A CITY PARALYZED BY A MINI-BLIZZARD

by Charles H. Pierce

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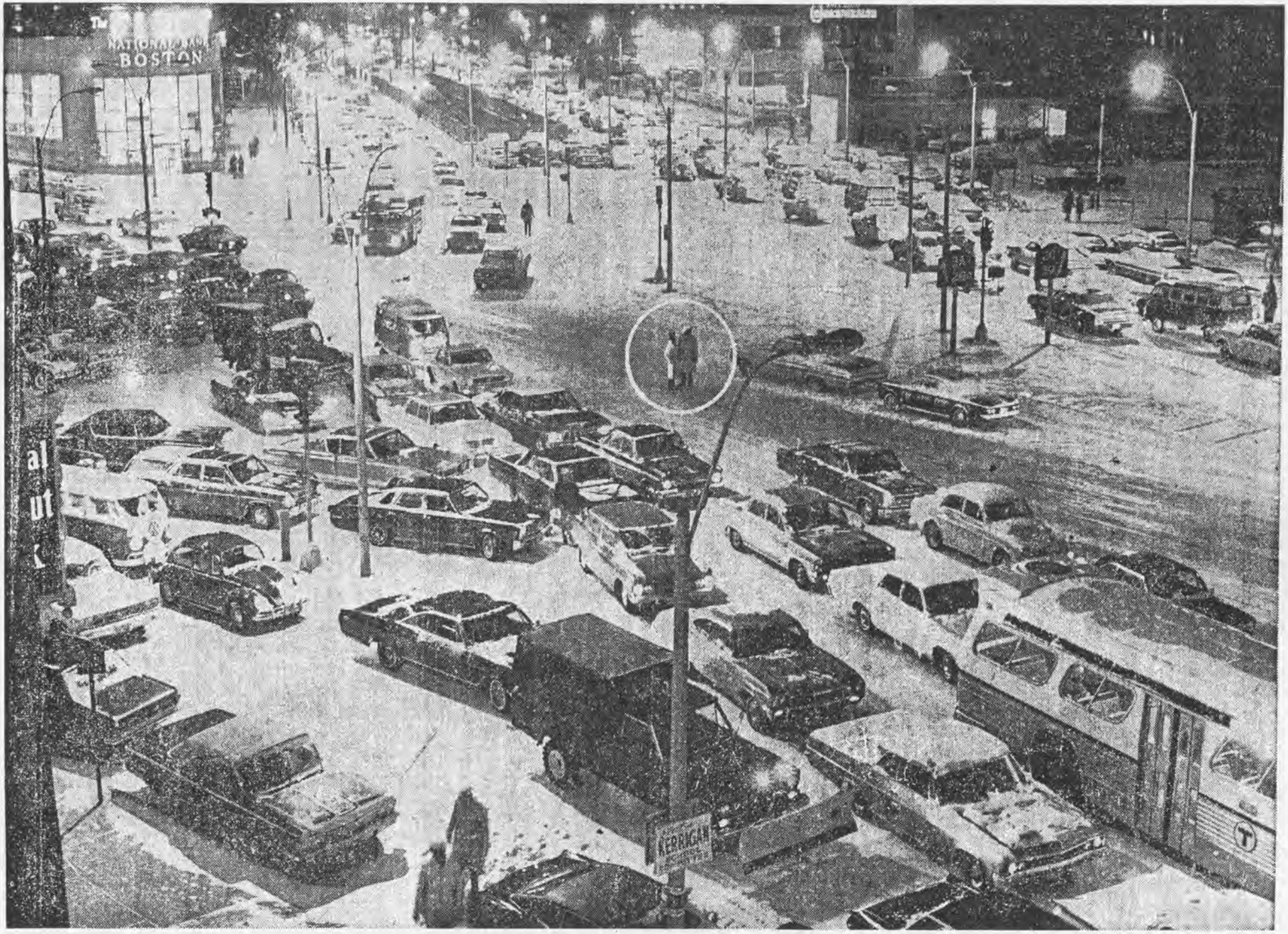
First, I want to thank Dr. Kenneth Hardy of the Weather Radar Section of the Air Force Cambridge Research Laboratory for making available to me the pictures of the radar scope taken at Sudbury during the storm of November 15, 1967. I also want to thank Mr. William Lampkin for assisting me in interpreting these pictures.

Man's rapidly expanding technology is making him, more and more, the master of nature. He builds a network of dams to control the floods produced by a winter of heavy snow. He dams the estuaries to keep out the flood tide of the hurricane. He constructs the supersonic plane and the super-highway to cut down the time of getting from one place to another. However, every now and then man succumbs to the whims of nature, not in spite of his technological "know-how", but because of it. Such an event occurred at Boston on the 15th of November of this past year. On this date, a snowstorm - called a mini-blizzard by the press - made a shambles of the traffic on the super-highways and roads in and around a great city.

This catastrophe was front page news for all the Boston newspapers with headlines such as "Sneak Snowstorm Paralyzes Traffic". Fifty years ago, a similar snowstorm might have been mentioned in three inches of space on an inside page. Or if the same storm had occurred six hours later or six hours earlier it probably would not have made the front page.

In other words, it took the right timing and the right ingredients of the storm to make it a catastrophe to the Boston commuter. The snow started in the city at approximately 3:30 p.m.--at the very beginning of the evening exodus to the suburbs. The temperature, which had been 36 degrees earlier in the afternoon, dropped to 26 degrees shortly after the snow started. Thus the snow partially melted as it hit the relatively warm pavement, then froze to ice on which more new snow fell. Visibility was reduced to one-quarter to one-half mile and winds were 25 mph-gusting to 40. Another important factor was that this was the earliest in the season that measurable snow had fallen in the city thus far during the 20th century. People in Boston usually wait until late in November or early December to transfer to snow-tires. Therefore on November 15th very few cars were equipped for winter driving. Autos that were forced to stop on the slightest incline were helpless. It did not take long before traffic backed up for miles behind these "bottle necks" and by 5 p.m., the streets of Boston became one huge parking lot. (Fig. 1)

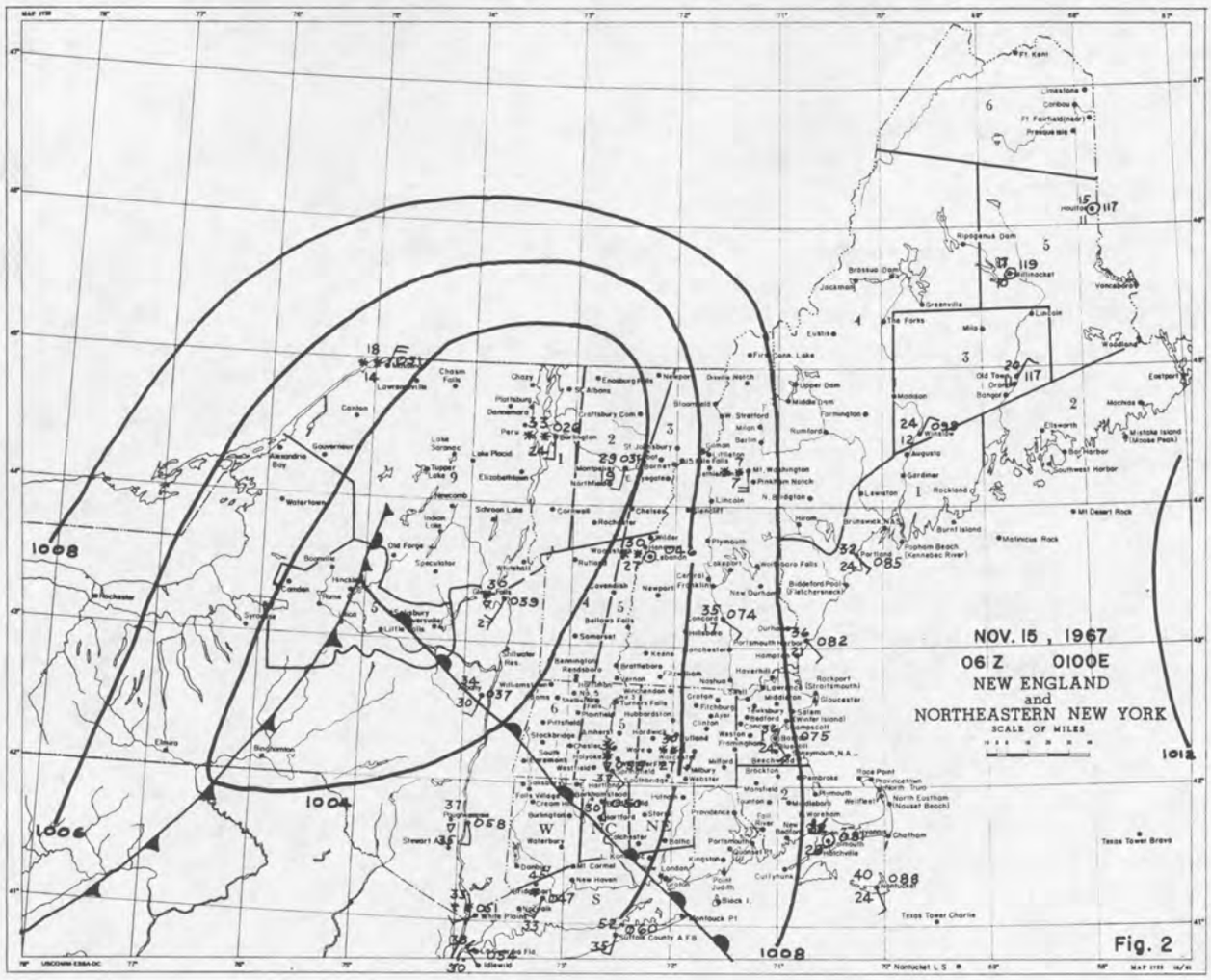
As a forecaster, there are two words that I have come to dislike; one is "sneak" and the other is "backlash". However, I must admit that these two words best describe this storm.

