

INTRODUCTION

A BRIEF CHRONOLOGY
OF 'TORREY CANYON' EVENTS

Close to 09.00 hours on the morning of Saturday 18 March 1967 the 970 foot long tanker 'Torrey Canyon', bound for Milford Haven from the Persian Gulf and carrying within her eighteen storage tanks some 117000 tons of Kuwait crude oil, ran aground on the Pollard Rock of the Seven Stones 15 miles west of Land's End and 7 miles north-east of the Isles of Scilly (see Frontispiece map). The tanker was travelling at about 17 knots when she struck the reef. Six of her tanks were reported as having been torn open by the impact and others were thought to be less severely damaged. Engines hard astern failed to move the ship and she was to remain on the reef in progressive stages of disintegration until six weeks later, a submerged and broken wreck, she was declared to contain no more oil.

Phase 1: 18-20 March

Oil began to escape from the ruptured tanks immediately after the stranding, and by nightfall a narrow slick some 8 miles long had thrust southwards from the Seven Stones to the east of the Isles of Scilly under the influence of the fresh northerly wind. By the Sunday evening (19 March) an estimated 20000 tons of oil had escaped from the tanker and 24 hours later it was thought that almost 30000 tons had been discharged on to the surface of the sea. The main oil mass was now 18-20 miles long and moving to the south. But, with the wind freshening and backing to the west, the escaping oil began to be blown eastward, more directly threatening the southern shores of Cornwall, and causing serious concern for an extensive contamination of more distant coastlines of the Channel.

It had thus become apparent within the first three days of the stranding of the 'Torrey Canyon' (i) that an oil release was developing on an unprecedented scale, (ii) that it was occurring in a geographical situation where, with the return of the prevailing south-westerly winds, there would be an inevitable and heavy contamination of long stretches of the coastlines of the English Channel and Bristol Channel, and (iii) that, in order to minimize the effects of the invasion, urgent and energetic measures would be needed to remove the oil at source or to disperse it from the surface of the sea.

The first efforts to disperse the oil at sea had been made within 12 hours

of the grounding of the tanker. For some time past the Navy had been using mixtures of solvent and emulsifying chemicals (detergents) for cleaning up relatively small oil spills in harbours and coastal waters. It was therefore natural that they should use the detergent method of oil dispersal in dealing with the 'Torrey Canyon' efflux. Two naval vessels which began spraying on the evening of 18 March were joined by a progressively increasing number of large and small ships, and within three days some 15 000 gallons of detergent had been discharged on to the oil.

Meanwhile, there had been set up at Maritime Headquarters, Mount Wise, Devonport, a control centre where the measures needed to cope with the more immediate problems were being organized and co-ordinated. The Minister of Defence, Mr Denis Healey, placed the operations under the overall control of the Under Secretary of State (Royal Navy), Mr Maurice Foley. Mr Foley's first discussions with officers of the three Services, scientific advisers and representatives of local authorities were held at regional headquarters on 19 and 20 March. Press reports of the meetings gave especial prominence to plans for increasing the production of detergents, and for mobilizing stocks for use in the cleansing of beaches should oil be cast ashore in quantity.

Phase 2: 21-23 March

On the Tuesday and Wednesday (21 and 22 March) following the grounding of the 'Torrey Canyon' the fresh 15-knot westerly breeze of the previous day persisted. More oil was driven up Channel but it remained sufficiently distant from the shore not to threaten immediate danger. Moreover, with the wind veering to the north-west on the following day there came renewed hope that the fouling of the coastline might be further postponed. It was of course realized that so long as the 'Torrey Canyon' remained on the reef and charged with oil the invasion must surely come. But, if compressed air could be injected into the damaged tanker to give her added buoyancy in time for the onset of the spring tides, there seemed to be a reasonable hope that the ship would lift sufficiently to be hauled off the reef. Nevertheless, since there was no guarantee that the vessel would be freed, an official Committee of Scientists was convened on 22 March under the chairmanship of the Chief Scientific Adviser to the Government, Sir Solly Zuckerman, to advise on the actions to be taken if the measures already being considered were to fail. By Thursday 23 March (the last day of this second phase of the operations) the tensions had so far eased that *The Times* front page reporting of the 'Torrey Canyon' news was limited to a paragraph of a few lines. Some weeks were to pass before the 'Torrey Canyon' again achieved a comparable level of obscurity.

