeles, New York, Tokyo and Sydney are cities with regular photochemical smogs. Los Angeles has the worst problem. Its ozone levels have been recorded at ten times the maximum safety level, while Sydney has had occasional readings of four times the safety level.

One of the major steps Australia took to reduce the causes of photochemical smog was to control the emissions of car exhausts. Since 1976 new cars have had emission controls to limit the amount of incomplete combustion. This will reduce the concentration of hydro-carbons in the air, and it is hoped that the problem of photochemical smog will be reduced.

City	*Highest level of ozone recorded (p.p.m.)**	*Common maximum level of ozone (p.p.m.)**
Los Angeles	.58	.38 - .40
Sydney	.38	.25 - .30
Tokyo	.38	.25 - .30
Osaka	.29	.20 - .25
Melbourne	.25	.15 - .20
Toronto	.21	.15 - .20
Chicago	.20	.15 - .20
London	.21	.12 - .18
Adelaide	.14	.10 - .12
Brisbane	.14	.10 - .12

*parts per million

Fig. 4.2 A comparison of air pollution levels in a number of cities. Ozone level is used as an indicator of air pollution. Compare the figures with the maximum level advised by W.H.O.

Smog in Sydney

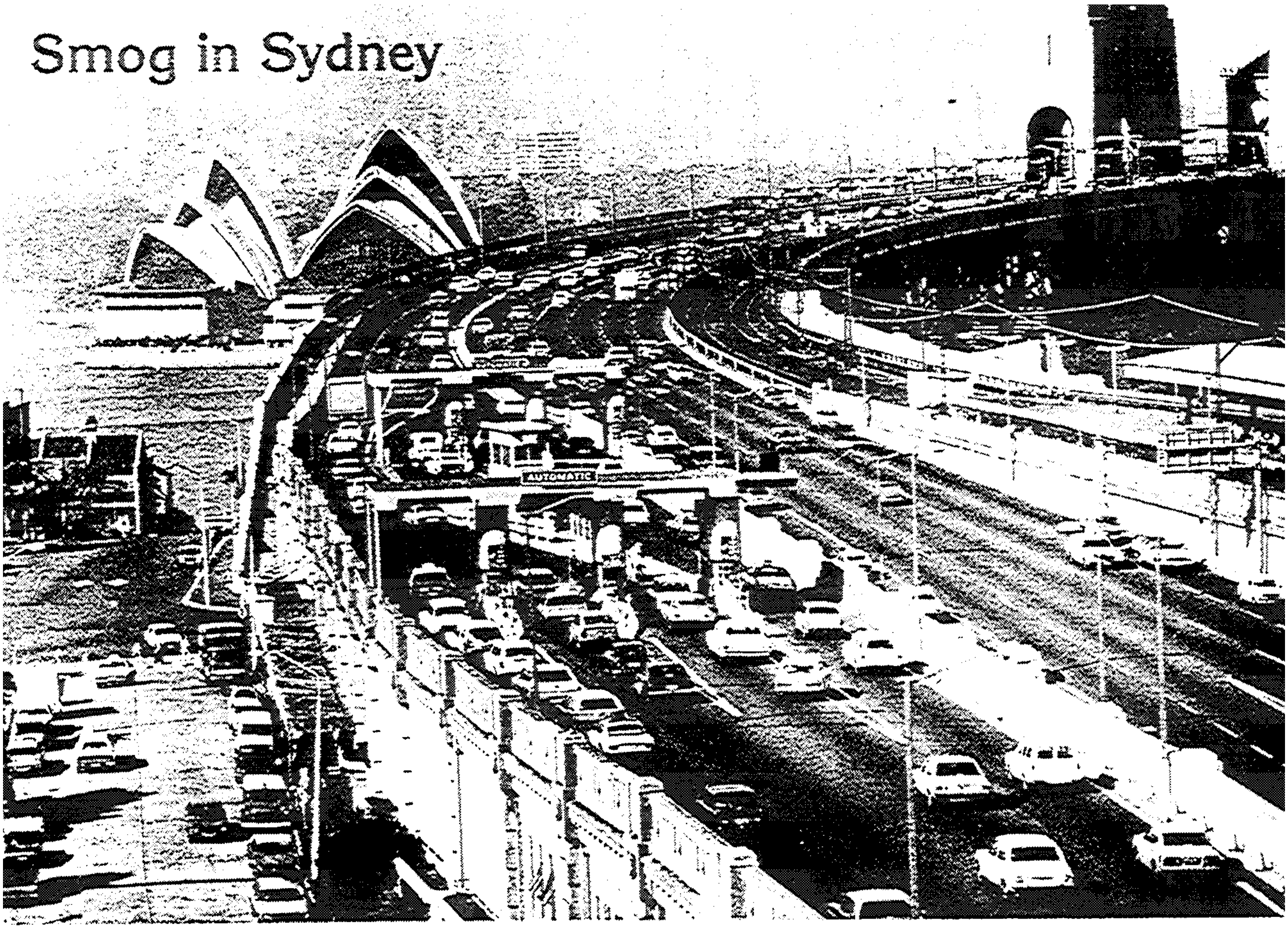


Fig. 4.3 Sydney smog and part of its cause.