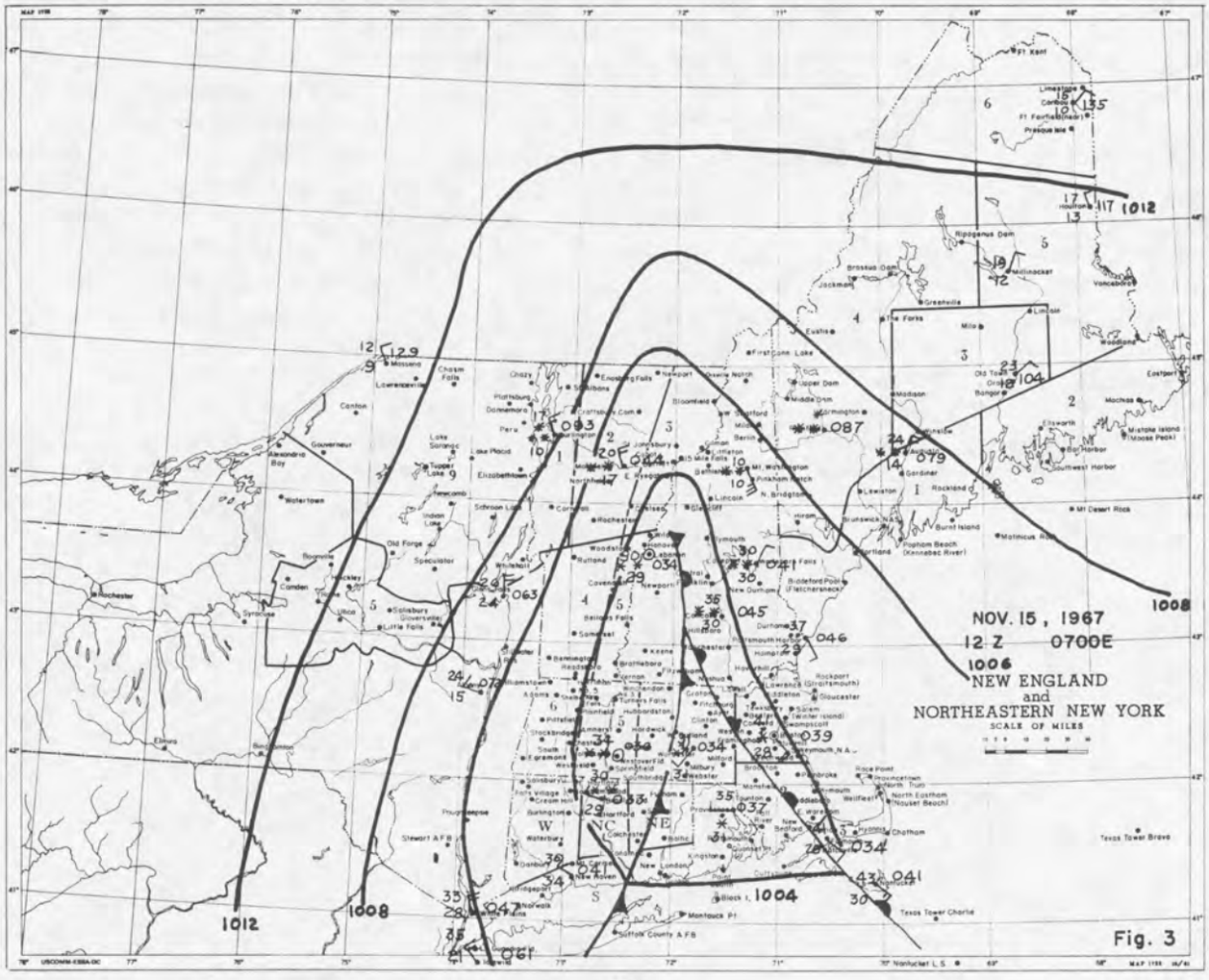


(Herald Traveler Staff Photo by George Dixon)

Two usually busy policemen (circle) had nothing to do in vehicle-choked Kenmore Sq. at 7:50 p.m. last night. Nothing was moving.

Fig. 1


NOV. 15 , 1967
06 Z 0100E
NEW ENGLAND
and
NORTHEASTERN NEW YORK
SCALE OF MILES
1008
1004
1006
1012
Fig. 2


NOV. 15 , 1967
12 Z 0700E
1006
NEW ENGLAND
and
NORTHEASTERN NEW YORK
SCALE OF MILES
1012
1008
1004
Fig. 3

Let's take a look at this storm then to see why it was so sneaky and to find out if there is anything that we can learn to help us to better forecast a similar situation.

On the synoptic charts for the northeast starting with that for 1 a.m., on November 15, (Fig. 2) we find a low pressure system centered over northeastern New York. This was forecast to move across central New England and pass off the coast north of Boston. At the same time another weak disturbance, located approximately 240 nautical miles east of Cape Hatteras, was moving northeastward toward Nova Scotia.

The ocean storm was deepening, and by 1 p.m., the disturbance moving off the New England coast was becoming absorbed by it. A decided change in the isobaric pattern took place between 7 a.m. and 1 p.m. (Fig. 3 and 4)

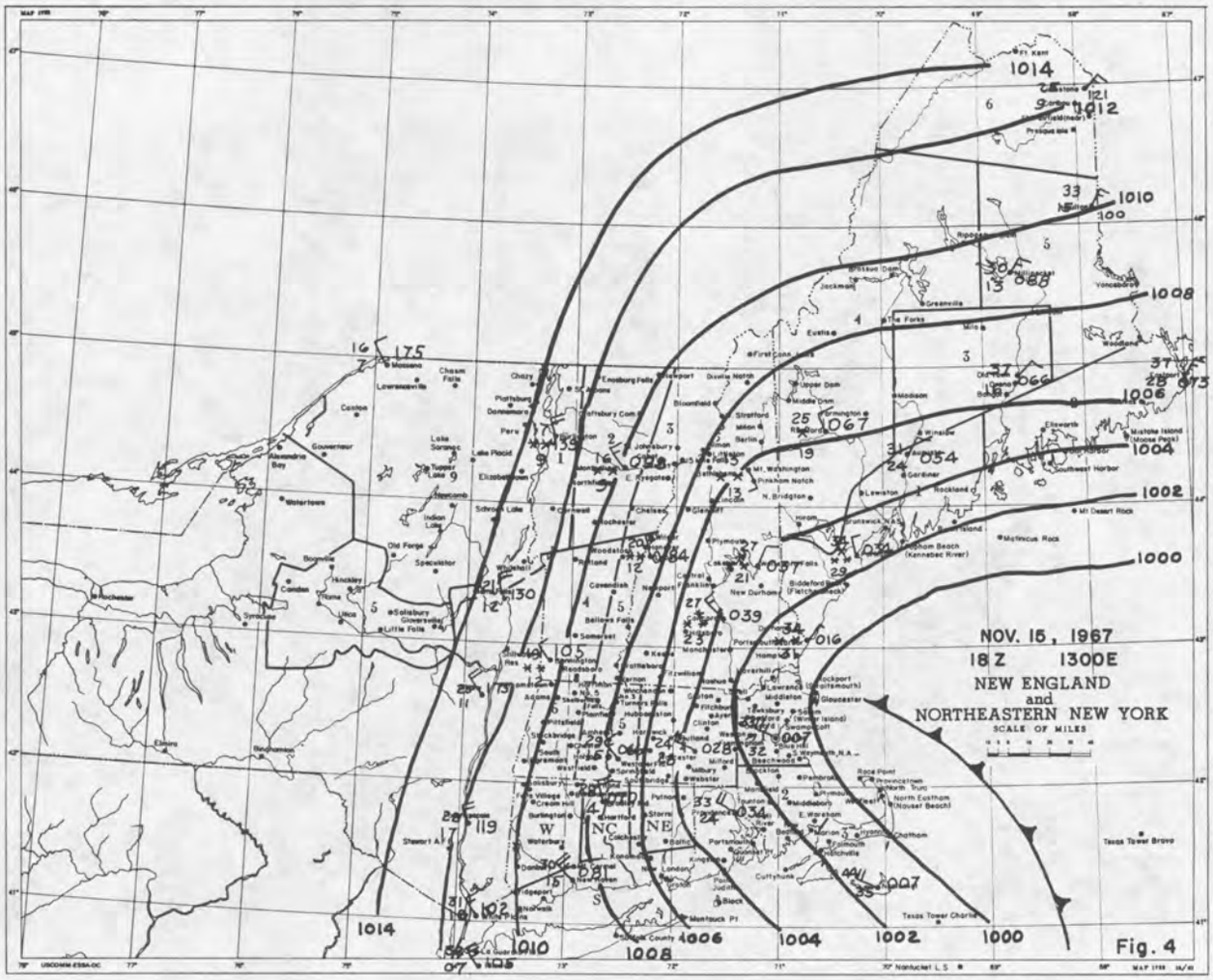
At 1 p.m., there was a flow of moist air along the Maine coast converging with the colder air from the northwest that followed in the wake of the eastward moving storm. The sharpest isobaric curvature was to the northeast of Boston.

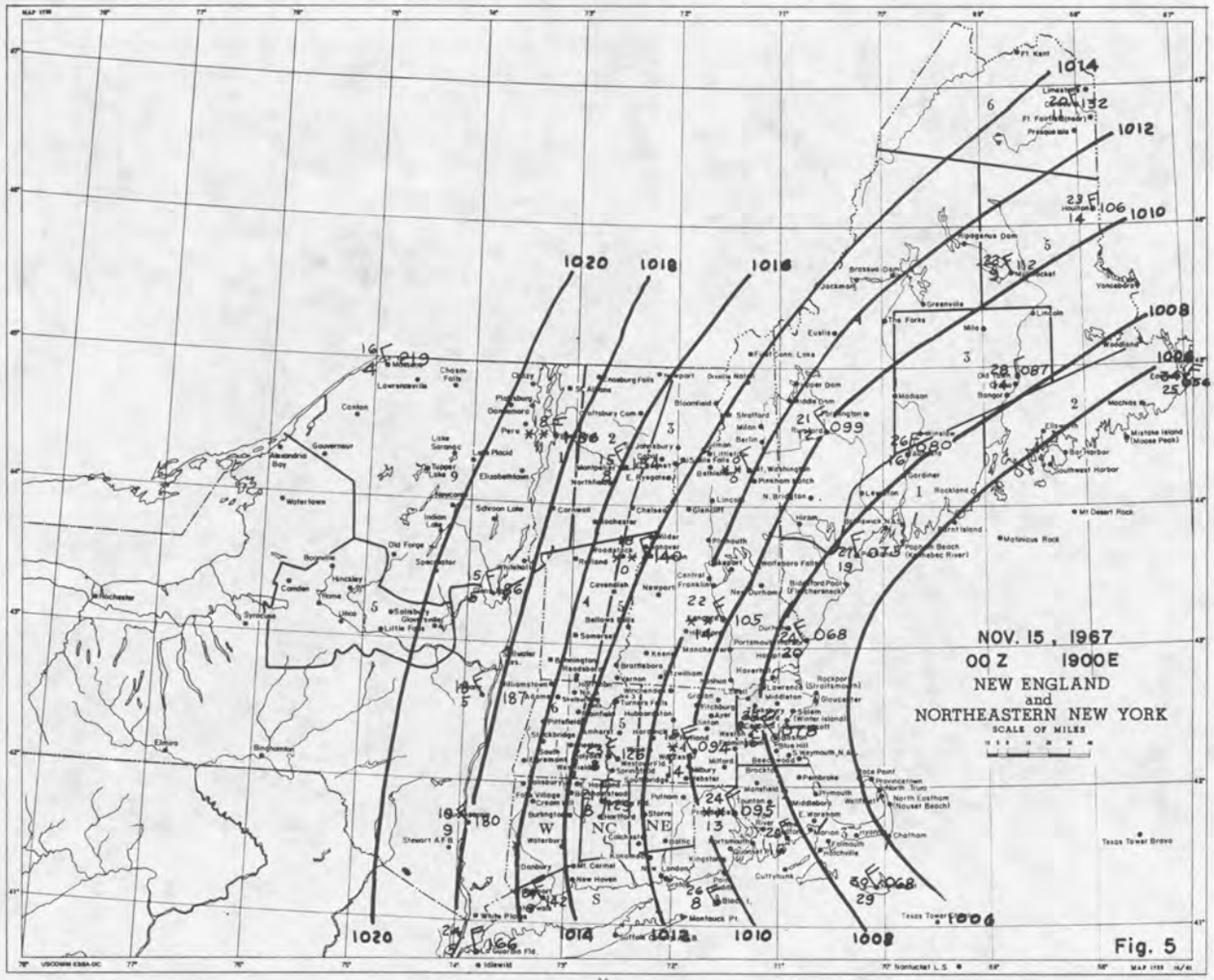
The 7 p.m. chart of November 15 is similar to that of six hours earlier except that the curvature of the isobars has diminished. (Fig. 5)