INTRODUCTION

Phase 3: 24-26 March

During Friday 24 March (Good Friday) the wind backed from north-west to south-west and freshened to 25 knots. Oil newly released from the tanker, and the oil of previous days' release thrusting out to the east of the Seven Stones, began to be pushed inexorably towards the Cornish coastline. By midnight on the Friday two large masses were standing off the Land's End peninsula, and the first thick oil came ashore near St Just on the morning tide of Saturday 25 March. The oil continued to come ashore in massive quantities throughout the day. Along the south coast heavy fouling affected the greater part of the coastline from Land's End to the base of the Lizard at the east end of Mount's Bay, the least affected being a stretch 12 miles westward of Penzance. To the north of Land's End oil was driven in a north-easterly direction parallel to the coast, and at some distance from the shoreline, as far east as Newquay.

During the following day, 26 March (Easter Sunday) the wind veered from south-west to west and increased to gale force. On the south coast the movement of oil into the eastern side of Mount's Bay and along the west coast of the Lizard was completed, while along the north coast of Cornwall the long-shore movement of the oil was continued almost to the entrance of the Camel estuary. This girdle of oil was driven ashore in quantity from St Ives to Trevone Bay two to three days later with the turning of the wind to the north-west. While few of the north- and east-facing bays were affected, shores open to the north-west and west received a heavy pollution.

By the late afternoon of Easter Sunday it was estimated that some 48000 tons of oil had issued from the 'Torrey Canyon'. Most of the early release (about 30000 tons) had, as we have seen, moved southwards, and was too distant from the mainland to be returned by the later-developing but short-lived south-westerly wind. Much of this oil was later (11 April onwards) to inflict upon parts of the coastline of Brittany a heavy and damaging pollution, the oil smearing in its passage across the Channel a part of the Guernsey coastline (7 April).

The south-westerly wind which blew throughout the Saturday and Sunday of the Easter week-end captured most of the remaining 18000 tons of oil that had, up to that time, been released from the tanker and drove it rapidly towards Land's End. This 15 per cent or so of the oil carried by the 'Torrey Canyon' (now reduced a little by the evaporation of its lighter fractions) comprised, save possibly for some relatively small amounts that came ashore later, virtually the whole of the oil deposited on the British shoreline.

Almost all came ashore within the short space of four to five days, thereafter to be withdrawn and redeposited for a while with the rise and fall of the tides.

Phase 4: 27-30 March

Around 19.00 hours on the evening of Sunday 26 March, the 'Torrey Canyon', pounded by the heavy seas, broke her back, releasing an estimated 40000-50000 tons of oil into the sea. This immense mass of oil, at first driven in a south-easterly direction, was then, for two days, blown by a south-westerly wind towards the English coastline. Then, almost at the last moment, it was deflected seawards by the backing of the wind to the north. Thereafter, from 3 April, a north or north-easterly air stream persisted most uncharacteristically for a full 30 days, and the British coastline was relieved from further serious threat. For some weeks, at least, the greater part of this later outspill remained at sea. When in the Biscayan area it was treated extensively with powdered chalk by ships of the French navy and a substantial part of it was reported as having been sunk. A very small proportion of this oil eventually landed on the west coast of Brittany (Chapter 9).

The 'Torrey Canyon', her back broken and now almost beyond hope of salvage, was bombed on 28, 29 and 30 March. Oil in the ship and on the surrounding water was set alight, but in spite of the feeding on to it of aviation fuel the fires were not for long maintained. Thereafter, some oil continued to escape from the three separated sections of the wrecked tanker, which only gradually became submerged. The ship disappeared from view towards the end of April, by which time she was probably empty of oil.

THE PLYMOUTH LABORATORY
AND THE 'TORREY CANYON' INVESTIGATIONS

The Plymouth Laboratory is the research laboratory of the Marine Biological Association of the United Kingdom. The Association, founded in 1884, is supported by the subscriptions and donations of private members, universities, scientific societies, the Fishmongers' Company and other public bodies.

Nowadays the Laboratory, with an annual budget of about £250000, is financed almost entirely from government funds which since 1965 have been administered through the Natural Environment Research Council of the Department of Education and Science. As a grant-aided, independent institution the Plymouth Laboratory is thus in close liaison with the Research Council and its advisory committees, as well as with the Council of the

Marine Biological Association, and both bodies advise on the scientific programmes to be undertaken by the Laboratory.

