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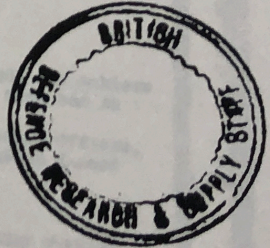
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C.B. 04570

OPERATION HURRICANE

REPORT BY THE NAVAL COMMANDER

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M. 0259/53

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## PHASE III OF THE OPERATION

## OUTLINE

Phase III of the operation started with the firing of the weapon shortly before 0930 on 3rd October and ended on 31st October 1952. The main tasks in this Phase were:-

- (a) Contamination survey
- (b) Recovery of scientific records
- (c) Salvage of scientific equipment
- (d) Demolitions
- (e) Backloading plant, equipment and stores

2. The controlling factor throughout was radiological safety. No person was allowed to receive any radiation unless this was necessary and maximum dosages were laid down for any given task. The Naval Commander, who was responsible for radiological safety, had on his staff a Safety Adviser appointed by the Ministry of Supply. The Radiation Hazard Group, operating from Health Control in H.M.S. TRACKER, was responsible for safety measures within the policy laid down.
3. Initially, all re-entry to the islands was through TRACKER. Ultimately when radiological surveys had established the limits of contamination, 'clean' areas were declared. Operations were then divided into 'clean' and 'dirty'.
4. The recovery of records and salvage of equipment from 'dirty' areas continued to be controlled by the Health Ship. The Officer in Charge of Health Control drafted programmes of work, in consultation with scientific groups of the M.O.S. The boats and parties required to implement the programme were organised and allocated by the Naval Commander and the scientific teams concerned. Operations in contaminated areas were completed on 23rd October.
5. The southern part of Hermit Island was declared 'clean' on D + 1 and five days later the service camp at H.2 was re-established to accommodate plant and equipment drivers, working parties and some landing craft crews. Under the direction of M.O.S. personnel, who travelled to Hermit daily, equipment on Hermit was rapidly packed ready for back-loading. 'Clean' operations on Trismouille, Alpha Island and H.3 were also carried out. Nearly all 'clean' M.O.S. equipment and stores were back-loaded by 23rd October.
6. The last week of October was spent in decontaminating 'dirty' boats, landing craft, Land Rovers and other gear, and in back-loading Royal Engineers' plant, equipment and stores which had been required ashore during Phase III. Once again circumstances precluded the accurate checking of stores salvaged.
7. The detailed orders for this Phase of the operation are contained in H.T.O.s 270 to 282.

## RADIATION POLICY

8. As a fundamental policy, no person was allowed to be exposed, knowingly, to ionising radiations unless such exposure was necessary in the execution of the operation.
9. In cases where exposure was necessary:-
  - (a) No person was exposed who had not passed the appropriate medical tests.
  - (b) The actual dosage received was kept to a minimum and was restricted to a maximum laid down for the task in hand.
10. Three dosages were authorized for the operation:-
  - (a) The normal working rate
  - (b) The lower integrated dose
  - (c) The higher integrated dose
 These dosages were proposed and approved by the M.O.S. after consultation with the Medical Research Council. They were accepted by the Admiralty and the War Office.
11. The orders on radiation policy are given in H.T.O.s 160 and 161.

## CONTROL OF RE-ENTRY

12. From E-Hour onwards entry into and exit from the area of the islands was controlled. To achieve this control all personnel proceeding into the area and all personnel returning from the area had to pass through the Health Ship.
13. The duties and responsibilities of the Health Ship were divided between the Commanding Officer, H.M.S. TRACKER, (referred to hereafter as TRACKER) and the Officer in Charge of the Radiation Hazard Group (referred to hereafter as Health Control).
14. Health Control. Health Control was responsible for:-
  - (a) Contamination survey.
  - (b) Briefing Radiological Surveyors and Health Escorts in their duties and all re-entry parties and boats' crews in radiological conditions at and en route to the sites they were visiting.
  - (c) Providing Health Escorts for all re-entry teams.
  - (d) Providing protective clothing and personal monitoring devices to all personnel.
  - (e) Providing radiological instruments to surveyors and escorts.
  - (f) Decontaminating all personnel, records and equipment on return.
15. TRACKER. TRACKER was responsible for:-
  - (a) Briefing boats' crews in navigational hazards.
  - (b) Controlling all boats allocated to the Health Ship.
  - (c) Supervision of the 'dirty' boat trots and securing 'dirty' boats.
  - (d) Maintenance of boats allocated to the Health Ship.
  - (e) Decontamination of boats.
16. When the limits of contamination were established only those personnel entering a contaminated area were required to pass through TRACKER.  
(The time kept at Monte Bello was 'IK' = G.M.T. + 9½ hours)