The upper air pattern accompanying the surface charts just discussed showed sharp trough over western New York and southward moving to eastern New England in 12 hours with a maximum vorticity region over southern New England.

The forecast for Boston and vicinity prepared the evening of November 14th for the next day was the best forecast made for this situation. It called for "Snow flurries or Squalls becoming windy and turning colder. Temperature dropping below freezing during the afternoon." Subsequent forecasts were more optomistic. Partial clearing during the afternoon was called for 12 hours later as the cold front approached Boston and the clouds were breaking over the Connecticut River Valley. This forecast seemed to be working out well when the snow ended and there were occasional glimpses of the sun in the early afternoon. All was not well, however, and this was indicated by calls from the Air Traffic Control Center in Nashua, New Hampshire every half hour until after lunch asking when the snow was going to stop! Reports of heavy snow filtered down from the Haverhill-Lowell area to Danvers. It was assumed to be a line of squalls which would continue on eastward.

Fortunately, the Weather Radar Section of the Air Force Cambridge Research Laboratory operated their CPS-9 radar continuously for about 8 hours during the snowstorm. Pictures of the echoes point out several interesting features and give a detailed account of the changing precipitation pattern. The elevation angle of the antenna was automatically changed and pictures were taken at every degree up to twelve degrees and then every two degrees to twenty degrees, after which it dropped down to zero to start over again. Slides were made of the echoes at the zero degree angle and three degrees for about every two hours. These will be shown and a few interesting comparisons will be made.


NOV. 15, 1967
18 Z 1300E
NEW ENGLAND
and
NORTHEASTERN NEW YORK
SCALE OF MILES
1014
1012
1010
1008
1006
1004
1002
1000
Fig. 4