The permanent staff at Plymouth includes some twenty-five scientists and an approximately equal number of supporting technical staff. Many visiting scientists from British and overseas universities and research laboratories work at Plymouth for longer or shorter periods, the visitors at times outnumbering the resident scientists. Two research vessels, 'Sarsia' and 'Sula', and a motor launch, 'Gammarus', are used to collect material for purposes of research and teaching, and to carry out, under the direction of the Laboratory's scientists, hydrographical and biological surveys and investigations of the sea and sea floor, mainly in the English Channel and the Atlantic approaches.

In broad terms the biological work of the Plymouth Laboratory includes ecological surveys of sea shores and of the sea floor; investigations of the floating populations of the (mainly minute) plants and animals of the phytoplankton and zooplankton; studies of the natural history, behaviour, development, physiology and biochemistry of many individual species, including important modern work on fishes, squids and cuttle fishes; and investigation of a variety of living processes and activities such as nerve conduction, muscle contraction and locomotion. On the physical side much work has and is being done on the cycling of nutrient salts in the sea; studies on the availability to and utilization by plants and animals of dissolved and suspended inorganic and organic substances; the identification and characterization of water masses of differing origins and properties; as well as many other types of study requiring the special expertise of chemists and physicists.

At the time of the stranding of the 'Torrey Canyon' none of the work of the Plymouth Laboratory was directly concerned with the effects on marine organisms of noxious substances discharged into the sea. The Laboratory nevertheless possessed in its facilities for scientific work on shore and at sea, and in its staff of scientists expert in a wide range of scientific disciplines and techniques, an organization which could usefully and without much difficulty turn its attention to the problems posed by the threat of the 'Torrey Canyon' oil.

The first steps in the involvement of the Laboratory in the 'Torrey Canyon' programme were taken on Thursday 23 March, five days after the stranding of the tanker, with a visit to regional headquarters at Mount Wise, Devonport. We were introduced to key personnel, learned of the essential arrangements for the control and co-ordination of operations, and declared our willingness to assist in any investigations that might be made of the biological consequences of the oil spill.

These opening inquiries were made towards the end of the second phase

(21-23 March) of the 'Torrey Canyon' events when the fear of an imminent flow of oil on to the Cornish beaches had in some measure abated, but when the continued use of detergents as a means of dispersing oil at sea had begun to raise publicly expressed fears about the damage they might cause to marine organisms and, in particular, to coastal fisheries. On Saturday 25 March it was reported that Scillonian fishermen were worried about the possible effects of detergents on their crab and lobster fisheries; and on the same day, in an article in the *Guardian*, Anthony Tucker severely criticized the view that had been expressed by Mr James Hoy, Parliamentary Secretary to the Ministry of Agriculture, Food and Fisheries, in a written answer to a parliamentary question, that detergents sprayed on to the surface of the sea would become so diluted that they would not be seriously harmful to marine life.

It was known from recent experience of three oil spillages in Milford Haven in which detergents had been used to clear the oil that crabs, barnacles, winkles, shore-living fishes and other animals, as well as some algae, were killed in considerable numbers. In the most recent of the spillages upwards of 250 tons of oil had issued from the damaged tanker 'Chrissi P. Goulandris', and 8000 gallons of detergent had been used to help clear it. The plants and animals which were affected by the detergent had, in this instance, previously been surveyed in detail by Dr Anthony Nelson-Smith of the University College of Swansea and, at the time of the 'Torrey Canyon' stranding, he was resurveying the shores for 'before and after' comparisons. The preliminary findings were kindly made known to us, and the full results are now being published (Nelson-Smith, 1968).

Very few quantitative data were available in March 1967 about the toxic effects of detergents. The main information came from some unpublished tests made by Mr A. C. Simpson, Director of the M.A.F.F. Laboratory, Burnham-on-Crouch, Essex. These showed that, over periods of 1-24 hours continuous exposure, solvent/emulsifying mixtures could be lethal to various commercially important shellfish in concentrations ranging from 3 to 250 parts per million (ppm). The tests had not, however, included the detergents mainly to be used on the Cornish beaches, nor were the commoner shore-living plants and animals among the organisms which had been tested. And among the many important questions which remained unanswered were the possible effects on animals of sublethal doses of detergent applied over a long period of time.