In March 1976, a class of Sydney schoolchildren were in the schoolyard, taking part in sports activities. The atmosphere that day was hazy with photochemical smog. During the lesson, some of the children had problems with breathing, and others developed pains in the chest. Thirteen of the children were taken to hospital where the diagnosis was that the breathing problems were due to smog.

That day Sydney had a severe photochemical smog, and the ozone concentration was measured at 0.2 parts per million. This is many times the maximum safety level of 0.06 p.p.m. advised by the World Health Organisation and the 0.08 p.p.m. level advised by the U.S. Environmental Protection Agency. However, in 1977, a Sydney suburb recorded an average concentration over an hour of 0.38 p.p.m. ozone level.

Sydney's smogs occur from October to April. The most favourable conditions for smog are on a calm day, when the sky is clear. An afternoon sea breeze adds to the likelihood of smog.

During the night a *temperature inversion* forms. This means that the temperature at ground level is lower than at a few hundred metres altitude. A temperature inversion prevents air from rising and mixing, and so the particles of pollution are concentrated in the lower layer of the atmosphere. The fact that Sydney is bounded by higher ground on three sides also prevents the smog from dispersing.

Sydney's days of smog usually begin with little or no wind. The traffic exhaust and smoke from factories are trapped in the lower levels of the atmosphere. A gentle easterly wind from the hills may slowly move the pollutants across the coast. As the nitrogen oxides and hydrocarbons drift over the sea, the sunlight reacts with them to form ozone.

Around midday, a sea breeze starts to blow. The smog is blown from the sea and coastal suburbs to the city. Ozone levels soar as the sea-breeze reaches the central and eastern suburbs. As the smog sets in, the atmosphere becomes murky, visibility drops, and the potential for health problems rises.

Oil pollution of the sea

In 1970, Thor Heyerdahl crossed the Atlantic on a balsa raft, re-enacting the journeys of earlier centuries. Sitting on the raft just above the surface of the water, he was surprised and distressed to find that he was rarely out of sight of man-made garbage. A major component of this was lumps of *oil tar*, about 6 cm in diameter.

These lumps of oil tar were the residue from numerous oil spills, blowouts, leaking wells, washing of ship tanks and other spills both large and small. It is estimated that the loss of oil into the seas is 0.1% of the total shipped each year. However, this seemingly small percentage is a total of *ten million tonnes*.

