MOTHER CLOUD OF THE FARGO TORNADOES OF 20 JUNE, 1957

by

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TORNADO RELATED HOOK-ECHOES

A PRONOUNCED hook-echo associated with the Illinois tornadoes of 9 April 1953 was successfully detected by the Champaign radar. Studies of that storm made by Huff, Hiser and Bigler,[1] and by Fujita[2] revealed that the tornado which moved north of Champaign was not located at the center of the major vortex center defined as a hole encircled by the hook-shaped echo. Penn, Pierce and McGuire[3] reported similar features in their study of the Massachusetts tornadoes of 9 June 1953.

RHI pictures cutting through the center of the hook-echo of 22 April 1958 were taken by Bigler.[4] They show a hole extending from the ground up to 35,000 ft.

It became evident that some tornadoes are produced by a mesoscale rotation system with horizontal dimensions varying between a few and 30 miles, and with a vertical extent reaching thirty to forty thousand feet. This report will show photographic evidence of a rotating cloud which produced four tornadoes in the Fargo-Moorhead area.

ROTATING CLOUD IN ITS DEVELOPING STAGE

R. E. Jensen, U.S. Weather Bureau at Fargo Airport, who drew Fig. 1 at the time of the Fargo Storm of 20 June, explained that the small cumulus attached to the left end of a huge cumulonimbus, northwest of the airport, grew with great vertical speed after eruption of a funnel from the base of the cumulus. The cloud was located about 25 miles to the west when he observed it. He indicated that the funnel backed in shortly after its appearance, but the cumulus kept growing until it reached the shape shown by him in Fig. 2. This towering cumulus, he explained, was probably a cumulonimbus, now. The top extended into a broken layer of As-Ac which was the ceiling layer. The base of the cloud was rotating cyclonically. No funnel was sighted between the times represented by Figs. 1 and 2.

TRIANGULATION OF THE ROTATING CLOUD

As the rotating cloud approached Fargo, some people thought that such a dark rotating cloud might be a large tornado, and they started to take pictures of the mother cloud long before the Fargo tornado, the second tornado produced by the system, dropped in the field some three miles west of the city.

An unusual number of the cloud pictures were collected by D. Bergquist, WDAY-

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TV weatherman, Fargo, and they were made available to the author. Figure 3 shows the result of the triangulation of the rotating cloud made by organizing about sixty pictures showing the cloud.

As shown in the figure, identification of each photograph is made by letters A, B, C, . . . showing the chronological frame order of each photographer, as well as by numbers assigned to each spot where pictures were taken. Motion pictures are identified by letters a, b, c, . . . representing the first frame of each continuous shot.

The shape of the rotating cloud was estimated for every five-minute interval. A tail-like stratus which was being sucked up into the core of the rotating cloud developed into a long tail by 1815 CST, then it decreased in size, while rotating as much as 90 degrees