When a meeting of the staff scientists of the Plymouth Laboratory was held on Easter Monday, 27 March, to decide how far the Laboratory should be committed to the investigation of the biological consequences of the wrecking of the 'Torrey Canyon' and what its programmes should be, there were several matters which could be seen to be in urgent need of attention.

It was decided to divert the entire resources of the Laboratory to the 'Torrey Canyon' programmes for a period of six weeks, after which the position would be reviewed. Thoughts were turned to two aspects of planning. First, it would be necessary to decide on the scientific programmes of the Laboratory. Secondly, since the Laboratory would undoubtedly become, because of its situation, the regional centre for biological activities and information exchange, some sort of organization would be needed to cope with these requirements.

Scientific programmes

The Laboratory programmes were to be limited to the examination of oil/detergent pollution on the marine plants and animals living between tide-marks and in the offshore waters both in the open sea and on and within the sea floor. None of the investigations would be primarily concerned with commercially important species solely because of their commercial importance—this being the area of inquiry within the special competence of the Ministry of Agriculture, Fisheries and Food. Nor would the surveys overlap the special interests of the Nature Conservancy, the Cornwall Naturalists' Trust and the Cornwall Bird-Watching and Preservation Society in the effects of pollution on life in the border regions between sea and land and on sea birds.

Within our self-imposed terms of reference it seemed important to discover without delay whether the detergent-spraying of oil at sea had adversely affected the fish, crustaceans, molluscs and other animals living on the sea floor and the plants and animals living in the surface and intermediate waters in the neighbourhood of the oil cover. It was therefore decided that, on the following day, the laboratory's vessel 'Sarsia' should go to Mount's Bay and the Seven Stones to take plankton samples and trawl hauls both in areas uncontaminated with oil and in places where oil was present and detergent had been used. Samples of sea water were also to be taken for later laboratory testing of the concentration and toxic levels of the chemicals present at the various stations.

It was also decided to organize within the laboratory a programme of toxicity-testing of all the proprietary brands of detergent that were being used or would be used in dispersing oil at sea or on the beaches. The organisms to be tested were to include planktonic larvae of various kinds and as many as possible of the commoner plants and animals of the intertidal region and nearby offshore waters. During the course of these tests note would be taken of the varying sensitivities of the different organisms to known concentrations of detergents in order to select a few suitable examples to be used as indicators of the toxicity of sea-water samples

collected during cruises or shore surveys. Many extensions and developments of this kind of analysis were to be made during the course of these experiments. Although it would not be appropriate at this stage to mention them in detail, they included, for example, measurements of the toxicity of components of the various proprietary detergents and of the conditions of their persistence or decay in the sea and during laboratory experiments.

The third type of work in which it was important that the Plymouth Laboratory, situated as it was within working distance of the polluted beaches, should take the initiative was the survey of the effects of oil and detergent pollution on the plants and animals living between tide-marks.

The shore surveys had two main aims. First it was intended to put on record, in however brief a form, and for as many localities as could be visited, the extent of the initial oil pollution, the varying intensities and conditions of the subsequent detergent treatment, and the effect of the treatment on their resident populations of intertidal plants and animals. Secondly, it was thought important to survey in detail the effects of initial oil cover and of the subsequent detergent treatment in two or three localities chosen because they were well known beforehand and were therefore useful for making 'before and after' comparisons.

Other programmes which had not been thought out fully at the first staff meeting on Monday 27 March were developed later. These included underwater surveys with the main laboratory effort concentrated on the examination of the offshore movements and toxic effects of detergent used in beach cleansing at Porthleven, the plotting of the movements at sea of oil derived from successive phases of discharge from the 'Torrey Canyon', and the prediction of these movements in relation to the day-to-day variations in the speed and direction of the winds acting on the sea surface. Finally, there is included a report on the methods adopted in France for coping with oil at sea and with the oil deposited on the Brittany beaches.

Most of the work referred to in the foregoing paragraphs was completed for the purposes of this Report by the end of May, some ten weeks after the stranding of the 'Torrey Canyon', but observations of polluted shores are being continued. The chapter on the French experiences is based on a seven-day visit to Brittany by two members of the Plymouth staff in mid-June, during which they had many helpful consultations with scientists and representatives of the civil and service departments engaged in the anti-pollution operations. They were also able to visit a number of oil-polluted beaches and to inspect the methods of shore cleansing which were being used.