The object of contamination survey was to determine the degree and extent of contamination and its movement due to movement of air or water and the decay of radio-activity. A plot of contamination was built up and maintained by Health Control using information obtained by three methods:-

- Registered Survey. The readings of a number of dose-rate meters at selected sites ashore were transmitted to the Health Ship. These readings gave the first indication of the extent of contamination and the telemetry system operated for about ten hours after the explosion.
- Water and Land Survey. A trained team of Radiological Surveyors, consisting of six naval and nine army officers, carried out surveys of land and water.
- Helicopter Survey. Helicopters were employed to survey the general limits of contamination and areas which could not be covered adequately by water and land surveyors.

28. The detailed analysis of contamination is contained in the M.O.S. Technical Report. It is sufficient for the purpose of this section to say that an area north of a line drawn from just south of T.2 to just north of Alpha Island was heavily contaminated except for the eastern coast of Trimouille. The water in the northern half of the lagoon was contaminated and spread through the northern channel South West Island and Trimouille. To the southward, contaminated water eventually spread to cover the entire approach channel for several miles but by this time contamination was slight.

29. Shortly on D-Day by signal and daily thereafter by hand message a trace of the contamination plot was passed to CAMPANIA for the information of the Naval Commander, Technical Director and scientific groups.

RECOVERY OF RECORDS

30. The time at which any individual record could be recovered depended on:-
- The scientific importance of the record.
  - Any time limit within which the record had to be recovered if it was to be of value.
  - The radiation dose rate en route and at the site of the record.
- The last was not known until after the explosion. Records were however placed in three categories depending on (a) and (b).
31. Category A records, for the recovery of which the higher integrated dose was permitted if necessary, consisted of three special samples and one very important photographic record.
32. Category B were those which consisted of photographic records or radioactive samples which would deteriorate with time. For these the lower integrated dose was authorised.
33. Category C records embraced all others and these were recovered within the normal working rate.
34. Where possible, records in categories A and B were recovered before category C. All records in the heavily contaminated areas, particularly north Trimouille, had to wait until the radioactivity had decayed sufficiently for recovery to be carried out in safety. In the meantime nearly all category C records in areas of lesser contamination had been recovered.
35. From the contamination plot it was possible to forecast the time at which the various sites could be visited within the limits of radiation dosage permitted for the record concerned. From this information the Officer in Charge, Health Control, in consultation with scientific group leaders, was able to draw up a recovery plan three or four days ahead.
36. The teams employed to recover records were organised by the scientific group concerned. All teams entering a contaminated area were accompanied by a trained radiological surveyor (known as Health Escorts when employed on this task) who had complete and overriding authority over the movements and activities of the team as far as radiological safety was concerned. Teams employed in the more heavily contaminated areas had communication members and 'Walkie-talkies' for communication direct to Health Control or to their boat.

SALVAGE

27. Equipment in 'dirty' areas was only salvaged if there was a reasonable hope of successful decontamination. As in the case of recovery teams, salvage teams entering contaminated areas were accompanied by a Health Escort.
28. 'Dirty' salvage was carried out in two ways. On the southern part of Trimouille equipment was not more than lightly contaminated. Some of it was 'clean'. It was collected at T.1 where it was decontaminated and checked by a team from Health Control. It was then salvaged as a 'clean' operation. The same method was employed at A.4.
29. Equipment salvaged from North West Island and T.5 was more heavily contaminated and was taken to TRACKER for decontamination. No gear was salvaged from the heavily contaminated area on Trimouille between T.2 and T.4.

DEMOLITIONS

30. Extensive demolitions had been envisaged during the planning stage, largely as a security measure. In the event, the requirement was small and involved the demolition of four separate items of equipment. Demolition was done by the Royal Engineers.

