distance away from that location no movement of the low should be forecast. This relationship is valid at 500 mb as well as the 700 mb level. This relationship is referred to as "Henry's Rule" and can be determined by inspection of the maps. The next parts should be considered also.

2. Determine the intensity of the circulation around the low. With an intensity value (ΔH) greater than 100 m (25 kt) no movement eastward would be expected. With values less than 60 eastward movement is likely. For the 500 mb level these values should be increased to 125 and 85. A decrease of ΔH by a factor of two indicates that the low is ready to move.

3. A Southwest Low will intensify after it crosses the mountains if there is a favorable cyclonic curvature of the contours in the area into which it moves. If a front exists along the east slopes of the mountains expect a wave (Colorado-low) to develop. If a strong ridge is predominant over the Mississippi Valley the low will be weakened. The extent of the precipitation depends upon the intensity of the low.

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MESOSCALE LOW LEVEL VORTICITY CENTERS ASSOCIATED WITH CONVECTION AS VIEWED BY SATELLITE

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Several times during the spring and summer of 1977, an interesting small scale cloud feature was observed in morning satellite pictures and persisted throughout most of the day. This phenomenon, which displayed certain similar characteristics with each occurrence, apparently became a factor in significant weather developments later in the afternoon. Four examples will be shown here, with more detailed comments on the first two. This is by no means a complete study, but merely an initial presentation of some cases noted during this particular convective season.

The most striking example occurred on September 7 over Iowa and west central Illinois. A cluster of thunderstorms over central Iowa (Figure 1a, taken at 1000Z), was gradually decreasing in intensity. By 1500Z, most of this convection had dissipated, leaving behind a small area of clouds over southeastern Iowa with tops to mid levels (Figure 1b). As this cloud mass moved eastward, it gradually assumed a comma-shaped configuration, much like a well developed synoptic-scale vorticity center (Figure 1c, taken at 1630Z). A definite cyclonic twisting motion could be seen in the movie loops at the time.

The 12Z LFM initial analysis (Figure 1d) did not indicate anything of this nature over the area of interest. The prog for 00Z was equally unimpressive over Illinois (Figure 1e). (Barotropic and PE similar.) Furthermore, the morning 500 mb chart (Figure 1f), indicated anticyclonic directional and speed shear, as well as marked diffluence over the area.

Nevertheless, this cloud feature remained intact as it drifted eastward toward the Illinois border. By 18Z (Figure 1g), the first signs of new convective development appeared near the Iowa-Illinois border, just downstream from the twisting cloud mass. Weather radar indicated tops to 36,000 feet half an hour later. The succeeding chart depicted a small cluster with tops above 40,000 feet just ahead of the apparent circulation center. The largest cell can be clearly seen on the 20Z picture (Figure 1h).

