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722-f

JTF 132
PROJECT 6.4b
RMO 107, c/o RM
San Francisco, California

[REDACTED]

7 November 1952

SUBJECT: Meteorological Aspect of Mike Shot

TO: The Commanding General
Task Force 132

FM: The Commanding General
Air Force Cambridge Research Center
250 Albany Street
Cambridge 39, Massachusetts

1. In accordance with instructions contained in various letters from your organization under the above-mentioned reference and in a letter J-13457, dated at the Headquarters, Joint Task Force 132 on 7 August 1952, I have this day acted as an observer of the meteorological effects at Eniwetok Atoll of an explosion known as MIKE.

2. Since any possible value of this report to you lies in its reception at your headquarters with the minimum delay, I am writing it without the benefit of consultation with other advisers of Joint Task Force 132 and without access to data other than that taken by visual observation by Major O. W. Stopinski, USAF, and myself. Hence the observations and the conclusions derived from them are tentative, being subject to correction when more detailed instrumental quantitative data become available to your laboratories.

3. The detonation occurred at 07.15 LST, 1 November 1952, as scheduled. It was observed from the flag bridge of the USS Estes AGC-12 at a distance of 31 miles on a line bearing approximately 155° from the shot island.

4. The weather near time of firing and at the point of observation is tabulated in Appendix 1 to this report.

5. The initial aspect of the explosion, seen through density goggles, consisted of an immense fireball which appeared on the horizon like the sun when half-risen; however, the angle subtended by the half-disc at maximum was at least twice that of the sun. ~~A rough estimate indicates~~

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722-f R2009 F [REDACTED]

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~~at maximum was at least twice~~ that of the sun. A rough estimate indicates that its diameter at this time was between 3 and 4 miles. The fireball was not homogenous but consisted of a bright inner core of approximately two thirds the total diameter surrounded by a thin, relatively dark shell (orange in color as seen through the goggles), the whole being enclosed in an outer, very bright shell which was the limiting region of the fireball.

6. The fireball seemed to ascend very rapidly after an initial hover time whose duration cannot be estimated, but which seemed to be shorter than those occurring with weapons tested last year.

7. During its rapid initial ascent the ball contracted horizontally and became transformed into a fiery and exceedingly turbulent columnar cloud, losing its quasi-spherical form soon after the ascent began. I thought I saw a small secondary explosion in the fiery column at this time, but other observers do not confirm this. I removed the goggles immediately after this secondary detonation.

8. The "doughnut" or smoke ring was then formed, without much slackening in the rate of ascent. I estimate that the mushroom cloud reached the tropopause within H plus 3 minutes. Its vertical deceleration after 2 minutes was very rapid and was accompanied by a tremendous lateral spreading many times faster than that seen in A-bomb clouds. It appeared as if the cloud "splashed" against the tropopause.

9. The shock wave arrived at approximately H plus 2 minutes 28 seconds. Its intensity was not great, being estimated to be no greater than that from a 16 inch naval gun firing at 7 miles distance.

10. The stem passed into the head of the cloud and moved upward with it from the time the latter was first formed. At first the stem was relatively narrow, being not more than 1 mile in diameter and perfectly vertical; it seemed to be very turbulent but was not marked spirally as are some A-bomb stems. The turbulent appearance soon vanished and the stem expanded laterally to a diameter of 10 miles. At maximum and before deformation it presented a very smooth appearance like a pile of inverted saucers of different diameters, stacked one upon the other. The only natural cloud resembling the stem at this time is the vertically stacked altocumulus lenticularis seen over and near high mountains during foehn periods. I have seen clouds like the stem over the Sierras in California, and the Southern Alps in New Zealand and I have seen photographs taken in Sardinia of similar structures associated with the Alps. There is no doubt in my mind that the smooth stem is a surround formed about the narrow turbulent initial stem by condensation in outside air taking part in the vortex-ring circulation. The smooth outlines indicate that this part of the circulation is non-turbulent streamline motion and that the various "saucers" are the result of variations in moisture content in the

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atmospheric layers partaking in the motion upward through the middle of the vortex ring. It may be assumed that the rapid lateral extension of the initial stem is an index of the rate of entrainment of outside air into the vortex ring system; if so, the rate must be many orders of magnitude greater than that in any previous detonation. At the point where the stem joined the head several large skirts formed toward the end of the ascent. Their presence suggested a highly saturated atmospheric layer at about 30,000 feet.