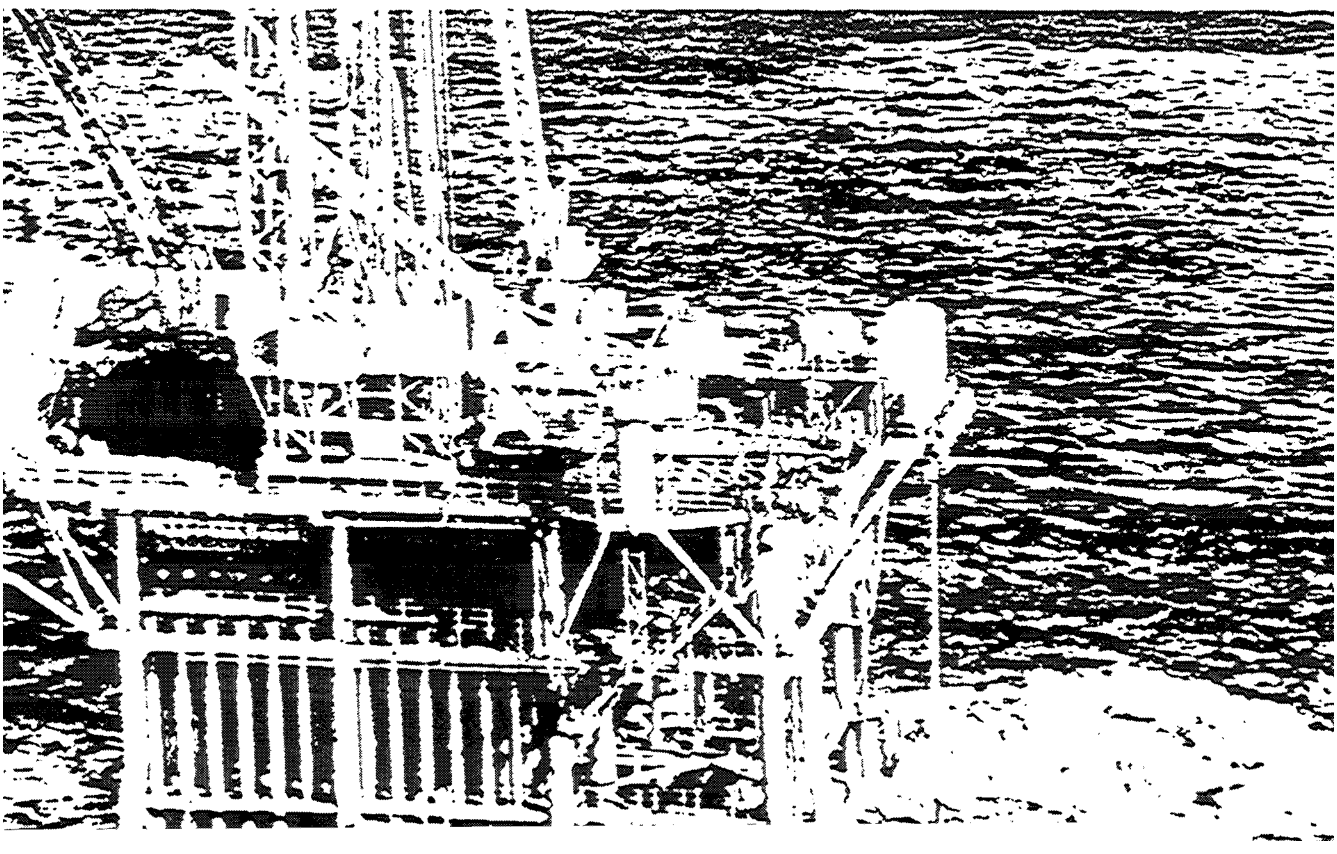
What effect is this influx having on the ocean? The immediate effects are known. Birds which have their feathers coated in oil are prevented from flying, and when they preen their feathers to remove the oil, are poisoned by ingesting it. Fish and shell-fish are affected because their food and surroundings become coated with oil.

The long-term effects are less well known. What is known is that *hydro-carbons* (the building blocks of oil) can pass through many stages of the food chain without breaking down. This means that hydro-carbons which coat plants in the sea can be eaten by small marine animals, which in turn are eaten by larger animals. Eventually they may be ingested by humans eating fish from the sea. The hydro-carbons are passed all the way along. People may notice an unpleasant taste in the fish they eat. This comes from certain oil substances in the fish's system. Another more serious consequence is the possibility of people eating substances in their food which may cause cancer, or may poison the body in other ways.

Scientists know of another long-term effect on marine life but it is not fully understood. It was discovered that fish find their food and mates and escape from predators by releasing low concentrations of certain chemicals. This works for the fish the way a sense of smell works for land animals. When oil is spilt into the sea the hydro-carbons interfere with this natural process. This may ultimately have the effect of wiping out some species of fish.

The oceans are a great food source for mankind. With increasing pressure on the land, the sea will become an even more important source of food. Before it is too late, we must influence governments to take significant action to preserve the seas as a major resource for us all.

Fig. 4.4 A major blow-out on an off-shore oil rig. Thousands of tonnes of oil spill into the sea. The effects are devastating.



OIL WRECK LOSS WORST EVER

LONDON, Fri., AAP. — The giant tanker Torrey Canyon's encounter with the Seven Stones Reef may prove Britain's costliest peace-time disaster.

Legal wrangles over who foots the bill for what, could go on for years.

The British Government's battle to save beaches from being ruined by thousands of tons of oil could cost $A32 million for detergent alone.

Coastal holiday resorts which attract up to six million visitors each summer are threatened by huge oil slicks.

Then there is the cost of the RAFs bombing raids on the tanker. The three-day bombing operation has apparently succeeded in burning out the remaining oil in the shattered hulk.

On top of this will be insurance claims for the ship and its cargo, and claims from people whose living could be threatened by the disaster.

Another big worry is the possible effect of the oil and detergent on the fishing industry.

The Torrey Canyon was insured for $A14.75 million, and her 120,000-ton cargo was covered for another $A1.5 million.

So far there has been no flood of cancellations for summer holidays at tourist resorts either affected or threatened by the drifting oil slicks.

Most people are waiting to see if the cleaning operations — launched with detergents and flame-throwers — are successful.