NOV. 15, 1967
00 Z 1900E
NEW ENGLAND
and
NORTHEASTERN NEW YORK
SCALE OF MILES
1020
1018
1016
1014
1012
1010
1008
Fig. 5

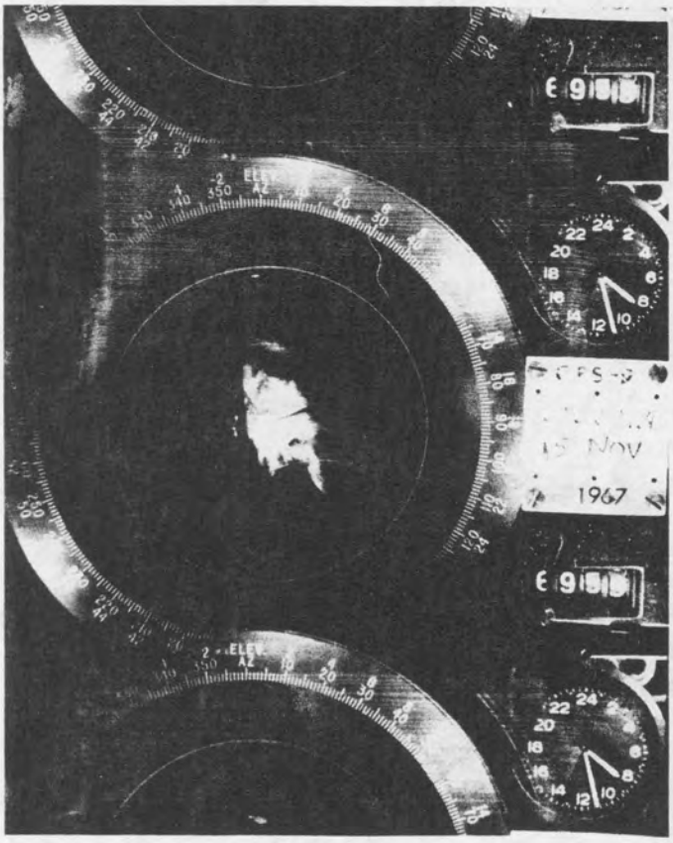


Figure 6

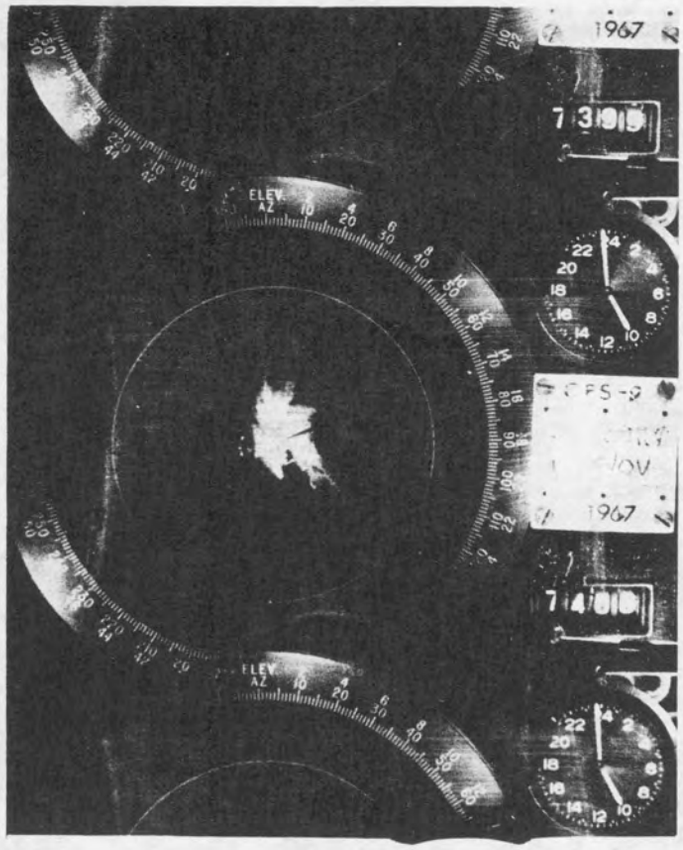


Figure 7

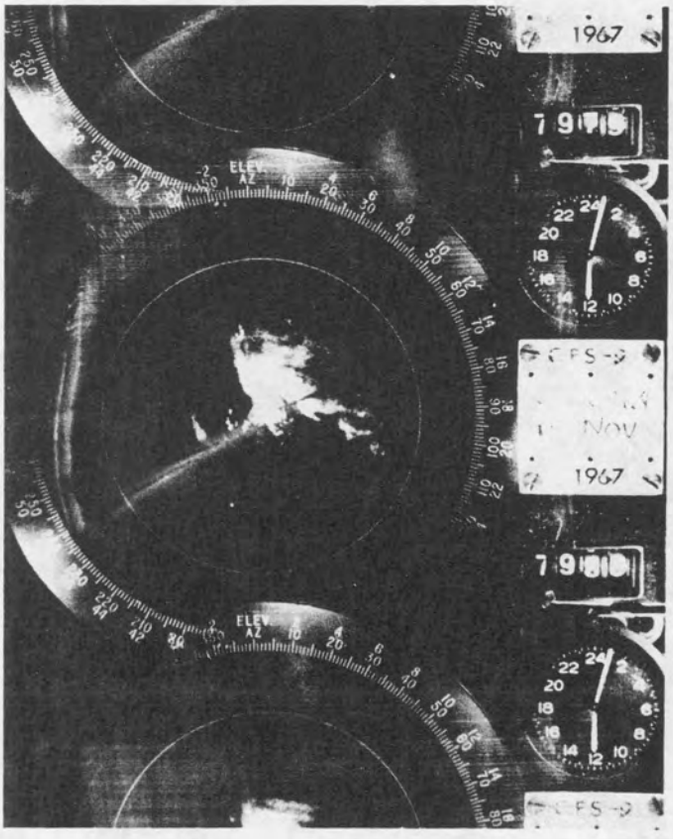


Figure 8

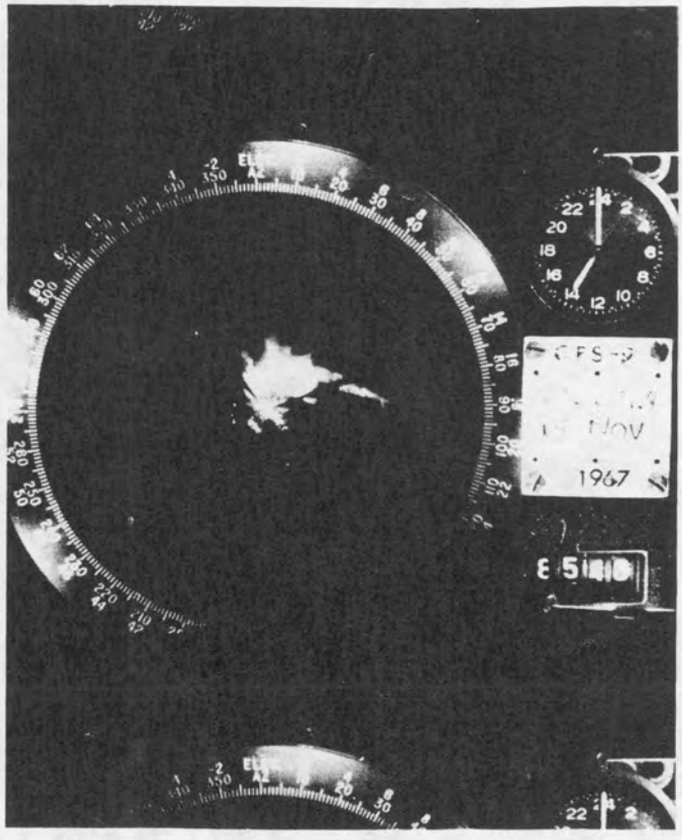


Figure 9

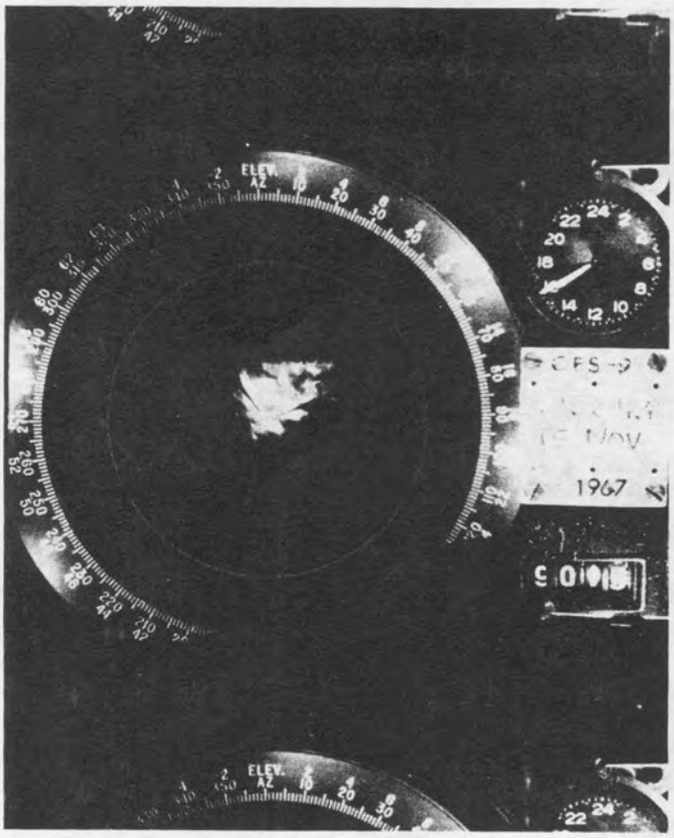


Figure 10

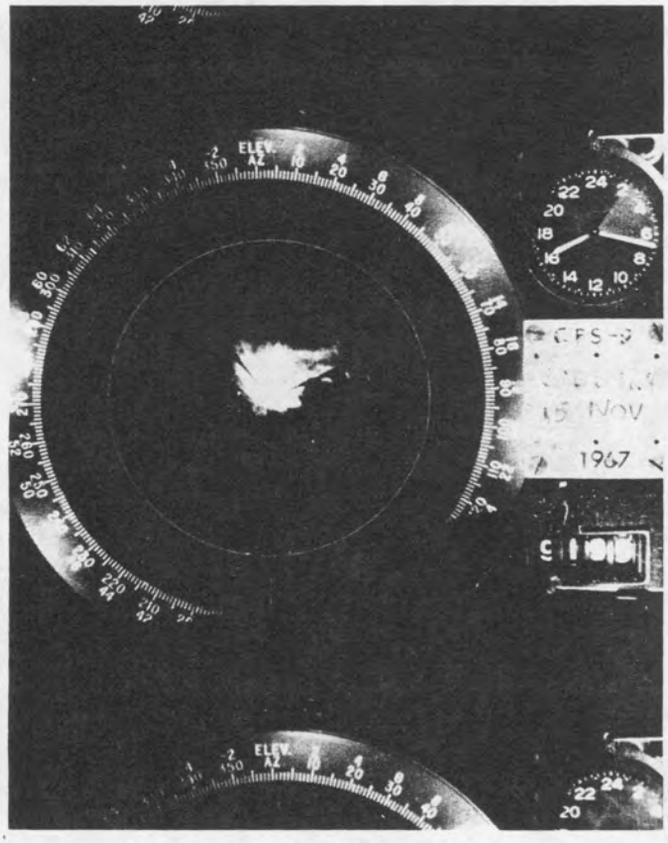


Figure 11

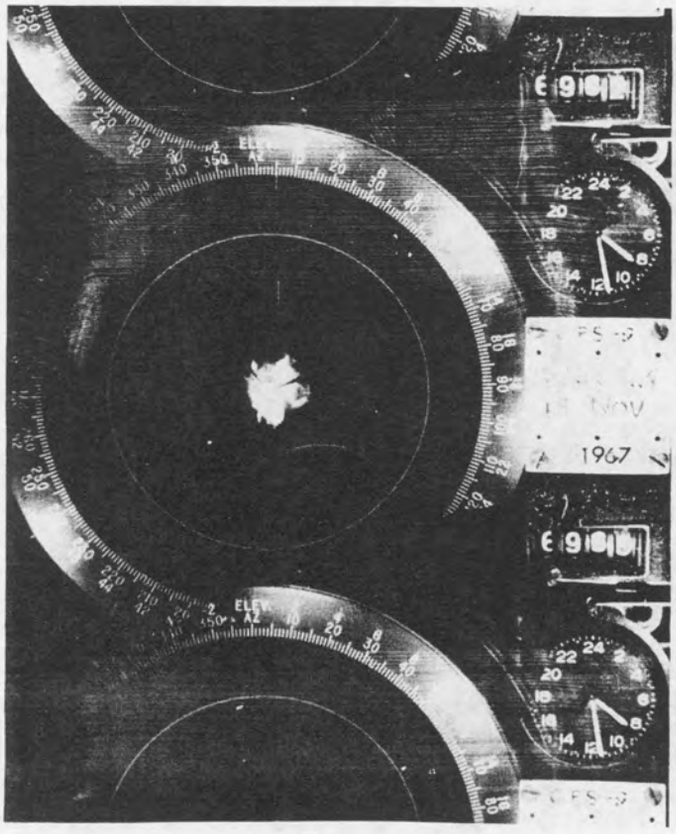


Figure 12

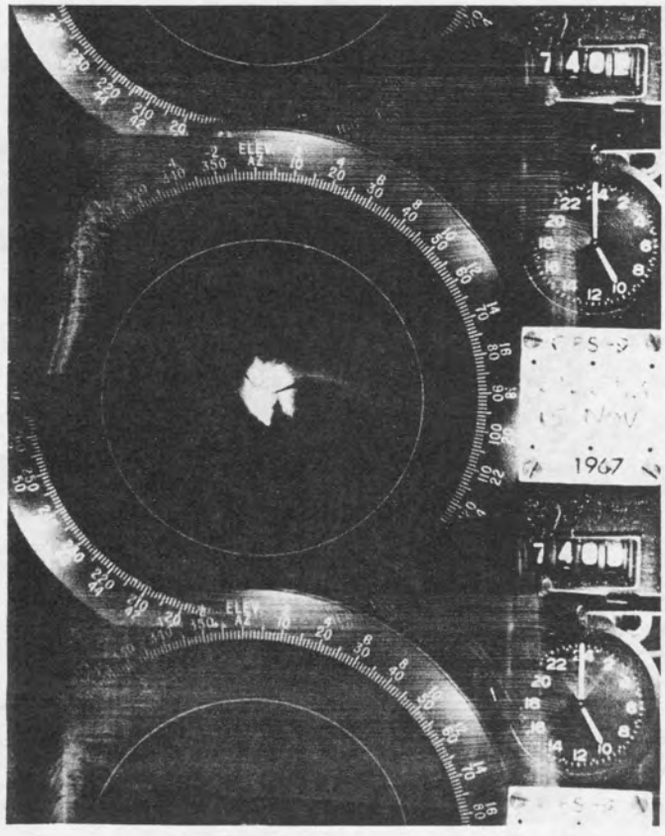


Figure 13

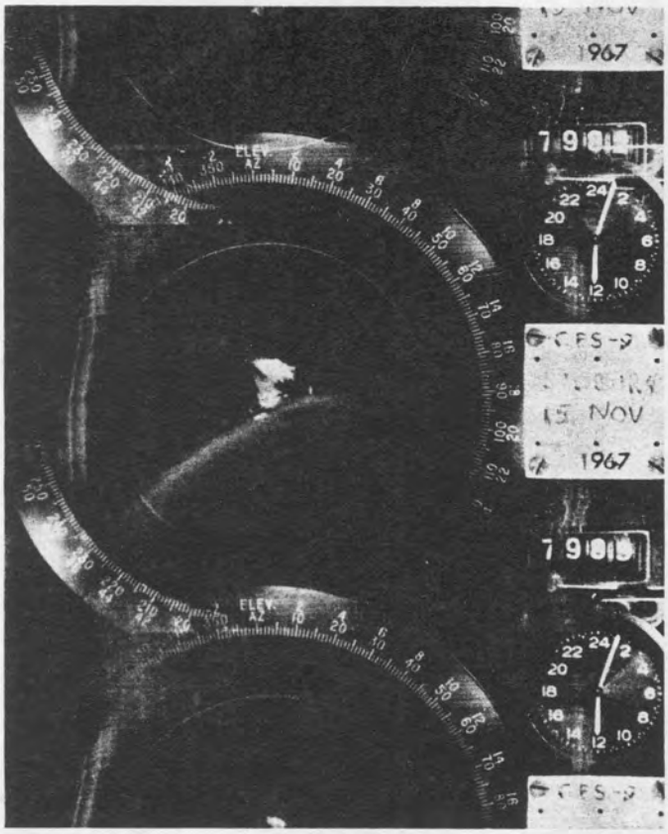


Figure 14

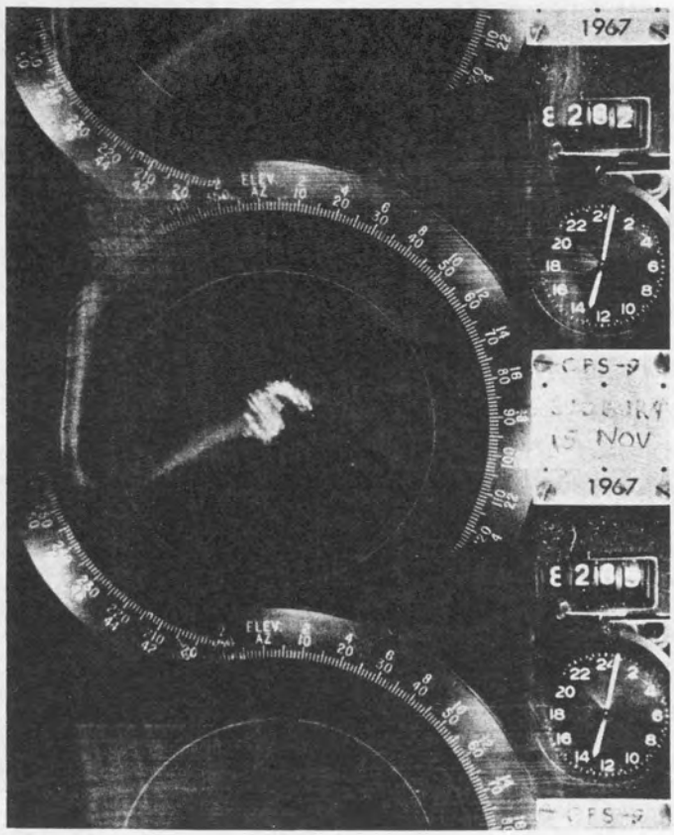


Figure 15

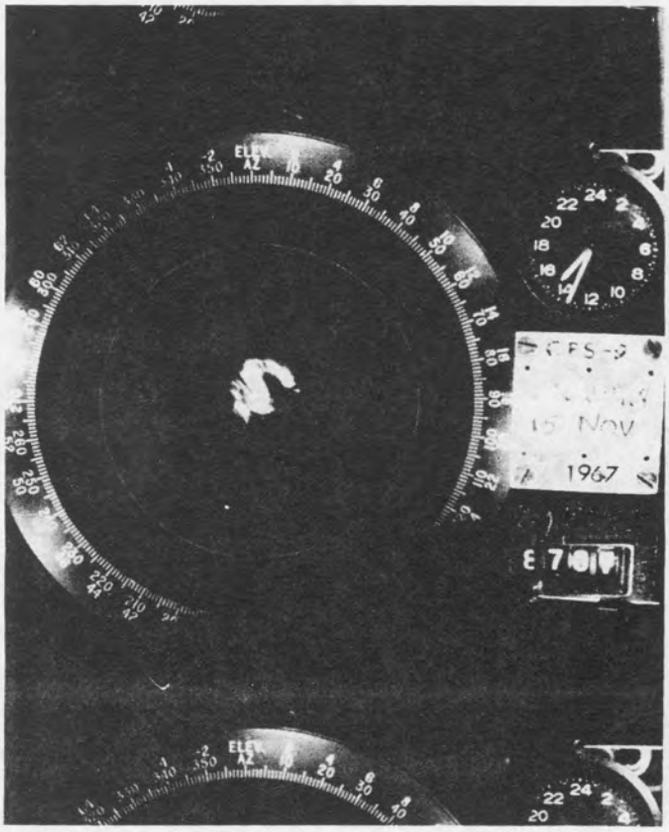


Figure 16

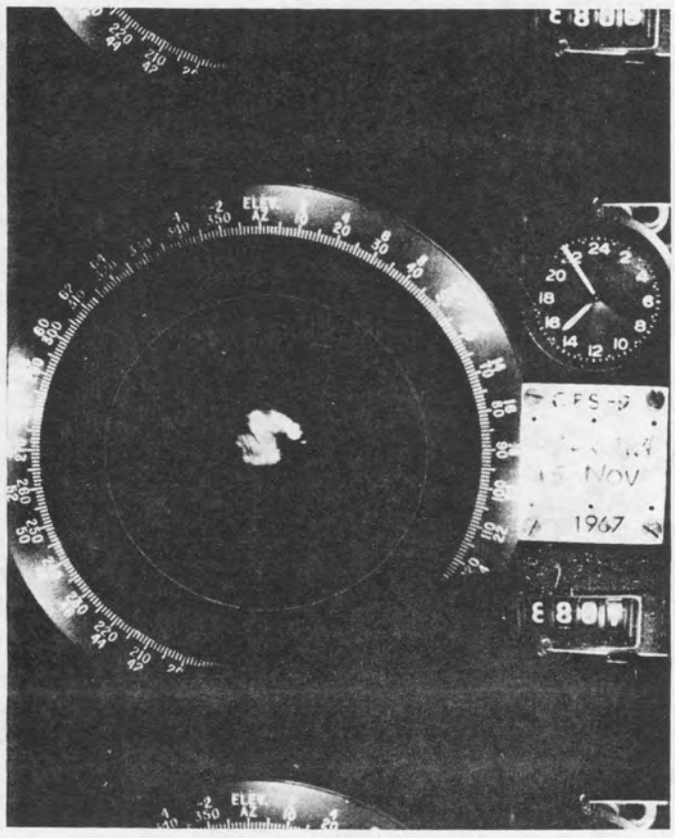


Figure 17

The radar site at Sudbury is about 20 miles almost directly west of the Logan International Airport.

The cold front extending southeastward from the radar position rotated northeastward and the echo area decreased to the southeast and east of the site but continued unabated to the north until 2:00 p.m. After that the area to the north of the city showed a slight motion to the south and east. (Figs. 6, 7, 8 and 9)

This motion continued and by 3:40 p.m. the area covered the city (Fig. 10). The echo area at 4:17 p.m. is illustrated in Fig. 11.

Pictures at the 3 degrees elevation angle show the echo movements clearer. The echo decreased in size so that shortly after noon there was one strong echo 10 to 25 miles north of the radar site.

(Figs. 12, 13 and 14)

An hour later, even this seemed to be weakening.

(Fig. 15)

At 2:33 p.m., the echo showed some intensification. The next two hours show further brightening and filling in of the clear wedge to the northwest of Boston.

(Figs. 16, 17, 18 and 19).

The maximum height of this cell was 13 to 14 thousand feet.

A comparison at 3 degrees elevation shows the change in the area between 8:28 a.m. to 1:02 p.m. Notice the distinct shift to the north. (Fig. 20).

Another interesting comparison is the echo pattern at 1 p.m. compared with the isobaric pattern at the same time. The echo covers the area where the curvature of the isobars is the sharpest.

(Fig. 21)

The last comparison to be made is between the precipitation pattern shown by the radar with zero degrees elevation at 2 p.m. and at 4 p.m. The 2 p.m. area is outlined in dashed lines and 4 p.m. solid. It shows that the area has filled in to the northwest of Boston. (Fig. 22)

This then was the "backlash" aspect of the storm. The southwestern edge of the precipitation area moved beyond Boston - halted - and returned again to the city.