PROTECTION OF PERSONNEL

31. The following measures were taken to protect personnel from any harmful effects of exposure to radiation hazards. These measures were the responsibility of Health Control, (see also Chapter XVIII for medical aspects).
32. Personal Monitoring.
- File badges were worn by all personnel at all times whether or not they were in a contaminated area. They were issued by Health Control prior to the commencement of Phase III and were withdrawn and interpreted at the end of the operation. In the case of personnel working in the contaminated area they were renewed after each day's work.
  - Arrangements were made to issue more than one badge to each of a number of selected personnel entering the contaminated area in order that an assessment could be made of the relative dosage received by different parts of the body.
  - In addition, pocket electroscopes were worn by all persons whilst in a contaminated area to enable the approximate dose received to be read at a glance.



In May 1951 details of the assistance requested from Australia in order to prepare for and carry out the operation were passed to the United Kingdom High Commissioner in Australia by the Commonwealth Liaison Office. The following summary indicates, albeit inadequately, the great deal of assistance requested from Australia.

AT THE ISLANDS

Survey of the Islands. This extensive survey was carried out in a remarkably short space of time by H.M.A.S. WARRAGO in July - August 1951. It included the laying of moorings and placing of Navigational Aids. Work was carried out by H.M.A.S. KARANGI starting about six weeks before the arrival of Phase I ships. She laid one first class, three fourth class and one special six arm mooring as well as four boat trots. Accuracy of positioning of the moorings was of a high order and anchors were inspected by divers to ensure they were properly bedded in. A total of seven navigational buoys were also laid. Due to shortage of mooring gear in Australia the first class mooring was provided from United Kingdom resources.

Moorings Vessel. H.M.A.S. KOALA was attached to the Force during Phases II and III and was employed on operational mooring duties. On one occasion she raised a sunken L.C.A. sent by a detachment of the Fifth Airfield Construction Squadron, R.A.A.F., who established a camp on Fremantle Island and were working in the islands from March to September 1952. During this period they also constructed the fresh water pipe-line at the Fortescue River on the mainland referred to in Chapter XI, paragraph 32.

TRANSIT CAMP

An army transit camp was established at Onslow and was used as a staging post for personnel and stores arriving at and departing from the operational area. This had not been foreseen as a requirement, and was provided by the Australian Hurricane Panel on their own initiative, a good instance of the helpful attitude adopted by Australia throughout. It filled an essential role.

AIR SUPPORT

7. Air Transport Service. A special bi-weekly air courier service was provided between Guildford (near Perth) and Onslow, in addition to the use which was made of the normal weekly civil air service operated by the MacRobertson-Miller Aviation Co. Ltd. Details of the courier services are given in Chapter XIV.
8. Shore-based Air Patrols. A daily security patrol of one Dakota aircraft was operated by the R.A.A.F. at Onslow from 1st - 26th September. See also Chapter XIII, paragraph 2.
9. Air Sampling and Monitoring. The R.A.A.F. undertook the planning and operation of sampling and monitoring flights over the Australian mainland. The necessary meteorological information was supplied by the Naval Commander. See also Chapter XIX.

NAVAL SUPPORT AND SHIPPING

10. Patrol Vessel. H.M.A.S. HAWKESBURY was attached to the Force from the beginning of Phase II until the end of the operation. She was employed on patrol and other special duties such as laying and recovery of sampling dan buoys and the transport of personnel to and from the mainland, when numbers exceeded the capacity of the other tenders.
11. Fleet Support. Units of H.M. Australian Fleet co-operated by providing air and surface patrols during the latter stages of Phase II and over the actual period of the trial. Full details are given in Chapter XIII.
12. Supplies and Tenders. Logistics are fully dealt with in Chapter XIII. Provisions and stores were delivered at Monte Bello by ships of the State Shipping Service. The following tenders were provided to operate with the Force:-  
H.M.A.S. WARREN  
H.M.A.S. LIMICOLA (General Purpose Vessel 948)  
Motor Refrigerator Lighter 252  
Motor Water Lighter 251
- LIMICOLA was unserviceable for much of the time. WARREN was therefore used for the twice-weekly routine ferrying of provisions, mails and personnel between Onslow and the islands. The M.R.L. was used to hold the reserve of refrigerated stock. The M.W.L. stored the reserve of water made by ships' distillers and also transported provisions between Onslow and the islands.

SECURITY

13. Two officers of the Australian Security and Intelligence Organisation (A.S.I.O.) worked with the Force at the islands, and an Army Field Security Detachment was based at Onslow to guard security on the mainland.