11. In contrast to the broad stem the head remained turbulent. It still presented a cumuliform structure at H plus 45 minutes. By this time however, parts of it were being transformed into altocumulus and other parts (at the same level but on the opposite side of this cloud) into cirrus. After comparing notes with other observers, I am convinced that the mushroom cloud remained below the tropopause throughout the period of its expansion and thereafter. This is not to say that the entire cloud was limited by the tropopause but only the great bulk of it, consisting largely of condensation in entrained air, condensed steam from the sea surface and coral and other debris from the destroyed islands was so limited. There is indirect evidence that the initial central turbulent pillar pierced the tropopause at about H plus 3 minutes but its further ascent would be hidden by the great lateral development of the vortex ring (mushroom cloud). This expansion seemed to be symmetrical and very rapid in its initial stages but began to diminish sensibly by H plus 10 minutes. By H plus 15 minutes it had in all appearances ceased and the mushroom cloud at that time was 65 miles in diameter. In direct sunlight it was of a creamy white color but the shadows were intense orange. The first evidence of precipitation from the mushroom cloud occurred at H plus 6 minutes. Dark trails were seen descending from it in the vicinity of the stem. I suggest that these trails consisted largely of mud and rain. The first rainbow was seen below the top and to the left of the stem at H plus 7 minutes and rainbows were seen in various positions under the cloud as the ship maneuvered between H plus 30 and H plus 45 minutes.

12. After H plus 15 minutes, the intrinsic cloud motions having virtually ceased, the whole structure began to move and to be deformed by the winds near Eniwetok. Up to that time, however, it can be considered to be independent of the wind, the explosion having set up its own local symmetrical circulation over an area at least 65 miles in diameter. The mushroom cloud during the period of deformation was transformed into a dense sheet of altostratus topped by cirrus. Many cumulus shower clouds formed beneath it, penetrating it in places; rain also continued to fall from the altostratus but much of it was in the form of virga. The deterioration of the local weather prevented useful observation of the cloud after H plus 1 hour 30 minutes.

13. At sunset, the weather having improved considerably, opportunity again occurred of observing distant and high parts of the cloud. The sky color from 10 to 25 minutes after sunset was extraordinarily brilliant. Low in the west there appeared a chevron-shaped, brilliantly illuminated tenuous cloud which I suspect, since it was higher than natural cirrus in the vicinity, lay in the stratosphere. The tentative suggestion may be made that it was derived from a narrow filament that pierced the tropopause at H plus 3 minutes. Its position in the west suggests that it moved with the stratospheric winds between 60,000 and 80,000 feet.

12. I have summarized the crude observations recorded here in the form of sketches (Appendix II). A comparison is also made with a conventional former explosion with the intention of emphasizing that from the geophysical point of view MIKE belongs to a different order of events from those previously studied in this region and in Nevada.

C. E. Palmer

C. E. PALMER
Professor of Geophysics
Institute of Geophysics
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DISTRIBUTION:

- 1 Commander Task Force 132
- 1 Dr. Graves
- 1 Commander Fate
- 1 Lt. Col. Girardo

4

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APPENDIX I

1 November 1952

USS ESTES
ENIWETOK, MARSHALL IS

Latest Winds Aloft Taken on Eniwetok at 0100 Local (1300Z)

<u>ALTITUDE</u>	<u>DEGREES</u>	<u>KNOTS</u>	<u>PRESSURE</u>	<u>TEMP</u>	<u>DEW POINT</u>	<u>ALTITUDE</u>
Surface	110	12	1000 mb	25.8	23.8	280 ft
1,000 ft	110	13				
2,000 ft	110	15				
3,000 ft	110	15				
4,000 ft	120	15				
5,000 ft	120	13	850 mb	18.8	17.2	4,930 ft
6,000 ft	130	14				
7,000 ft	130	16				
8,000 ft	130	17	733 mb	11.8	10.2	
9,000 ft	130	17				
10,000 ft	130	14	700 mb	9.5	7.2	10,330 ft
12,000 ft	130	08				
14,000 ft	140	09				
16,000 ft	150	10	633	6.5	1.8	
18,000 ft	160	11				
20,000 ft	160	10	500 mb	6.2	-8.8	19,270 ft
25,000 ft	250	17	445	-13.2	-26.8	
			400 mb	-16.7	M	24,890 ft
30,000 ft	240	24	358	-24.0	M	
			300 mb	-29.7	M	31,790 ft
35,000 ft	240	14				
40,000 ft	250	15	200 mb	-48.5	M	40,910 ft
45,000 ft	330	18	150 mb	-61.2	M	46,950 ft
50,000 ft	350	15	117	-71.0	M	
55,000 ft	040	08				
60,000 ft	070	34				
65,000 ft	070	36				
70,000 ft	080	20				
75,000 ft	100	19				
80,000 ft	080	17				
85,000 ft	100	06				
90,000 ft	090	04				