Before the Torrey Canyon was wrecked on the British coast there was little public awareness of the problems of oil pollution of the sea. As the size of oil tankers grew, the dangers of large scale disasters increased. Unfortunately it took the events of 1967 to show the public what could really happen as the result of a major spillage.

On March 18 of that year, the Torrey Canyon was on its way from the Persian Gulf to Milford Haven in Wales. The tanker was making sixteen knots when it hit rocks off the Seven Stones reef, 25 km west of Land's End. The hull was ripped open along half of its length, and fourteen of the sixteen tanks were damaged.

30,000 tonnes of oil poured out of the tanker in the first few hours. More oil was pumped out in at attempt to refloat the tanker. On the Sunday, eight days after the wreck, a storm broke the back of the ship, letting 3,000 more tonnes of oil into the sea.

Meanwhile attempts were being made to combat the oil pollution. On the beaches of Cornwall, detergents were used to disperse the oil, and the layer of polluted sand was scraped away. However, both of these measures were used haphazardly, because of inexperience. The millions of litres of detergent used were almost as poisonous as the oil. A lot of marine life was killed.

In France, sawdust was used to sink some oil slicks, but huge quantities of oil reached the French coast and the beaches of the Channel Island. Oil was being washed ashore in the Bay of Biscay more than three months after the wreck of the Torrey Canyon.

Public sympathy and interest were particularly caught by the plight of the sea birds. It is estimated that over 25,000 birds were killed by the oil. Thousands of birds reached the coast covered in oil, any many of these were rescued and cleaned by volunteer workers. However, only a small number of birds survived.

Shortly after the Torrey Canyon wreck, many inhabitants of the coast of Cornwall predicted that their coast would be ruined for ten years or more. They envisaged permanently blackened beaches which would naturally repel the tourists, and permanently polluted fishing grounds which would destroy the fishing industry.

In actual fact, however, most of the beaches were cleared of oil within a few months. This was due to an enormous co-operative effort by local people and volunteers from outside the area. By the summer of 1968 the beaches were almost back to normal again. Even the fishing grounds recovered from their soaking in oil more quickly than had been predicted, a fact which gave some hope in the undesirable but possible event of another oil spill.

If the Torrey Canyon incident could be said to have had any good effect, it was to make various oil companies, and the general public, more aware of the increasing possibility of spillages. Governments, oil companies and research institutions were all spurred into studying ways of avoiding this sort of disaster and, if another spillage occurred, how best to clean it up.

Fig. 4.5 One of the more visible effects of oil pollution.

12 lost hours brought oil spill disaster

The picturesque tourist beaches of Brittany are fouled by an oil spill that should never have happened and the need has been underlined again for an international code of conduct to govern supertankers and their owners.

A rundown on the events that led to the Amoco Cadiz disaster has disclosed that 12 hours were lost during which the whole episode could have been averted and has raised the question of responsibility for quick executive action when such a situation threatens.

As things stand it seems that nobody wanted to know during the vital hours before it was too late to do anything.

Europe's worst tanker-caused pollution began on the afternoon of March 16 when the Amoco Cadiz ran into trouble off the French coast.

Yet it was 12 hours later that she sent up the first distress rockets — when she was already aground and beginning to break up. Although French authorities were able to rescue the ship's crew they were unable to take further action because it was dark and a gale was raging.

By next morning three of the Amoco Cadiz's tanks were holed and 60,000 tonnes of oil was spreading across the ocean surface. The rest of the tanker's 223,000 tonnes of crude were to follow as the ship slowly broke up.

But during the 12 hours between first finding itself in trouble and hitting the needle-sharp rocks of the Brittany coast the tanker was drifting well clear of the shore and could have been easily reached.

In fact, a German tug, the Pacific, was alongside the tanker just two hours after it first sent a radio message saying its steering had failed.

TERMS HAGGLE

The parties involved in the affair — the tanker's owners, the tug's owners and the French authorities — have all skilfully avoided fully explaining why those 12 hours were allowed to slip away.

No doubt any explanation would also involve attributing blame.

But the facts remain — and with the number of super-tankers plying the world's oceans they make disturbing reading.

The Amoco Cadiz made its first call for assistance at 10.15 GMT on March 16 to a Brest-based salvage firm. At the time she was drifting between 13 km and 15 km off the coast.

The tug Pacific was nearby and was sent immediately. It arrived at 1220 GMT. It immediately shot a towline aboard the tanker. The tanker skipper and the tug captain then settled back to haggle over terms.

The tanker's captain, Italian Pasquali Bardari, claimed his ship was in no danger and wanted an hourly towing contract to get it to Lyme Bay, Dorset, where repairs could be made and the load lightened.

The tug skipper disagreed, insisting that the tanker was in enough trouble to warrant a Lloyd's open contract, which would have meant the ship's owners paying a percentage of the cargo's $U.S.20 million value.