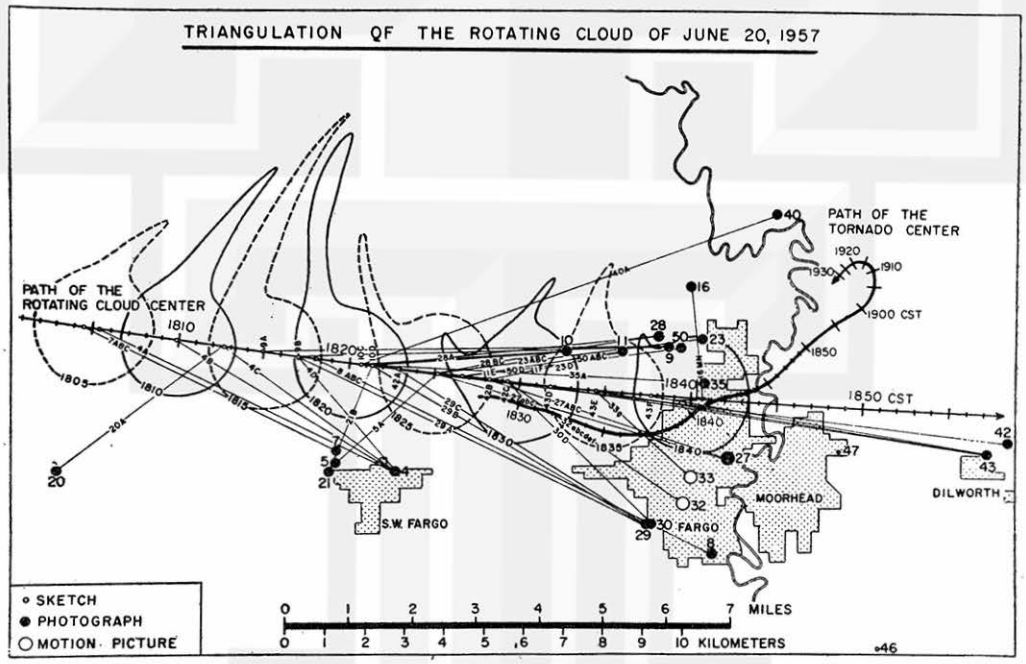

Fig. 3.

in 30 min around the circulation center. A new tail of stratus appeared to the north of the rotating cloud, but it lasted for only ten minutes.

At about 1828 CST when the cloud was above a field some three miles west of Fargo, a cone-shaped funnel dropped from its base. The funnel then moved eastward to the south of the rotation center of the cloud. At about 1840 CST the tornado, now in its dissipating stage, crossed the path of the rotating cloud center toward the northeast, and the shape of the funnel changed into a rope.

PHOTOGRAPHIC EVIDENCE

An attempt was made to reduce the photographs of the rotating cloud to the same scale so that the dimensions of the cloud in the different pictures might be directly compared.

Figure 4 shows the shape of the cloud between 1804 and 1820 CST, when it was

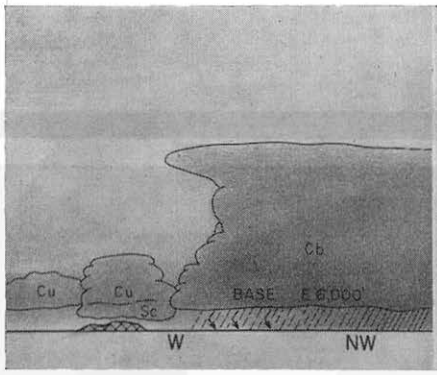
Cb
Cu
Cu
Sc
BASE E 6,000'
W
NW

Fig. 1.

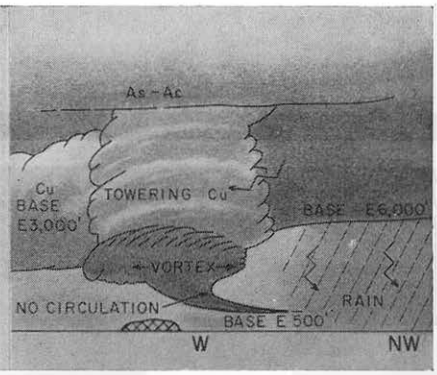
As - Ac
Cu
BASE
E3,000'
TOWERING Cu
BASE E6,000'
VORTEX
NO CIRCULATION
RAIN
BASE E 500'
W
NW

Fig. 2.