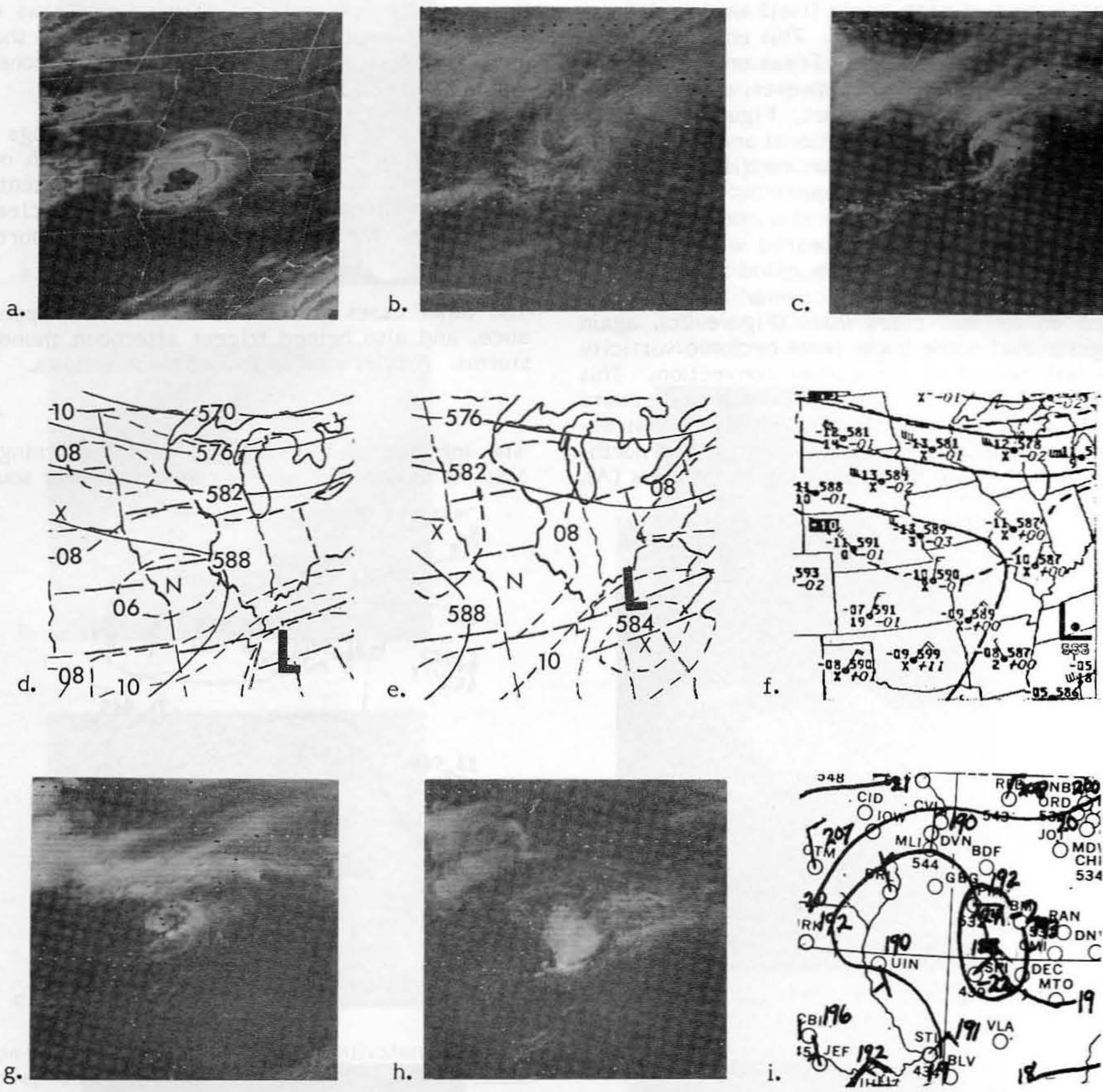

Figure 1. a. 1000 Z, 2 mi Enhanced IR, Mb Curve, 7 September 1977; b. 1500 Z, ½ mi Visible View, 7 September 1977; c. 1630 Z, ½ mi Visible View, 7 September 1977; d. LFM 500 mb Initial Analysis, 1200 Z, 7 September 1977; e. LFM 12 hr Forecast 500 mb, VT 0000 Z, 8 September 1977; f. 500 mb Analysis, 1200 Z, 7 September 1977; g. 1800 Z, ½ mi Visible View, 7 September 1977; h. 2000 Z, ½ mi Visible View, 7 September 1977; i. 1800 Z, Surface Analysis, 7 September 1977.

The isolated nature of this convection and its location relative to the above cloud feature strongly suggests that the thunderstorm development was influenced by this apparent lower tropospheric vorticity center. William Briggs, forecaster at WSFO Chicago, Illinois, investigated the activity and learned of several associated severe weather reports. These included a tornado 5 miles west of Avon (32 miles east-southeast of Burlington, Iowa) at 2010Z, and funnel cloud sightings with large hail at nearby Aledo. A tornado also occurred at Deer Creek (16 miles east of Peoria), destroying one home and causing minor damage to 30 others.

In this particular case, the disturbance was weakly discernible at the surface. An analysis of the 18Z data revealed a slight depression in the pressure field over western Illinois (Figure 1i). Noted also was a small area of 2 mb pressure falls during the preceding 3 hour period downstream from the center.