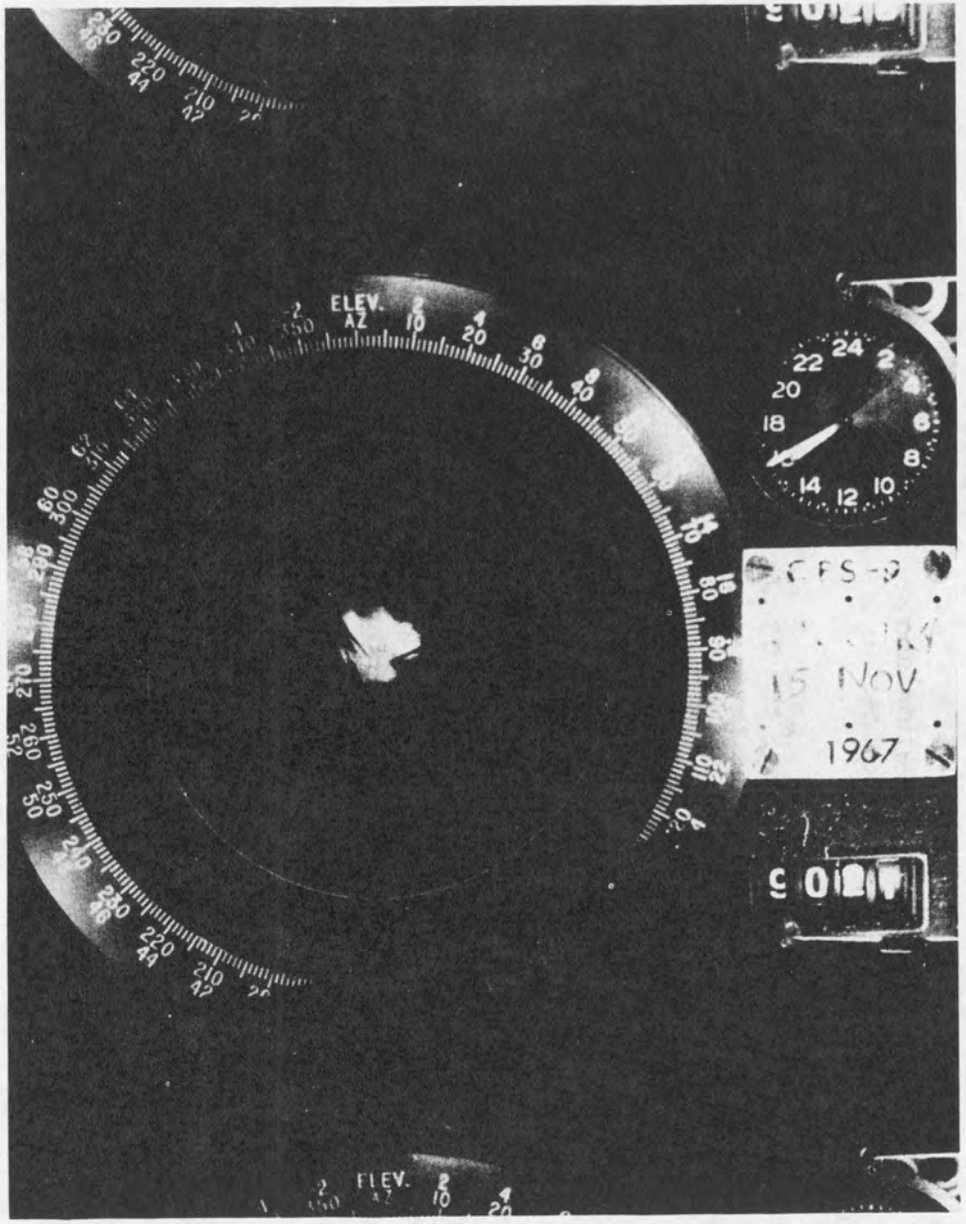


Figure 18

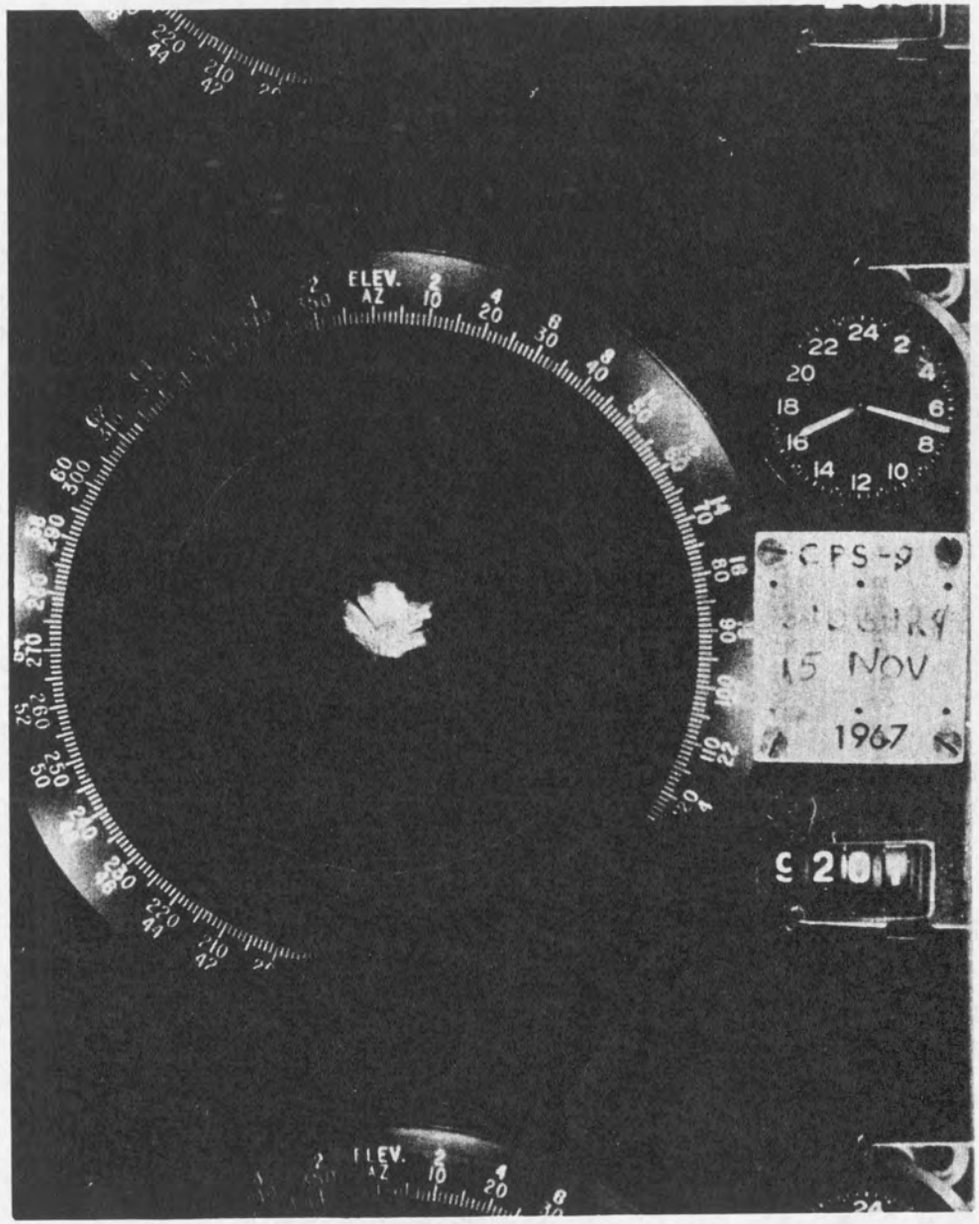
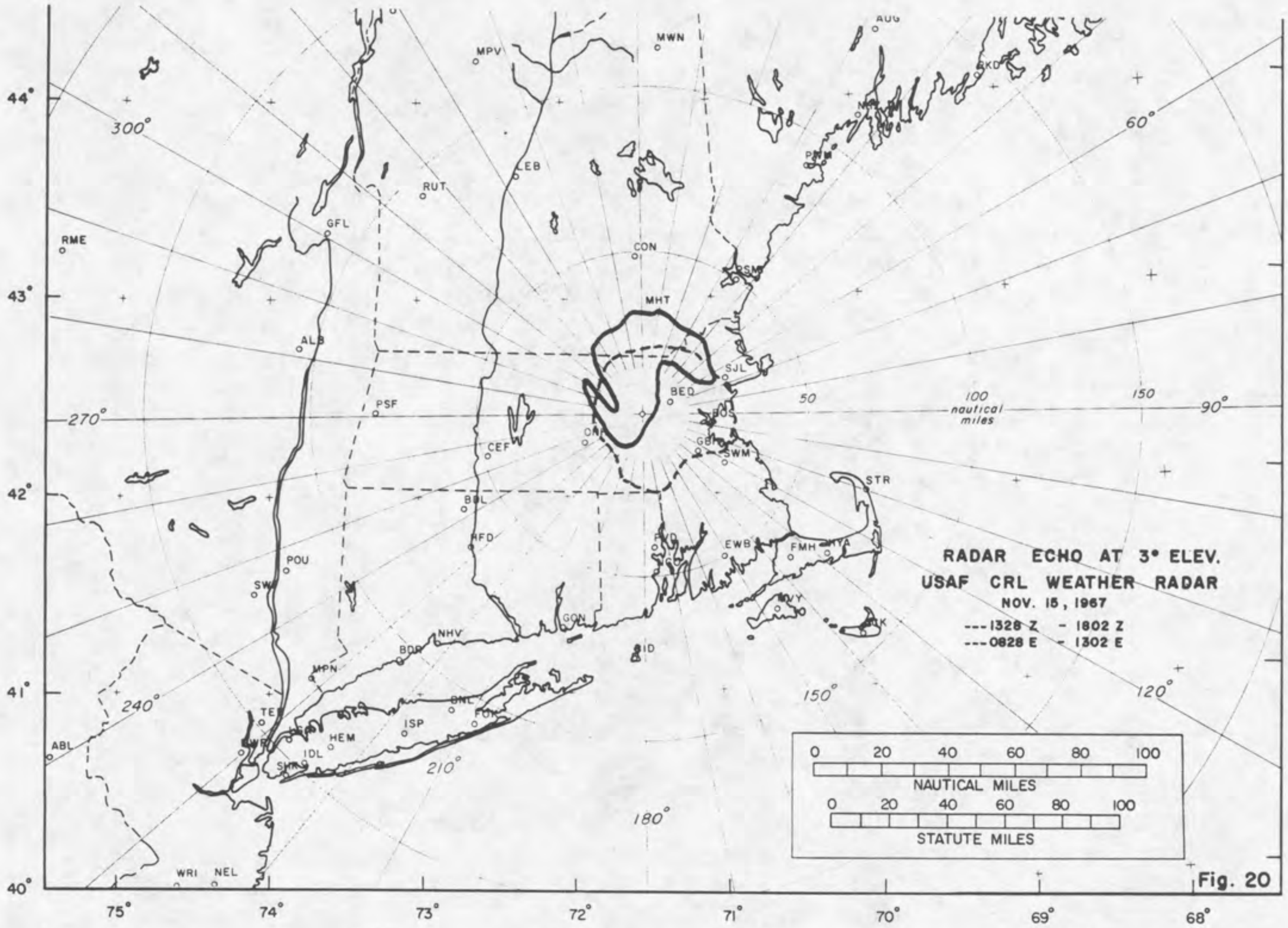
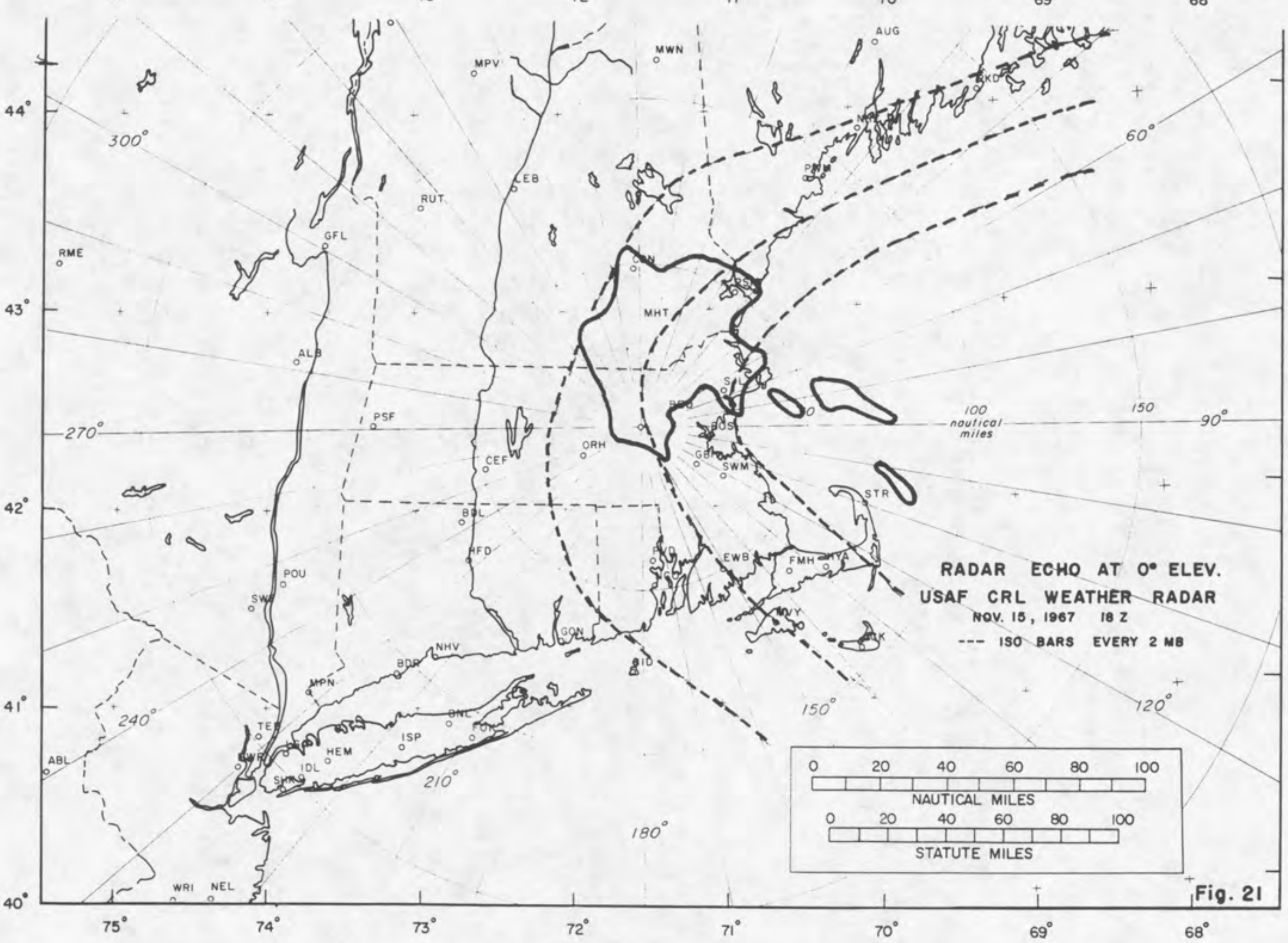


Figure 19


RADAR ECHO AT 3° ELEV.
USAF CRL WEATHER RADAR
NOV. 15, 1967
---1328 Z - 1802 Z
---0828 E - 1302 E
NAUTICAL MILES
STATUTE MILES
Fig. 20


RADAR ECHO AT 0° ELEV.
USAF CRL WEATHER RADAR
NOV. 15, 1967 18 Z
--- ISO BARS EVERY 2 MB
NAUTICAL MILES
STATUTE MILES
Fig. 21

The radar pictures suggest that there was a moving pivotal point on a line separating rising air to the east and north from descending air to the south and west. A schematic diagram of such a pattern is shown in the next figure. (Fig. 23)

The pivotal point situated first to the northwest of Boston moves southeastward passing north of the city. The positions shown are for every six hours. The meat cleaver pattern indicated by dashed lines marks the eastern edge of the rising air. Six hours later, dotted lines, oriented at about a 45 degree angle. Boston is now in the area of descending air. After another six hours, the area of rising air is oriented east-west and Boston is back in the area of ascending air. The hatched region shown over northeastern Massachusetts and extreme southern New Hampshire would be the area where air would be rising almost continuously for the 12 hour period. This was where the heaviest snowfall occurred.