METEOROLOGICAL OBSERVATIONS AND ANALYSES

14. A series of observations were made at Monte Bello and elsewhere on the mainland during the months of September - October 1951 in order to form a basis for planning and subsequent forecasting. These, together with observations made during the previous five years on the mainland, were analysed by the Director, Australian Weather Bureau, assisted by the Meteorological Officer attached to the Force.
15. Meteorological Officers (see also Chapter XIX). The Director, Australian Weather Bureau, provided two meteorological officers to assist with the analysis and forecasting in H.M.S. CAMPANIA. Their services were most valuable.
16. Weather Ship. H.M.A.S. CULCOA was provided for operation by the Naval Commander to act as weather ship in position 28° S., 110° E. from 25th September to 3rd October. Her reports were of great



Chapter XVII deals with the assistance given with communications.

COMMUNICATIONS

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Medical facilities were provided as required at Onslow and Perth.

MEDICAL

BEARING OF COSTS

20. The question of costs was settled in February 1952, when the Prime Minister of Australia made known that his Government intended to adopt a similar principle to that already in existence in the Joint United Kingdom-Australian Long Range Weapons Project (i.e. that each Government should bear respectively that part of expenditure which is incurred in its own country). This meant that the Australian Government would meet the whole of expenditure incurred in Australia, which was then estimated at £197,000, and which included supplies as well as services.

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meteorological task was twofold. Firstly it was required to forecast weather conditions suitable for carrying out the trial itself, and secondly it was necessary to track the radioactive cloud across the Australian continent in order to provide advice for air operations to obtain samples of the cloud at various distances from the explosion.

#### THE METEOROLOGICAL TASK

Preliminary investigations into the meteorological aspects of the operation were carried out in the Meteorological Office (Air Ministry) to which the Staff Meteorological Officer was temporarily attached. It was soon apparent that substantial assistance from the Australian Weather Bureau was necessary and accordingly the Staff Meteorological Officer visited Australia in January and February 1952 to discuss arrangements. After discussion and inspection of local facilities near the Monte Bello Islands it was agreed that the meteorological organisation should be concentrated in the Headquarters Ship and that two Australian meteorological officers should be lent to CAMPANIA for the operation.

#### INITIAL PLANNING

3. The conditions prescribed for the firing of the weapon were rigorous. No radio-active 'fall-out' was to affect the Australian mainland except at such a distance from the explosion that it could be regarded as innocuous. In order to safeguard the withdrawal of the scientists who remained ashore to fire the weapon, and also to ensure the safety of the ships of the Force, no fall-out or surface drift of contamination could be accepted within a wide sector south of ground zero. The state of sea locally had to be such as to permit the safe employment of boats and landing craft on the day preceding the trial as well as on the day itself.

#### CONDITIONS REQUIRED FOR THE TRIAL

4. The above conditions had to be interpreted in terms of meteorological conditions, and after discussion the following directive was issued:-

- (a) The mean wind from the surface up to all levels must not have a direction lying within the sector 300 deg. to 060 deg. through north.
  - (b) The mean wind direction must be south of 260 deg.
    - (i) for the layer from the surface to 5,000 ft.
    - (ii) for the layers above 25,000 ft.
  - (c) A direction of mean wind north of 260 deg. can be accepted for any layer between 5,000 ft. and 25,000 ft. provided
    - (i) the conditions in (a) are not violated,
    - (ii) the layer in question is not more than 5,000 ft. thick.
  - (d) The state of sea must allow the operation of boats and landing craft.
5. A forecast of these conditions was required by 0630 on the morning of D-1 Day. This implied that conditions in paragraphs 4 (a) and (c) had to hold for about twelve hours commencing twenty-seven hours after the issue of the forecast, and condition (d) for the period of thirty-six hours from the forecast. It is doubtful if a forecast of such a complex type has ever before been required.

#### METEOROLOGICAL INTERPRETATION

#### TRACKING OF THE RADIO-ACTIVE CLOUD

6. This would normally be a fairly straightforward process of constructing trajectories from upper air maps. It was rendered much more difficult in this operation by the fact that in the tropics isobars are a poor guide to the wind direction and strength, moreover the cloud seemed likely to travel south eastwards over the centre of Australia where observations are extremely sparse and infrequent in time. It was estimated however, that the height of the cloud would be between 25,000 and 30,000 ft., and at these levels the winds are fairly steady in direction and strength. In the event, the cloud did not rise above 10,000 ft. and this greatly complicated the problem.