It would have been difficult, at best, to forecast this isolated severe weather development by using only the morning conventional data. The disturbance was detectable in the satellite imagery, but only after the parent convective cluster dissipated. This sequence of events was typical of all cases.

On some days, cirrus debris from the parent thunderstorm cluster would itself assume a comma shape before dissipating. This is illustrated in the next case ... over west Texas on the morning of August 22 (Figure 2a). However, upper air data (see the 12Z 300 mb chart, Figure 2b) again indicated anticyclonic directional and speed shear over the area. This was verified by cirrus trajectories in the movie loop.

Typically, the cirrus disappeared within a short time, revealing the lingering cloud layers underneath. The subsequent comma configuration taken on by this cloud mass (Figure 2c), again suggests that some lower level cyclonic vorticity was left behind by the earlier convection. This feature retained its identity as it drifted eastward across Texas. By 22Z (Figure 2d), strong convection had developed over north central and northeast Texas ahead of the twisting cloud mass (A). Two tornadoes occurred late that afternoon from this activity just east of Corsicana, Texas (49 miles south-southeast of Dallas). One of these tornadoes destroyed two barns and caused considerable damage to a nearby residence.

An analysis of proximity upper air soundings for the above two dates did not provide much of a clue, either. It appears that the areal extent of these phenomena is not large enough to be clearly defined by the present network of reporting stations.

The other cases studied were similar in appearance, and also helped trigger afternoon thunderstorms. A brief look at two of these follows.

The infrared picture for 12Z on the morning of May 18 showed the parent convection over south-