Typical amounts are plotted on a chart which also shows the outline of the radar echo at noon. (Fig. 24)

There were several other interesting phenomena that occurred during the mini-blizzard. When the heavy snow began at the airport, the wind showed no variation at all. It continued blowing from 300 or 310 degrees at 25 knots with gust between 31 and 34 knots. The barograph which had been rising since 1 p.m. showed no change in slope. While the temperature dropped, the wet bulb and dew point also fell, but less markedly. It was astonishing that at 1 a.m., on November 16, 13 hours after the cold front passage and when the center of the low pressure system was over eastern Nova Scotia some 300 nautical miles east-northeast of Boston, the pibal showed geostrophic warm air advection at Boston. (Fig. 25)

A surface wind of 320 degrees 15 knots at the surface veered to 10 degrees 29 knots at two thousand feet. This exceeds what might have been expected by the Ekman spiral effect. The wind continued to veer and at six thousand feet was 30 degrees 20 knots. Above that it backed to 320 degrees 8 knots at 8 thousand feet. The thermal vectors are the dashed arrows for the 2 to 6 thousand foot layer and the 6 to 8 thousand foot layer. This plot suggests that the coldest air at low levels is to the southwest of the low center with an over-running of warmer air above the friction level. From 6 to 8 thousand feet there is advection of cold air. This indicates increasing instability. Of course the pibal sounding was post facto but radar pictures taken at a 6 degree angle showed the convective activity.

Here we see the top of a cell about 18 miles northeast of the radar site. (Fig. 26)

Forty-five minutes later at 3:40 p.m., the cell is shown to have grown and another cell appears 10 miles to the north. (Fig. 27)

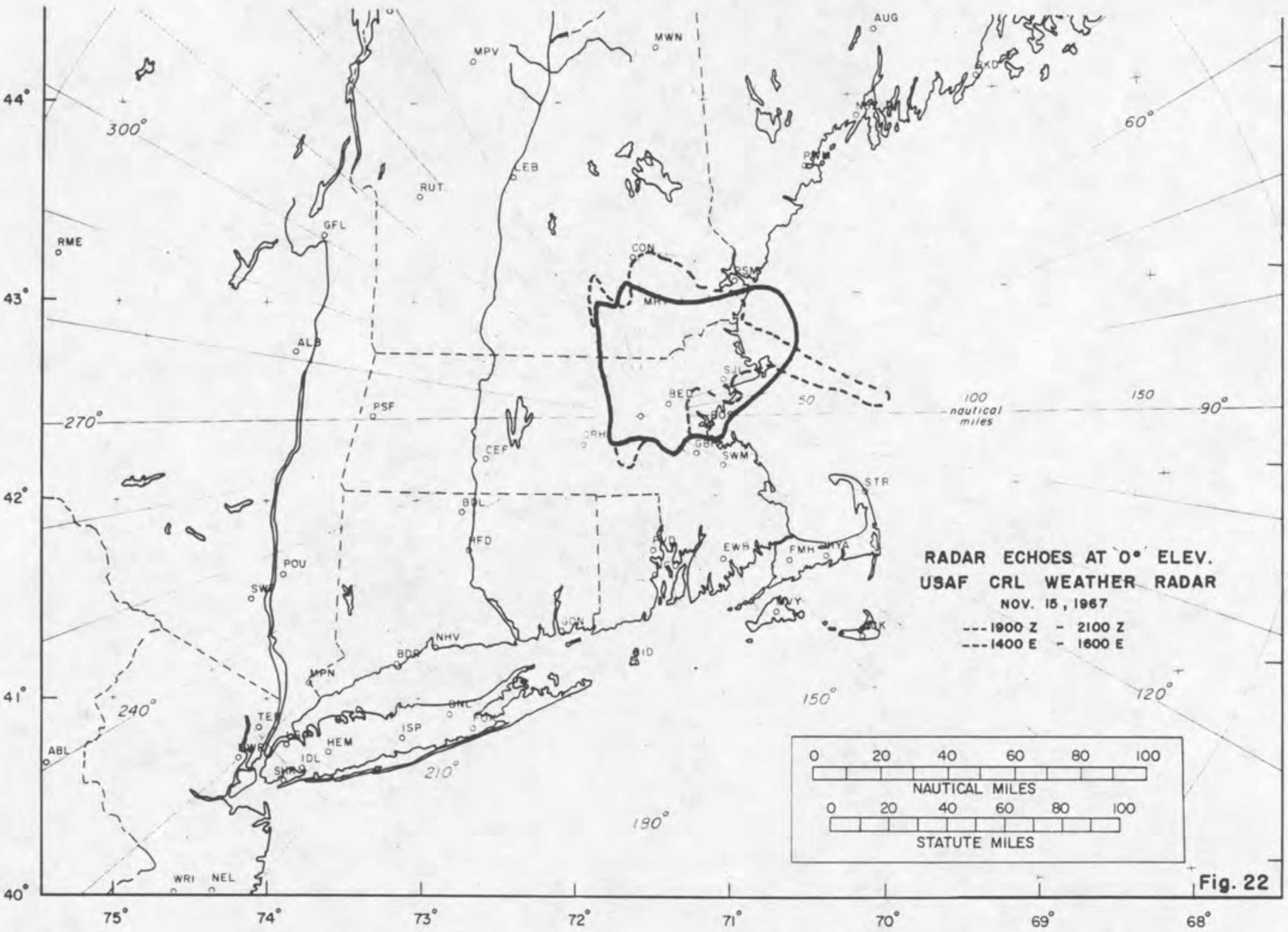

RADAR ECHOES AT 0° ELEV.
USAF CRL WEATHER RADAR
NOV. 15, 1967
---1900 Z - 2100 Z
---1400 E - 1600 E
0 20 40 60 80 100
NAUTICAL MILES
0 20 40 60 80 100
STATUTE MILES
100 nautical miles
50
150
300°
270°
240°
210°
180°
150°
120°
90°
60°
44°
43°
42°
41°
40°
75°
74°
73°
72°
71°
70°
69°
68°

Fig. 22

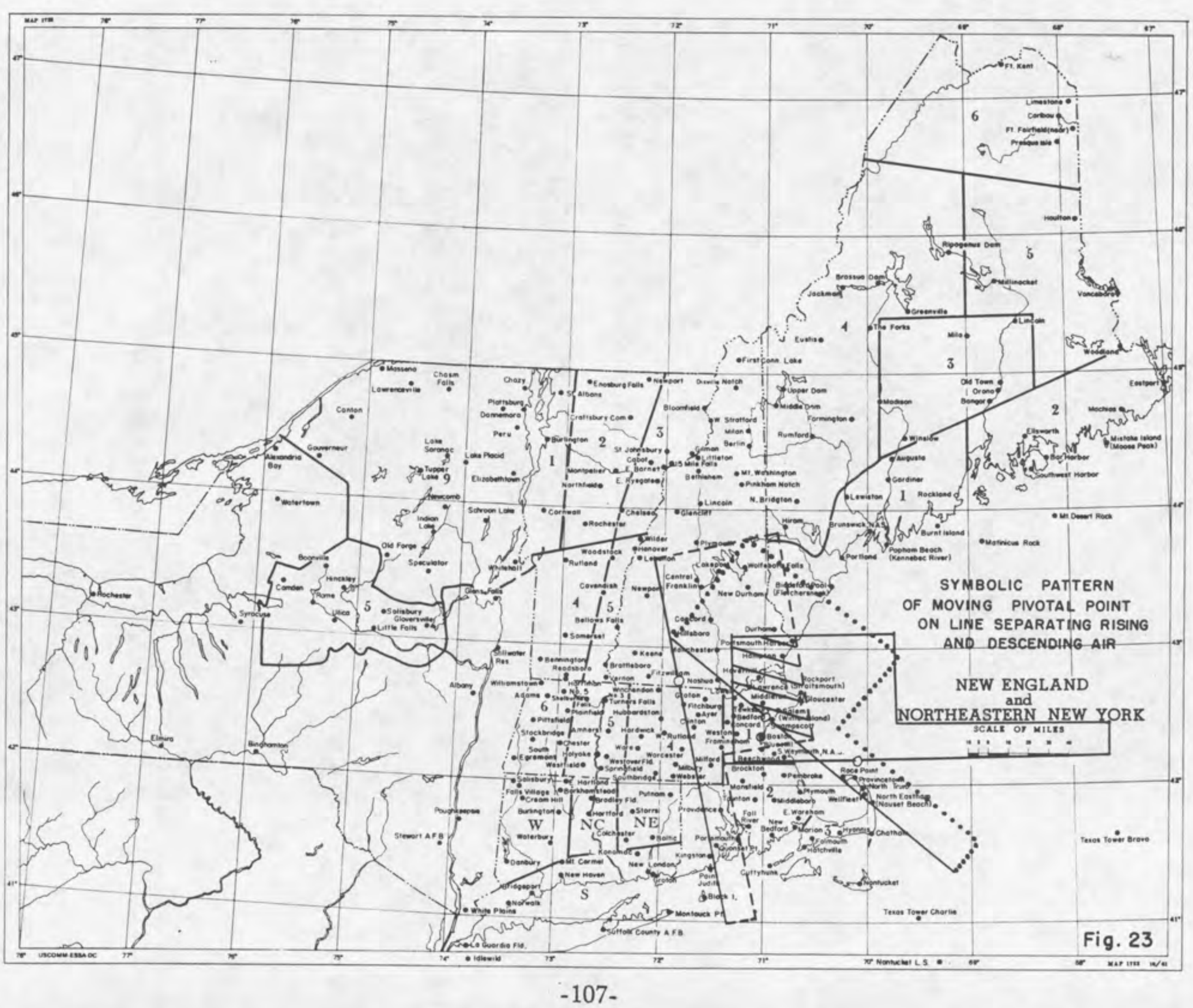

SYMBOLIC PATTERN
OF MOVING PIVOTAL POINT
ON LINE SEPARATING RISING
AND DESCENDING AIR
NEW ENGLAND
and
NORTHEASTERN NEW YORK
SCALE OF MILES