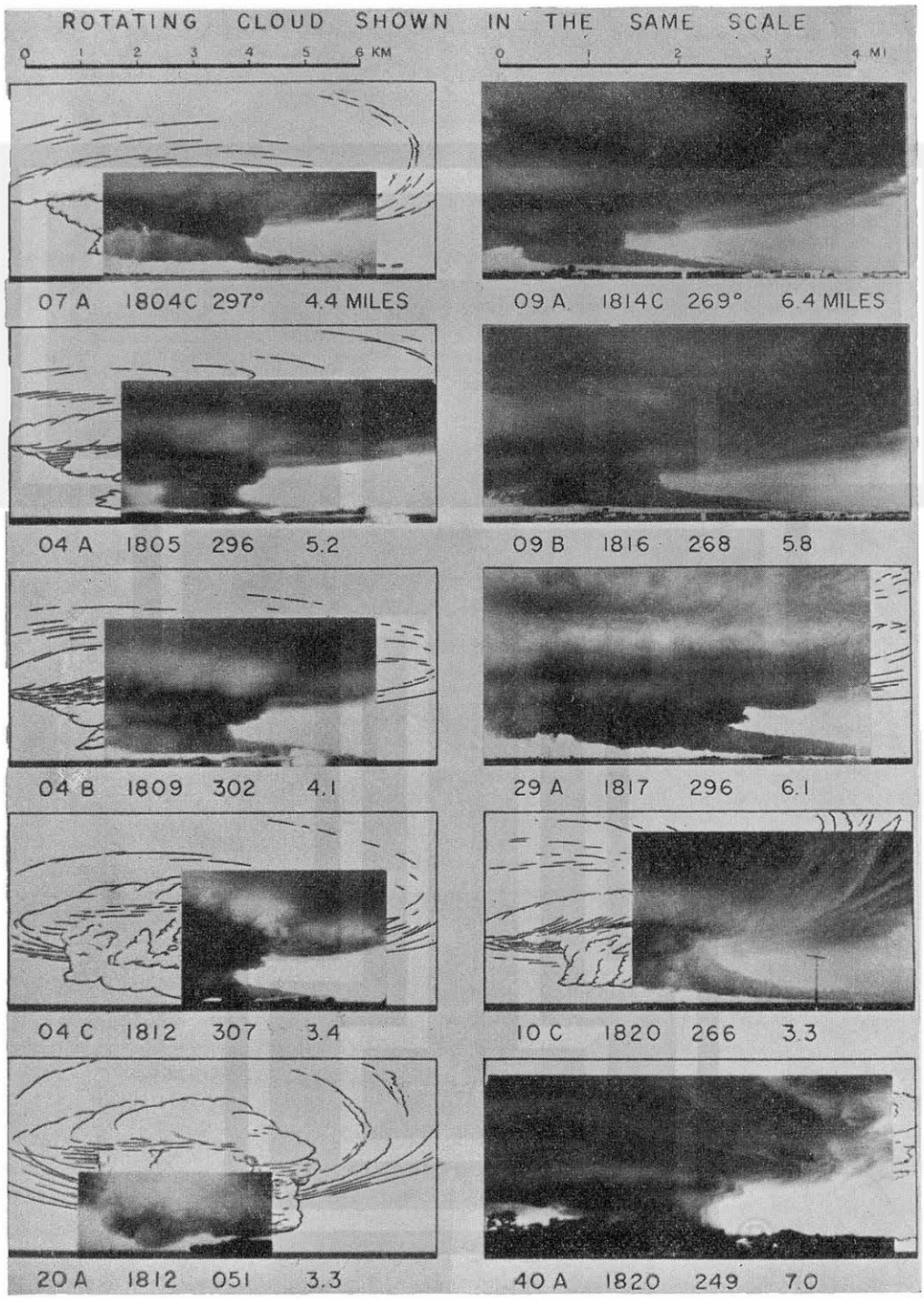
ROTATING CLOUD SHOWN IN THE SAME SCALE
0 1 2 3 4 5 6 KM
0 1 2 3 4 MI
07 A 1804C 297° 4.4 MILES
09 A 1814C 269° 6.4 MILES
04 A 1805 296 5.2
09 B 1816 268 5.8
04 B 1809 302 4.1
29 A 1817 296 6.1
04 C 1812 307 3.4
10 C 1820 266 3.3
20 A 1812 051 3.3
40 A 1820 249 7.0

Fig. 4.