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ENIWETOK

31-1400Z (5) 3/10 Cu 1700 ft -1/10 Ac 4/10 Ci 35,000 ft
01-0200L 10 miles 1008.0 MB 84°/78° 110°/10 Kts

31-1500Z (6) 5/10 Cu 1700 ft 1/10 Ac 9,000 ft 10 miles
01-0300L 1007.5 MB 82°/75° 110°/12 Kts RWV W

31-1600Z (4) 3/10 Cu 1700 ft 2/10 Ci 35,000 ft * 10 miles
01-0400L 1007.1 MB 82°/74° 090°/12 Kts OCNL LTGIC

31-1700Z (7) 7/10 Cu 1600 ft 11 miles 1007.3 MB 82°/74°
01-0500L 090°/9 Kts OCNL LTGIC

31-1800Z (7) 7/10 Cu 1600 ft 11 Miles 1007.3 MB 82°/75°
01-0600L 110 /9 Kts RWV ALL QUADS OCNL LTGIC

31-1900Z (8) 7/10 Cu 1600 ft 1/10 As 10,000 ft 10 miles
01-0700L 1007.0 MB 84°/77° 110°/11 Kts R.H. 80%

31-1913Z 1600 (I) 10,000 (I) 36,000 (I) 10 miles 110°/13 Kts
01-0713Z

31-1918Z 1600 (I) 10,000 (I) 36,000 (I) 10 miles 110°/13 Kts
01-0718L 85/77 Nuclear Cld NNW

31-1930Z 1600 (I) 10,000 (I) 36,000 (I) 10 miles 110°/13 Kts
01-0730L Nuclear Cld NW thru E

31-1945Z 1600 (I) 10,000 (I) 36,000 (I) 10 miles 110°/15 Kts
01-0745L Nuclear Cld NW thru E

31-2000Z (8) 5/10 Cu 1600 ft 1/10 As 10,000 ft 2/10 Ci Nuclear Cld
01-0800L 36,000 ft 10 miles 1008.6 MB 83°/77° 110°/15 Kts all quads

31-2030Z 1600 (I) 10,000 (I) 36,000 (I) 10 miles 110°/10 Kts
01-0830L Nuclear Cld all quads

31-2100Z (8) 3/10 Cu 1600 ft 2/10 As 10,000 ft 3/10 Cs Nuclear Cld
01-0900L 45,000 ft 10 miles 1009.0 MB 84°/76° 110°/10 Kts all quads

31-2200Z (8) 3/10 Cu 1600 ft 2/10 As 10,000 ft 3/10 Cs
01-1000L 45,000 ft 10 miles 1009.8 MB 85°/77° 090°/20 Kts

31-2300Z (9) 1/10 Cu 1600 ft 7/10 As 10,000 ft 1/10 Cs
01-1100L 40,000 ft 9 miles 1008.0 MB 85°/76° 090°/13 Kts

01-0000Z 4/10 Cu 1600 ft 2/10 As 10,000 ft 3/10 Cs
01-1200L 40,000 ft 9 miles 1009.1 MB 85°/77° 090°/13 Kts

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KWAJALEIN

²
31-1400Z 4/8 Cu 2000 ft 10 miles 1007.2 MB 82°/75° 090°/10 Kt
01-0200L

⁵
31-1500Z 4/8 Cu 2000 ft 10 miles 1006.5 MB 82°/75° 090°/5 Kt
01-0300L

^F
31-1600Z 6/8 Cu 2000 ft 7/8 CI / CS 10 miles DSNT-LTG
01-0400L 1006.2 MB 82°/75° 090°/5 Kts

^A
31-1700Z 2/8 Cu 2000 ft 4/8 CI / CS 10 miles 1006.5 MB
01-0500L 82°/75° 040°/5Kts