#### FREQUENCY OF OCCURENCE OF REQUIRED CONDITIONS

7. During the planning stage, efforts were naturally directed to ascertaining how frequently suitable conditions might be expected, and with what type of synoptic situation they were associated. It was, however, not only necessary that suitable conditions should occur; it was necessary for their development to be forecast rather more than twenty-four hours in advance. In order for this to be achieved with a reasonable degree of confidence, it is necessary for the meteorological situation to exhibit a degree of stability or permanence. Such a state of affairs had been found to be associated with the presence of a well established anticyclone over the Australian Right. This situation causes a current of south easterly wind which may in time extend up to a height of about 10,000 ft. This south easterly stream offsets the normal tendency for the wind above 20,000 ft. to be north westerly and results in a mean wind direction which falls within the safety limits required. Such a synoptic situation is, however, associated with fresh to strong south to south east winds on the surface.

8. After some experience of the local conditions at Monte Bello it rapidly became apparent that the state of sea locally was going to prove a severely limiting factor. Boat and landing craft trips of up to ten miles in the open sea were involved on the afternoon of D-1 and the swell produced by a southerly or south easterly wind of more than force five rendered the hoisting of boats and the transfer of personnel unjustifiably hazardous. This consideration virtually ruled out the solution depending on the build up of an anticyclone, and for a time, the prospects of a successful forecast looked bleak.

9. Consideration was then given to the alternative scheme of attempting to forecast one of the isolated instances of favourable weather. These were of short duration (12 - 24 hours) and usually occurred sandwiched between a lengthy spell of unsuitable conditions. On a number of these instances,

(The time kept at Monte Bello was 'I.K.' = C.M.T. + 9½ hours)



point of view the only anxious moment was a sudden reduction in wind strength in the afternoon which was not in accordance with the search of events as visualised. This set-back proved to be only temporary however, and soon the surface wind was of a strength as gratifying to the weather forecasters as it was worrying to those responsible for the operation of boats and landing craft. A wind finding check by radar about 0300 showed that the safety conditions were just satisfied. A favourable report from the shore wind finding team as a result of their last minute check was the only other requirement. This report as received on R/T at 0830, was highly disturbing and instructions were given to repeat the ascent. This was immediately done and, although the report was out short by the observer being ordered to take cover, it showed that all was well.

22. The weapon was fired at 0930 and the cloud rose slowly to about 10,000 ft. Within a few minutes the remarkable wind shear began to have its effect on the shape of the cloud.

23. The surface wind dropped steadily during the forenoon and by the afternoon calm conditions prevailed enabling the first stages of the re-entry phase to proceed under ideal conditions.

24. It seems probable that the behaviour of the cloud could have been predicted from an upper air diagram based on recent Radio Sonda data and certain reasonable assumptions. Discussion of this point is however outside the scope of this report.

PREDICTION OF CLOUD HEIGHT

METEOROLOGICAL ARRANGEMENTS AND ACCOMMODATION

25. In view of the decision to concentrate the meteorological organisation in CAMPANIA the ship's meteorological office proved much too small and, on arrival at Monte Bello, it was necessary to move into the officers' study. Display boards for charts had been fitted at Chatham in anticipation of this move.

26. The Radio Sonda receiver was installed in the A.I.C. and although it was satisfactorily operated from there the lack of space for spreading out the calibration curves proved inconvenient. A bench for filling the transmitter batteries and preparing the transmitters for launching would also have been an advantage. Further remarks are given in Chapter XX.

27. The filling and launching of the balloons carried out at the after end of the flight deck where a specially designed filling shelter had been erected.

28. The calibration screen, where the transmitters are tested before launching, was fitted at the after end of the flight deck on the starboard side. This position suffered from the disadvantage that the screen was frequently affected by the hot gases from the main engine exhausts. It is considered that a better site would be abaft the port conning position. A whip receiving aerial was used and proved extremely satisfactory. It should be sited near the calibration screen and as far from the ship's other aerials as possible.

COASTAL MONITORING

29. As a safety measure, arrangements had been made for two Dakota aircraft based at Onslow to carry out a low level radiological survey of the coast between Onslow and Broome. Although the conditions prescribed for the trial were such as to prevent any dangerous level of contamination being deposited on this strip of coast or further inland, a check was considered necessary in case of accident or errors in the forecast.