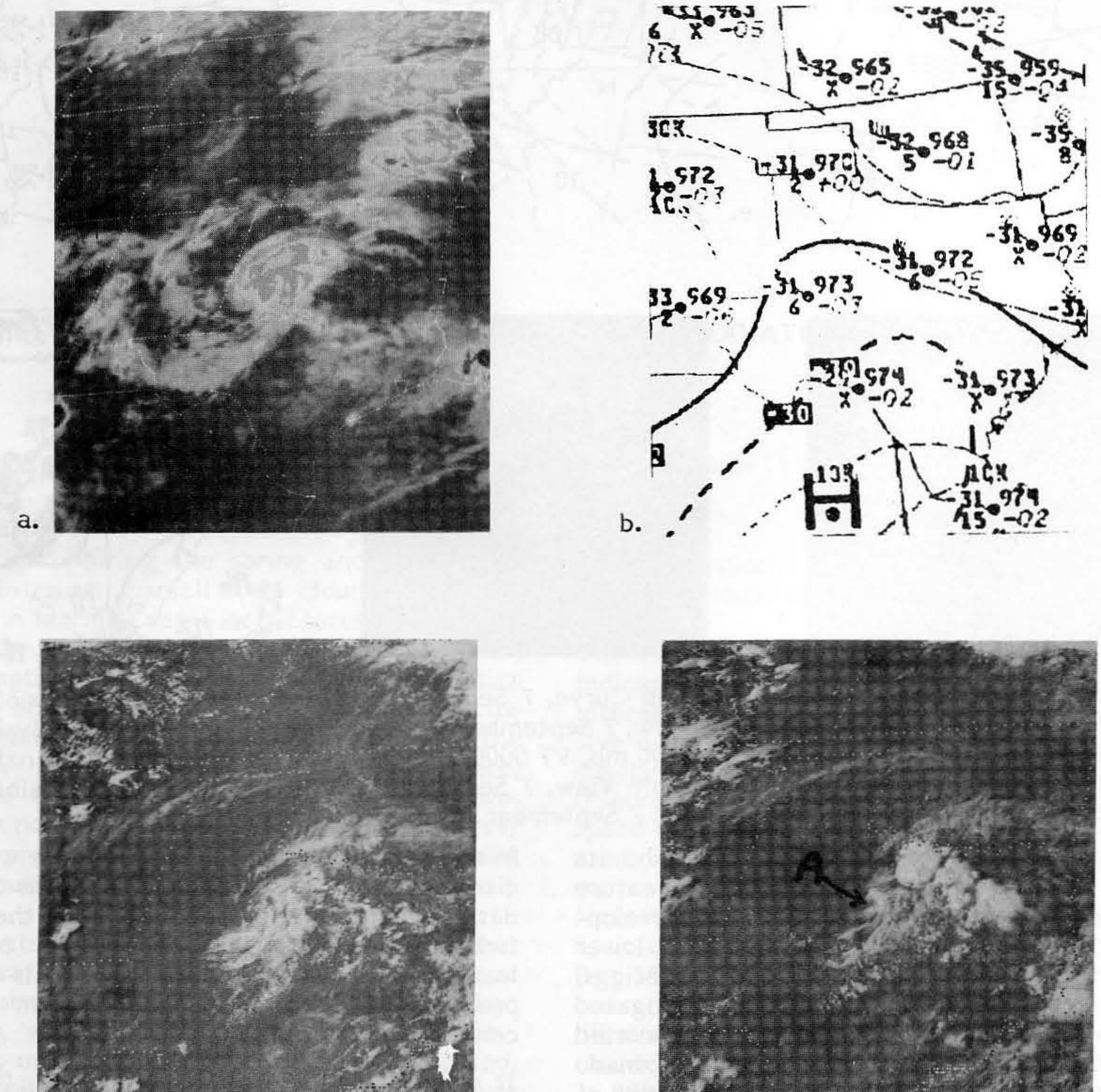

Figure 2. a. 1500 Z, 2 mi Enhanced IR, Mb Curve, 22 August 1977; b. 300 mb Analysis, 1200 Z, 22 August 1977; c. 2000 Z, 1 mi Visible Data, 22 August 1977; d. 2200 Z, 1 mi Visible Data, 22 August 1977.

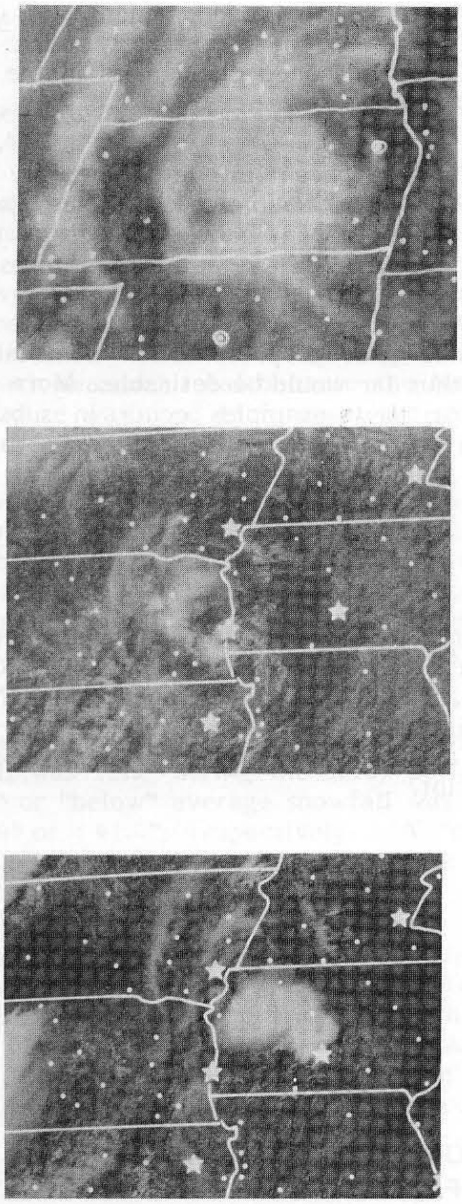

Figure 3. a. 1200 Z, 1 mi Equivalent IR, ZA Curve, 18 May 1977; b. 1800 Z, 1 mi Visible Data, 18 May 1977; c. 2100 Z, 1 mi Visible Data, 18 May, 1977.

ern Kansas (Figure 3a). Note the comma shape of the higher cloud tops, again within an area of anticyclonic, difluent flow. The cirrus dissipated, leaving an ill-defined, but suspicious cloud configuration at lower levels. The mesoscale system moved rather rapidly northeastward into Nebraska (Figure 3b) ... with the persistence of a small group of convective cells near Omaha indicating that the disturbance was still present. As this feature continued northeastward into Iowa, strong thunderstorms re-developed ahead of it northwest of Des Moines by 21Z (Figure 3c). Note the isolated nature of this activity also.