As the "negotiations" continued the tanker and the tug drifted closer to the French coast and the weather deteriorated.

The French coastal radio station at le Conquet, which had monitored Amoco Cadiz's first radio call for assistance, called the tanker several times during the afternoon asking if all was well.

The tanker's reply, according to Le Conquet was: "Everything is fine, don't worry."

Towing terms were eventually agreed after the tanker's captain had received the go-ahead for an open contract from his head office in Chicago.

Suddenly, the heavy towing chain parted. Worsening weather prevented another line being put aboard the Cadiz, despite repeated attempts.

At 7.30 in the evening French coastal authorities, who had been relying on visual contact to keep track of the tanker because they had no radar, lost sight of the stricken ship.

About 90 minutes later the tanker was grounded and its pump room holed. Twelve May Day rockets were fired, seven of which were seen in Le Conquet.

Naval helicopters plucked the crew to safety, but naval craft could not risk approaching the tanker at night in heavy seas. By the following morning it was too late.

The French authorities claim they did not know of the tanker's distress until the rockets had been fired — yet the Le Conquet radio contact had been made five or six hours earlier.

There is little doubt that the reflexes of the French authorities slowed by their natural respect for supertankers and the belief that even if the Cadiz ran aground it would not break up, although the authorities, going by the radio answers to inquiries from Le Conquet during the afternoon, were not to know how serious the situation was.

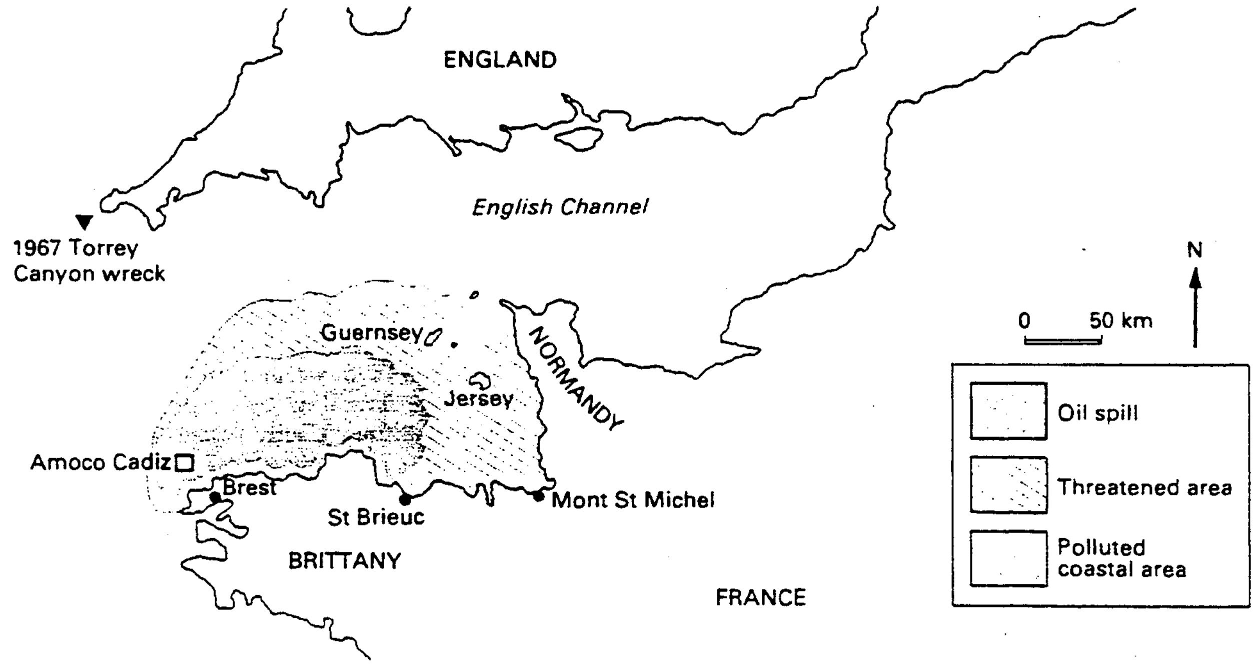


Fig. 4.6 The oil spill from the Amoco Cadiz.

One of the worst oil spills to date occurred in 1978, off the coast of France. The Amoco Cadiz, a tanker carrying 220,000 tonnes of crude oil, went aground near the fishing village of Portsall in Brittany. The initial cause of the accident was a steering failure, but the captain was accused of not acting quickly enough to save his ship from drifting onto the rocks. It was alleged that his ship foundered on the rocky coast while he argued with a tug-boat captain over the cost of being towed. He was charged with polluting French waters under a 1963 law on sea pollution.