30. It was originally proposed that the monitoring aircraft should be directed by the Naval Commander to search certain parts of the coast, but finally it was thought best to cover the whole coastal strip. The aircraft carried ultra sensitive recording ionisation chambers and flew at 500 ft., an operational height both uncomfortable and difficult to maintain under tropical conditions. During the Stand-by Period, a preliminary survey to determine the natural radio-active background was carried out. Aircraft were instructed to report immediately to the Naval Commander any ground contamination detected in case further action might be considered necessary. Arrangements were made at Onslow to fly a jeep to the airstrip nearest to any ground contamination detected, so as to enable a ground check to be obtained. On account of the extreme sensitivity of the recording instruments it was necessary to wait until risk of flying through airborne activity had passed since this would have given spurious readings. The survey was therefore planned for the morning of D + 1 Day.

31. In the event no ground contamination whatsoever was detected, but there was reason to believe that a small quantity of finely divided radio-active dust was drifting over the coast midway between Onslow and Broome at a height of about 10,000 ft. One aircraft was therefore instructed to fly at 10,000 ft. on the return trip from Broome to Onslow. The radio-activity, though much too weak to constitute any hazard, was readily detected on the recording apparatus.

32. It appears that further experiments of this type could yield valuable data on the subject of diffusion rates in the upper atmosphere and it is suggested that consideration be given to this in any future trial.

SAMPLING

33. Plans were made to obtain samples of the radio-active cloud at various distances from the explosion. A Squadron of R.A.A.F. Lincolns based at Broome were to attempt to get samples at a range of about 500 miles from the explosion. Another detachment of Lincolns at Townsville were to make the attempt at about 2,000 miles range, and a special point to point flight from New Zealand to Fiji would, it was hoped, pick up further samples.

34. In view of the concentration of all other meteorological responsibility for the operation with the Naval Commander it was decided that he should also provide the meteorological advice for all sampling operations. This was the limit of the Naval Commander's responsibilities. The technical conduct of sampling operations was the responsibility of A.E.R.E., Harwell. The responsibility for the conduct of the search operation rested with the Base Commanders at Broome and Townsville respectively. The tracking of the cloud after it had passed the eastern seaboard of Australia became the responsibility of the New Zealand Meteorological Service and it was arranged that the Naval Commander would pass to the New Zealand Meteorological Service the last estimated position of the cloud on the Australian coast.

35. It has been arranged that details of the type of information required and methods of communication should be decided at a meeting between Staff Officer (Meteorology) to the Naval Commander and the Commander of the Base Detachment, R.A.A.F., at Broome. This meeting took place at Broome on 24th September. Prior to the meeting the Naval Commander's proposals were sent by letter to Broome, Townsville and New Zealand. Agreement was rapidly reached on all points.

(The time kept at Monte Bello was 'L.K.' = G.M.T. + 04 hours)



the cloud would rise to between 25,000 and 30,000 ft. As previously mentioned, the wind north westerly at such heights.

PLOTTING THE TRACK OF THE CLOUD

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As soon as the cloud had ceased to rise appreciably, its height was estimated by sextant angles from the ship. Two complicating factors at once became apparent. The height was generally below 10,000 ft. and at such intermediate levels the winds were known to vary rapidly both with space and time. With the cloud moving out to sea it was obvious that within a few hours large and rapidly increasing errors in its estimated position were inevitable. In addition, there was an alarmingly large wind shear in the layers just below 10,000 ft. so that different parts of the cloud travelled in different directions.

38. It was decided to advise a search for the cloud at an earlier time than had been foreseen while there was still a chance that the estimated position was reasonably accurate. Owing to a signal mishap, the search signal took six hours before it was received in intelligible form at Broome. In spite of this the search took place and all aircraft obtained excellent samples.

39. A considerable amount of contamination was believed to be situated in the lowest 500 ft. of the atmosphere and it was thought of interest to obtain samples of this. Accordingly an estimate of the position of this contamination was made and, although it was out to sea at the extreme limit of the Lincoln's range, a search was organised. Again, thanks to excellent navigation, all aircraft obtained samples.

40. Since the presence of contamination had been detected by monitoring aircraft near Port Hedland at 10,000 ft., a further sweep by one Lincoln was made in this area and some weak samples were obtained.

41. By the morning of D + 1 Day, the main cloud was considered to be lost and it appeared that there was little point in keeping the Townsville and New Zealand aircraft standing by. With Dr. Penney's concurrence signals were sent advising the abandonment of the search.

42. A search was however made and some weak samples obtained both to the north of Townsville and on the flight from Wellington to Fiji. It is thought that these samples emanated from a small portion of the cloud which penetrated to about 11,000 ft. by not being thoroughly mixed.

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