^A
31-1800Z 2/8 Cu 2000 ft AsAc 7/8 CI / CS 10 miles
01-0600L 1006.5 MB 81°/75° 060°/10 Kts

^B
31-1900Z 2/8 Cu 1000 ft Ac 8/8 Cs 10 miles (RW in sight)
01-0700L 1007.4 MB 82°/75° 040°/10 Kts

31-2000Z
01-0800L REPORT MISSING

^B
31-2100Z 3/8 Cu 1500 ft AsAc 8/8 Cs 10 miles
01-0900L 1008.7 MB 82°/77° 100°/10 Kts *shown past hour*

^B
31-2200Z 2/8 Cu 1500 ft 8/8 AsAc 10 miles 1009.1 MB
01-1000L 84°/77° 050°/9 Kts

^B
31-2300Z 5/8 Cu 1500 ft 8/8 AsAc 10 miles 1008.7 MB
01-1100L 85°/77° 120°/9 Kts

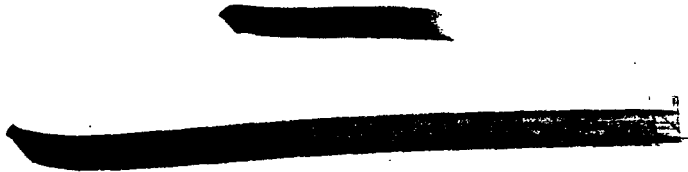
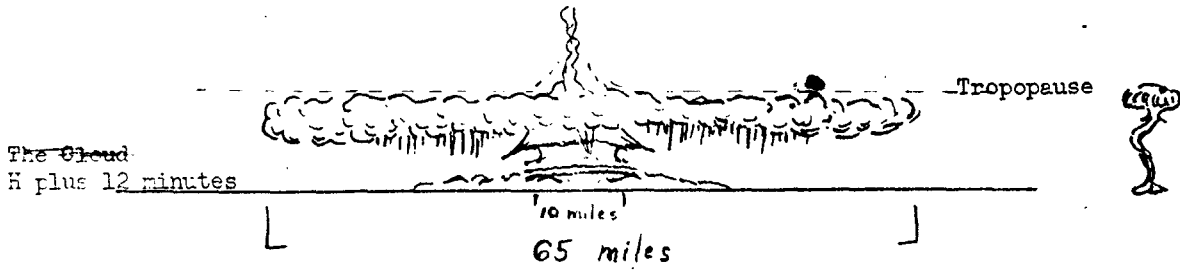
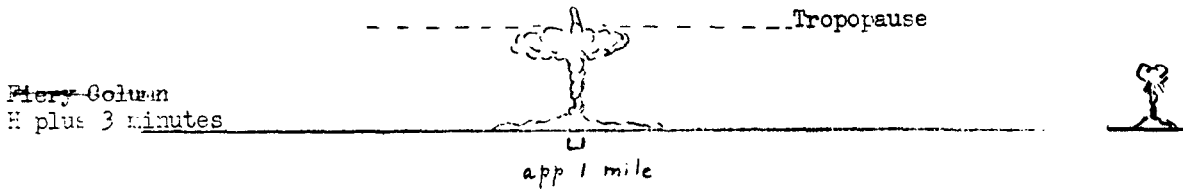
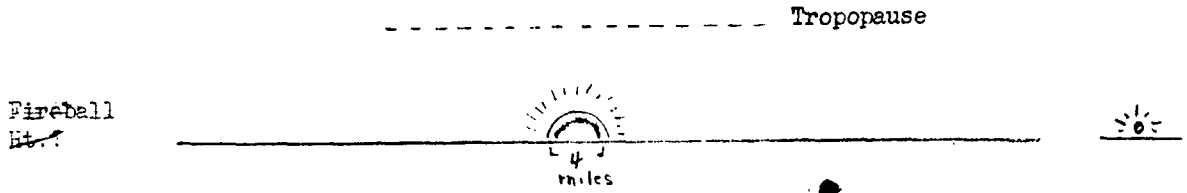
^B
01-0000Z 5/8 Cu 1500 ft 8/8 AsAc 10 miles 1008.6 MB
01-1200L 85°/75° 130°/9 Kts

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APPENDIX II.

MIKE

Schematic
Conventional
Weapon



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