All the tanks on the Amoco Cadiz were damaged. Most of the 220,000 tonnes of crude oil oozed into the sea. *This was twice the amount spilled from the Torrey Canyon in 1967*. Strong winds spread the oil slick along the coast of Brittany and towards the Channel Islands, depositing a black slime on beaches, seaweed, fish and birds.

Inflatable booms were used to try to stop the spread of oil, but the strong winds and high seas prevented them from being effective. Detergents were not used because previous experience had taught officials how harmful they could be.

There was one immediate difference between the Torrey Canyon spillage and the Amoco Cadiz and that was the type of oil they were both carrying. The oil aboard the Amoco Cadiz was of a lighter grade than that spilled by the Torrey Canyon and officials were not sure what the effects of the later spillage would be. Because the oil was lighter it meant that the tide would, to a certain extent, clear the beaches naturally. However, it also meant that the oil was able to seep into the sand to a depth of 50 cm. There were fears that this might have long term effects on the plant life along the shore. It was also predicted that the oil would spread through the seas affecting fish, underwater life and birds, such as pelicans and cormorants, which dived for the fish.

As with the Torrey Canyon incident, the economic effect on tourism was a major worry in 1978. France was concerned about how the spillage would affect the coast of Brittany and towns such as Mont St. Michel (an ancient abbey built on a tiny island). Britain, too, was concerned about the Channel Islands which also rely heavily on tourists for their income.

The French government acted quickly in response to public outrage at the disaster. It initiated charges against both the captain of the tanker, and the captain of the tug-boat which had delayed towing the tanker away from the rocky coast. The government also decided to ban tankers from travelling closer than ten kilometres from the French coast. In any future situation, tug boat captains must notify the navy when they answer distress calls. With such legislation the government hopes to satisfy public opinion and to prevent future disasters of the same magnitude.

▲ Fig. 4.7 The oil-covered bow of the Amoco Cadiz.

▼ Fig. 4.8 A massive clean-up job for volunteer workers.

As the slick spreads, the North Sea danger fighters win . . .

Blowout oil rig sealed

Stavanger, Saturday: Experts today closed the week-long blowout which had poured thousands of tonnes of crude oil from the Ekofisk Bravo 14 platform into the North Sea.

A spokesman for the Phillips Petroleum Company said that heavy rams had closed the well and a four-tonne safety valve was being bolted on.

"We are not completely out of danger until the process is completed and we have pumped mud down the well to kill it," he said. "I see plenty of smiles around our offices."

Earlier, in Glasgow, Aleks Buvik, 34, drilling engineer for the Norwegian Petroleum Directorate, described working conditions on the platform as "Like being in Hell".

He spoke to reporters in a plane flying over the rig.

The Associated Press said that from 3300 metres, the lowest safe level for aircraft in the area, the Bravo platform was like an inverted thumbtack on the sea, half-hidden in the spray of rust-brown oil and water pumped onto the derrick by the fireboat "Seaway Falcon".

Buvik was the first non-Phillips official to go to Ekofisk after the blowout last Friday, arriving on Saturday morning.

On the platform, the blowout is an unremitting thunderous roar, Buvik said.

"Boots" Hansen and the team are working in a cellar 13 metres square. They can't talk; they wear ear protectors. They're constantly drenched in a very heavy rain of hot oil — about the temperature you'd wash your hands in.

Buvik saw Hansen last Thursday evening after the third failure to cap the well.

No, he was not dejected. He says there's always a way to "kill a well".

From the air, the Bravo platform was dwarfed by the six-kilometre long complex of platforms and catwalks that is Ekofisk Central, the heart of the field with the North Sea Hilton — a 214-bed hotel on the oil storage tank core of the complex.

Four kilometres away, the "Seaway Falcon" played a ceaseless stream of water onto the gusher, while the headquarters barge, the "Choctaw 11", lay about 10 metres off the stricken rig at right angles to the fireboat.

A dirty brown slick, surprisingly narrow, like a thin rail to the platform, trailed off a mile or so before dispersing over the sea.

Drilling for oil is, in many ways, a risky business. To begin with there is the financial risk. Enormous sums of money are spent in exploring and drilling test wells, many of which produce no oil or gas in commercial quantities and have to be abandoned. Then there is the risk to human life and the safety of the workers. The oil or gas may be under great pressure and may behave quite unpredictably. Thirdly, there is the risk to the environment when something goes wrong. On the land, this is usually confined to the land immediately around the oil well; but accidents on off-shore oil wells can be far more damaging. An oil-slick will be carried for hundreds of kilometres by the tide and vast areas of the sea can be polluted.