A list of members of the staff and long-term visitors who participated is given on page xii.

Some aspects of collaboration and liaison

The investigations planned in outline on 27 March involved from the beginning close liaison and collaboration with a number of scientific organizations, administrative authorities, consultative bodies and private individuals. Some indication of the indebtedness of the Laboratory for the help it received in carrying out its programmes from these external sources will be evident from the list given above (p. xiii).

The total participation of the Plymouth Laboratory in the 'Torrey Canyon' investigations had, at the outset, been assured of the active support of the Council of the Marine Biological Association through a message received from its chairman, Professor A. L. Hodgkin, F.R.S. On this being made known to the Natural Environment Research Council, its secretary, Mr R. J. H. Beverton, put at the disposal of the Laboratory the funds needed to get the programmes under way. Meanwhile, on Tuesday 28 March, the Director of the Plymouth Laboratory, Dr J. E. Smith, F.R.S., had been co-opted as a member of the official Committee of Scientists on the Scientific and Technological Aspects of the 'Torrey Canyon' Disaster which, under the chairmanship of Sir Solly Zuckerman, K.C.B., F.R.S., was required to review the consequences of the disaster; and to make recommendations for any future research needed and on necessary safeguards. The establishment of these initial conditions of programme recognition and support thereafter ensured a ready access to the bodies most directly concerned with the progress of the research and with its practical implications.

By comparison with the well-defined and largely predetermined channels of approach to these central advisory bodies the regional network of operational communications was more complicated and, for a time at least to the biologists requiring them, unfamiliar.

There may have been some aspects of the 'Torrey Canyon' operations which made little demand on outside sources for help and information, but this was certainly not true of the biological work. Each facet of the inquiry into the biological consequences of the sea and shore pollution relied in very large measure on assistance and information known or thought to be available and which had to be actively gathered in for the service of the work. There was a need to know how much oil was escaping from the ship; the latest reported positions of the oil masses; the kinds of detergents that were being used, in what quantity, and in what places; the composition of the detergents; the kinds of help that might be available for undertaking experiments which, either because of pressure of work or insufficient knowledge of specialized techniques, the Laboratory was unable to do.

And, in addition to these and many other outgoing lines of inquiry, there was, in reverse, a daily stream of incoming offers of help and requests for information. Could a place be found in the programme for a team of underwater divers? Would it be helpful if naturalists living in Cornwall were to survey the shores with which they were familiar, and what methods of survey should be used? Could the laboratory give information to fishing interests, to the press or to broadcasting agencies on particular questions or on the general situation? And could discussions be arranged with scientists from overseas—for example, from France, Germany and the United States?

It is not easy, in retrospect, to say exactly how or with what degree of efficiency these and many other aspects of co-ordination and information exchange were dealt with, but the nature and functions of the main channels of communication may be conveniently described by referring to the information on staff participation and collaborative organizations set out above (pp. xii and xiii).

During the early stages of the 'Torrey Canyon' operations the first three of the collaborative organizations listed, namely the Ministry of Agriculture, Fisheries and Food, the Nature Conservancy, and BP Trading Company Limited, had representatives resident in the Laboratory. This made for easy day-to-day liaison at a time when frequent consultations were particularly necessary.

The two-way communication with all other collaborative organizations and individual contributors was made in the first place by staff concerned with 'external liaison'. Much of this was effected by telephone and correspondence but some members of the staff spent a good deal of time going in search of information when it could only be obtained effectively by talking with people on their home ground (e.g. at Maritime H.Q., Mount Wise; H.Q. 19 Group Coastal Command; and in connection with the Brittany survey). Most of the information passing through 'external liaison' was subsequently recorded and distributed on the initiative of the people in charge. But when further advice was needed or matters of general policy were implicit in the inquiries the questions were passed to the members of the 'general organization' group for a decision.

All survey collections, samples of oil, detergents and reports relating to field studies were accepted and dealt with by the group 'Survey Materials and Records' for distribution within the Laboratory or for indexing for general use.

A collection of photographs relating to the various aspects of the 'Torrey Canyon' investigations has been assembled. It will be kept in the library of the Plymouth Laboratory where it will be available for reference.