On August 31, the initial convective cluster located over southeast Kansas was quite small (Figure 4a). The apparent cyclonic vorticity left behind was evident in the tight lower level cloud circulation between Topeka and Chanute, Kansas at 14Z (Figure 4b). By 22Z (Figure 4c), this feature had moved to the northeast corner of Missouri, enhancing the convective development ahead of it.

As mentioned previously, certain characteristics appear to be common to all of the cases studied. In summary then, a few of these are:

1. Apparently, a small area of cyclonically rotating air within a parent convective cluster occasionally persists after the thunderstorms dissipate. Associated

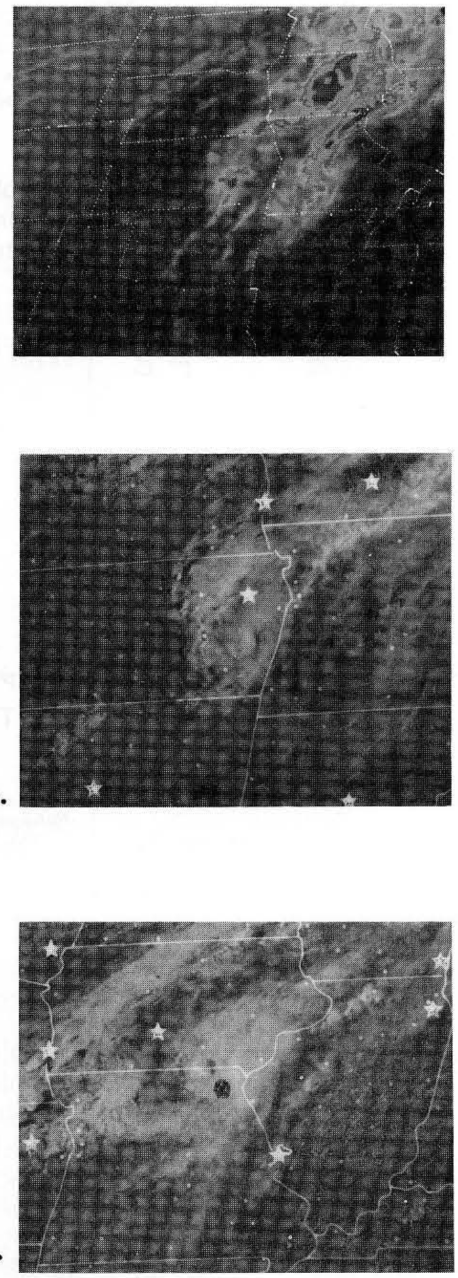

Figure 4. a. 1200 Z, 2 mi Enhanced IR, Mb Curve, 31 August 1977; b. 1400 Z, 1 mi Visible, 31 August 1977; c. 2200 Z, 1 mi Visible Data, 31 August 1977.

clouds are most often located in the lower levels of the atmosphere.

2. The area of concern is usually under an anticyclonic shear zone (directional and speed) at high levels ... not uncommon above a convective environment.

3. Clues to the formation of this feature probably will not be found on the upper air charts or vorticity progs, due to the anticyclonic shear zone aloft and the extremely small scale nature of these systems. It is doubtful that the reporting network is sufficiently dense to define this mesoscale phenomenon.

4. In otherwise favorable conditions, this vorticity center evidently has the potential for triggering severe weather.

5. A weak reflection in the surface isobaric and isallobaric fields will occasionally, but not always, accompany this feature.

6. At this time, satellite data appears to be the best method for detecting the presence of this phenomenon. It usually shows up in the imagery as a small, comma shaped cloud mass in the lower layers.

7. This apparent low level vorticity center is not discernible before the development of the parent convection, either in conventional data or satellite pictures.

Although samples are few at this time, it was determined that a presentation of the cases studied thus far would be desirable. More will be learned as new examples occur in subsequent convective seasons, probably leading to more detailed studies in the future.

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