Bravo was one off-shore oil rig on the *Ekofisk* field in the North Sea. In April 1977, engineers on the rig were in the process of sealing the well for maintenance, when it suddenly began to leak oil. The leak quickly became a fountain of oil, mud and flammable gas surging sixty metres into the air.

Immediately the men on the rig were evacuated. A ship was sent to the well to spray it with water to prevent the gas from igniting. Other ships moved close to the well with the booms which are designed to stop oil spreading across the sea.

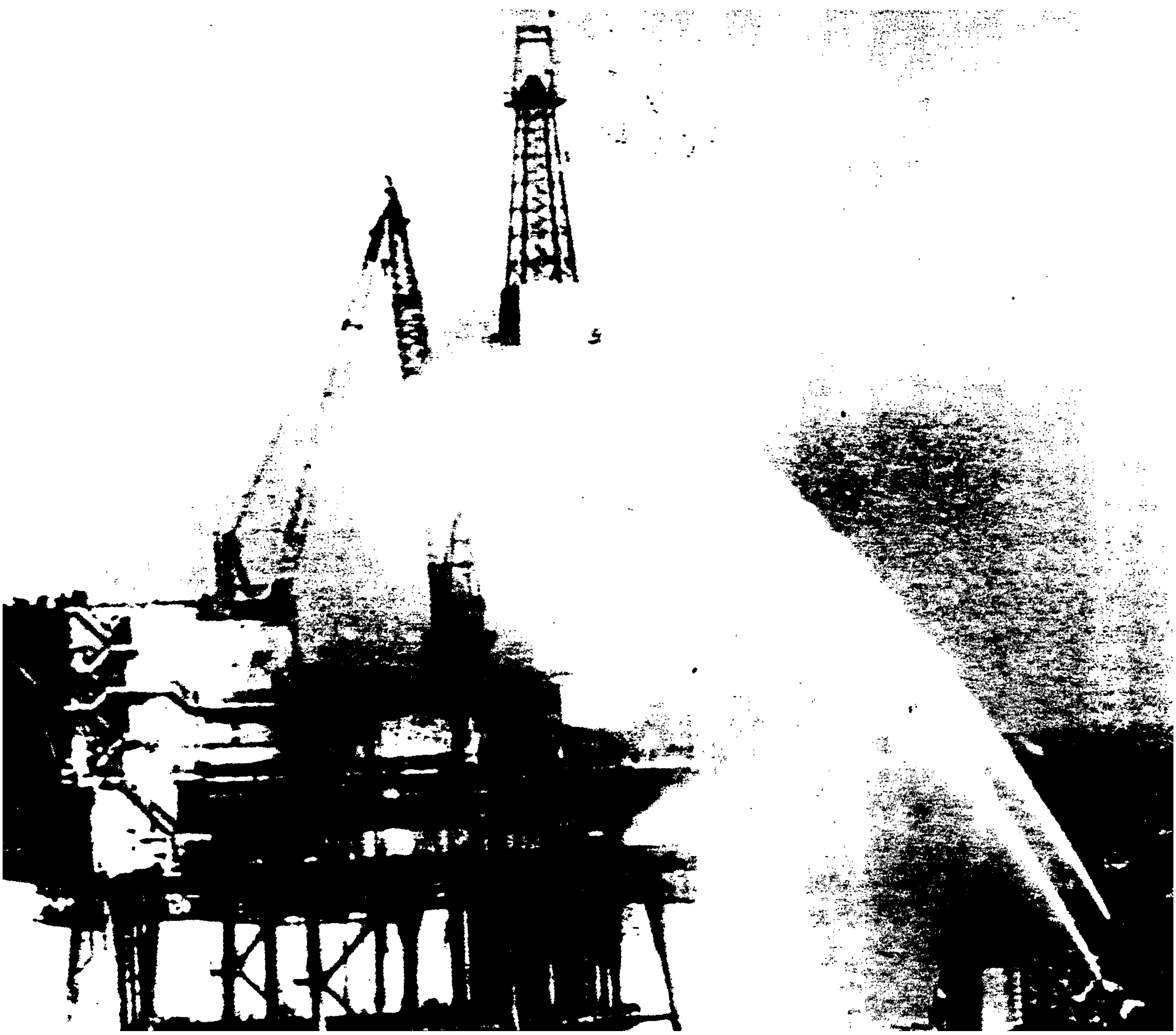
The work of stopping blowouts requires special skills. For twenty years it has been the job of one man called Paul (*Red*) Adair and his small team. They were called on to stop the Bravo blowout. To begin with only two of the team flew over from Texas. At first it looked like a relatively simple task, but their first four attempts to stop the fountain were unsuccessful. After a number of frustrating days, the two men were joined by their boss, Red Adair. He brought with him new techniques and new pieces of machinery. Eventually he stopped the flow of oil. Then the oil-rig workers had to pump hundreds of tonnes of very heavy mud into the well to hold the oil down.