Fig. 23

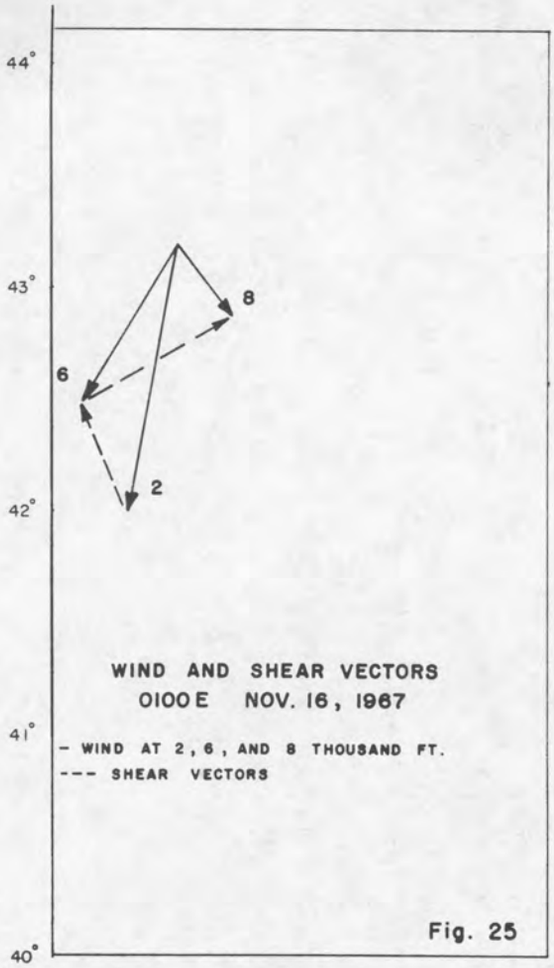


Fig. 25

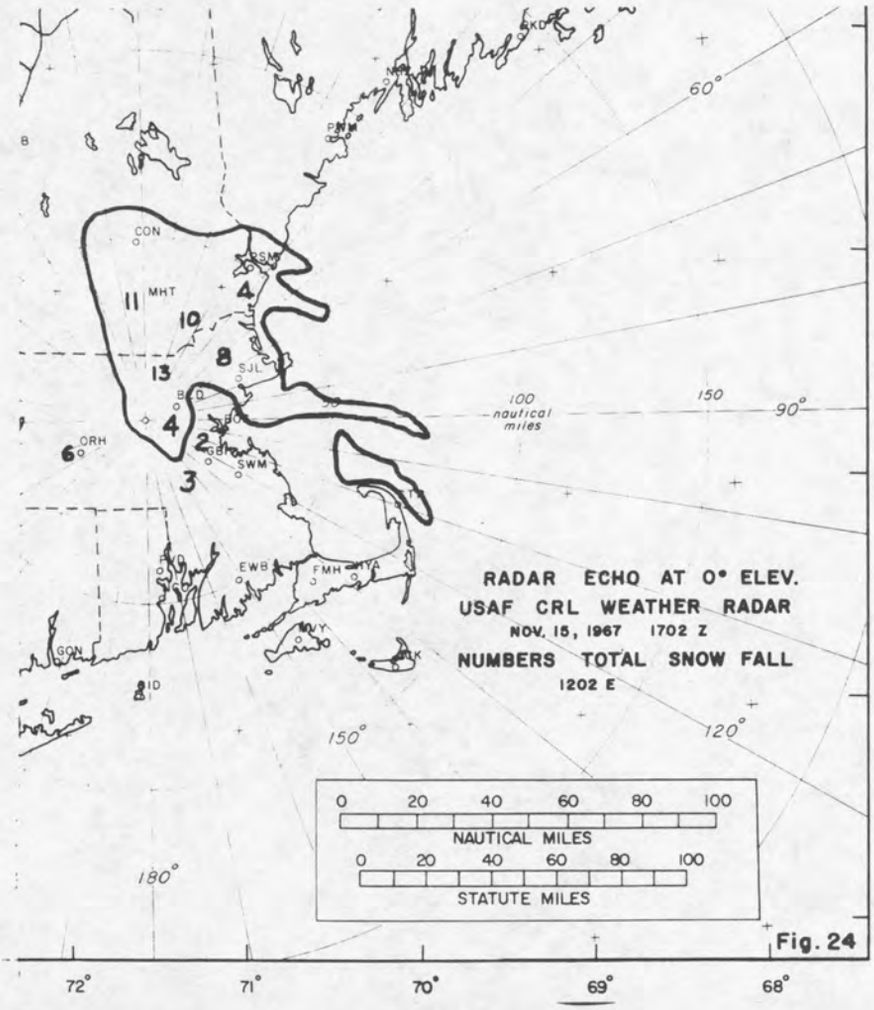


Fig. 24

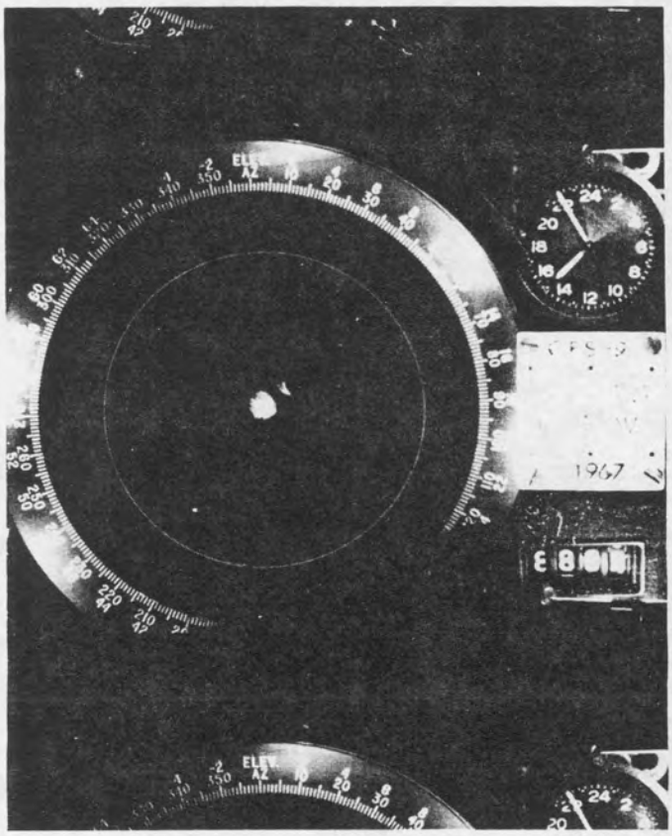


Figure 26

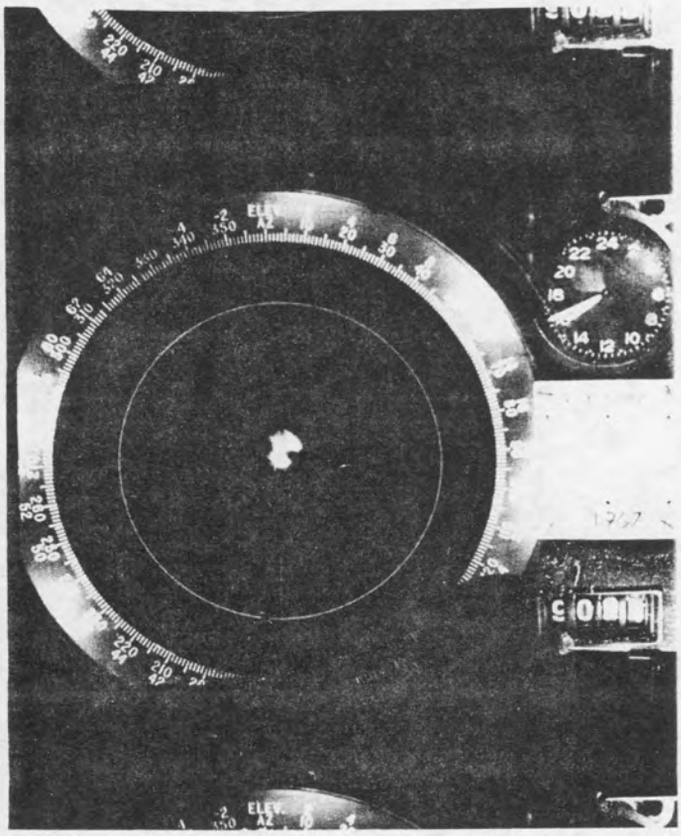


Figure 27

Another rather surprising feature shown by the radar was that at 3:46 p.m. when the time the Weather Bureau office at Logan Airport was reporting heavy snow, there were no echoes above 4 thousand feet over the airport. The situation continued until the radar was turned off at 4:20 p.m. Thus heavy snow at Boston must have originated from the clouds some distance to the north or northwest.

With the wind still from 310 degrees at 20 knots, the barometer rising, the snow ended shortly before 10 p.m. The mini-blizzard was over but the traffic was still stalled.

An editorial in the Boston Herald two days after the storm had this to say, "The Weather Bureau has never claimed - or been expected - to be infallible -- yet a society that can send satellites into space to report meteorological conditions not only around our own planet but around other heavenly bodies inevitably will demand better weather forecasting for its local communities". This snowstorm was of the meso-scale instability variety and it is going to be a long time before we can predict something like this as much as 6 hours in advance. Radar, a comparatively new tool in meteorology, proved to be a big help in understanding what happened in this storm. Close attention to the radar scope during the early afternoon might have given us another hours lead in forecasting snow. However, after seeing the echoes retreating from Boston up until 2 p.m., most forecasters would have felt that as far as Boston was concerned there was nothing to worry about. A radar set located at the Boston Weather Bureau office is unable to pick up snow and, therefore, would have been of no help. The answer to preventing reoccurrence of such an enormous traffic tie-up may have to come from technical knowledge in making the automobile less susceptible to "sneak" snowstorms.