Meanwhile, the effects of the oil blowout were becoming widespread. More than twenty thousand tonnes of oil had escaped into the sea and an easterly wind was causing it to slowly drift towards Norway. The oil slick on the surface of the sea covered about *two thousand square kilometres*. Rough seas were preventing the use of booms to confine the oil, and chemicals were not used for fear of doing more damage to marine life.

Many people in Norway had been very conscious of the risks to their coast and fishing industry since oil drilling began in the North Sea in the mid 1960s. The Bravo incident confirmed their fears. Part of the oil slick remained on the surface of the sea until it reached the coast and polluted it. The rest of the oil sank to the bottom of the sea where it polluted the breeding grounds of herring, mackerel and other fish.

The people in countries such as Norway and Britain, bordering the North Sea, are now putting more pressure on their governments to restrict the expansion of oil drilling. Oil companies may find that in response to this pressure, governments insist that they take more precautions against blowouts and pollution of the seas.

Fig. 4.9 A Norwegian fireboat pours water on oil platform Bravo in a battle to stop the outbreak of fire. 4,000 tonnes of oil spilled into the North Sea each day.



Problems of cleaning up oil pollution

The cost of the disasters

London, Sun., AAP. — The environmental impact of oil spills was first highlighted by the wrecking of the 61,000 ton Torrey Canyon off south-west England in 1967.

Much of its 117,000 ton cargo of crude oil spilled on to British and French beaches, causing millions of dollars damage and killing thousands of seabirds.

The following year the Liberian-registered Marlena was holed by rocks off Sicily, pouring thousands of tons of oil into the Mediterranean.

Another Liberian carrier, the 70,000-ton Wafra, ran on to a reef off Cape Agulhas, South Africa's southern-most point, in February 1971 and 30,000 tons of crude oil spread to the main breeding ground for Antarctic penguins.

Last year the super-tanker, Olympic Bravery spewed out its oil on to France's Brittany coast after crashing on rocks. The slicks polluted a six kilometre (four mile) stretch of coastline and killed hundreds of seabirds.

In May last year the tanker Urquoila exploded at the entrance to the north-western Spanish port of La Coruna, blackening local beaches and crippling Galicias shell-fish industry with an estimated 80,000 tons of crude oil.

As the number of large-scale oil spills from tankers has increased over the last fifteen years, the techniques for cleaning up have improved. A major problem is that tankers carry a great variety of oils. Even the basic crude oil carried varies from one source to another. Therefore chemicals, or other techniques that work with one form of oil, may not be suitable for others.

An additional problem is the sea conditions around the spillage. They may be rough or calm, warm or cold, salty or nearly fresh, shallow or deep. Therefore the techniques used will have different effects in each case.

Fig. 4.10 The problems of cleaning up after a major oil spill are mammoth. Booms are being used here in an effort to contain the oil.

The earliest methods were to use straw to soak up oil, and detergents to disperse it at sea. The detergents caused all kinds of problems for marine life, and in some cases did as much damage as the oil. Later, *booms* were used to contain oil spills in calm waters. A string of floating booms can be placed around oil spills, or ships leaking oil, but if the water is not calm then the boom is not likely to be effective. Sometimes chemicals are used in a similar way to contain the oil in one place. Pumps are then used to remove the mass of oil to a tank.

There are mechanical devices called *skimmers* which pick up oil from the top of the sea, but again they are useless in rough water. Some skimmers use blocks of absorbent material which can pick up oil and then separate it from sea water.

The method which was at first thought to be the best was the use of chemicals. These break up the oil spills into small particles by lowering the *surface tension* of the oil. The oil spills are dispersed throughout the sea. However, the chemicals used have often been toxic and have killed fish, birds and plants in the sea. Concentrated in a small area, the combined effects of oil and the toxic chemicals can be disastrous.

Another recent method developed is the use of *micro-organisms*, such as those which *eat* oil in the normal marine environment. They have been used in large quantities to get rid of oil spills. However, although they cause no dangers themselves, there are limits to the quantity and types of oil they can destroy.

During the Torrey Canyon panic, attempts were made to burn the oil. However oil in water is normally too cold to burn properly, and is cooled down further by splashing waves.

Research is continuing on methods of combating oil spills. Some research is being backed by governments acting on behalf of their populations. A lot of it is being undertaken by oil companies who see that they have a responsibility to the environment, and who do not want to damage their business prospects by bad public relations.