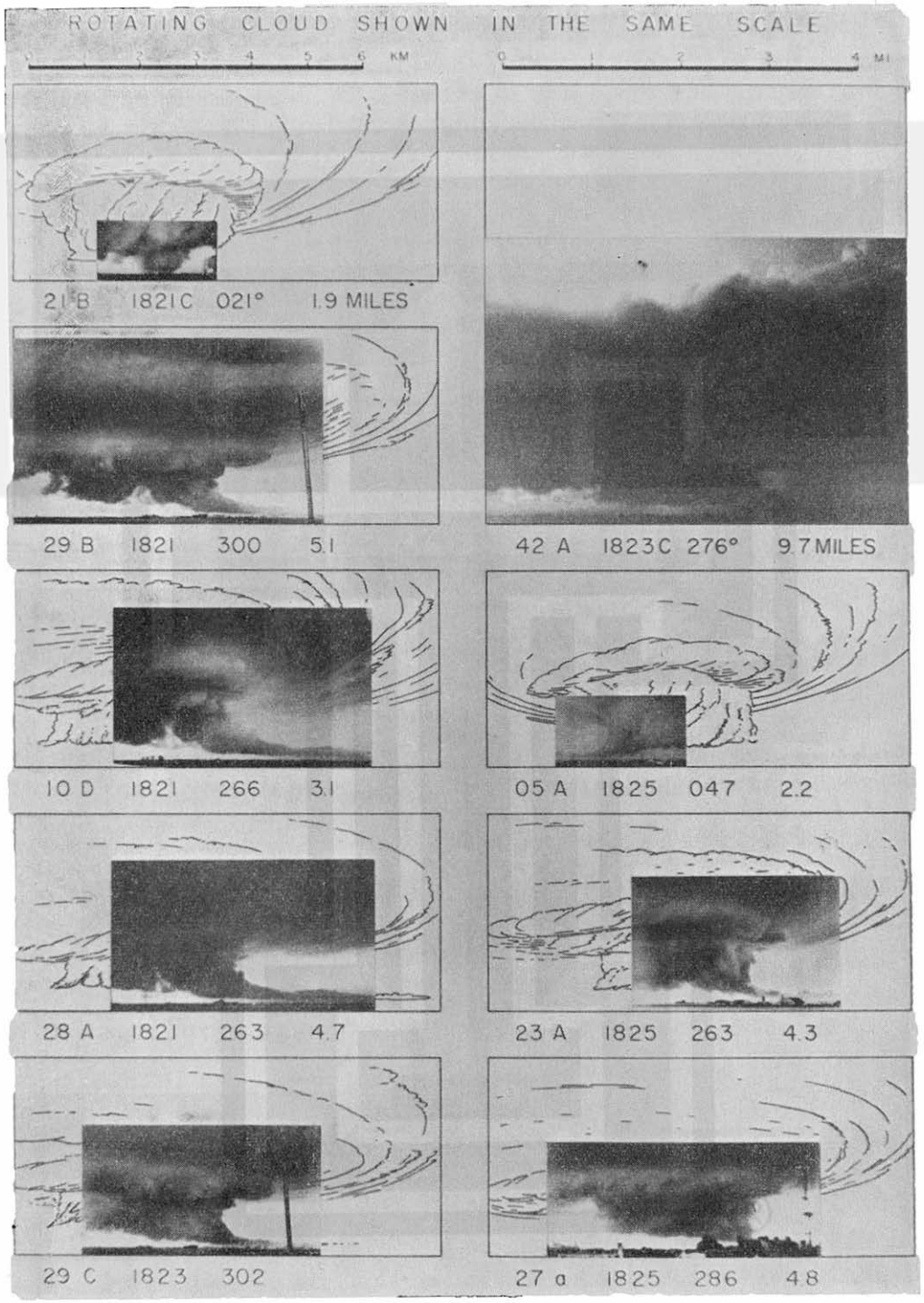
ROTATING CLOUD SHOWN IN THE SAME SCALE
0 1 2 3 4 5 6 KM
0 1 2 3 4 MI
21 B 1821 C 021° 1.9 MILES
29 B 1821 300 5.1
42 A 1823 C 276° 9.7 MILES
10 D 1821 266 3.1
05 A 1825 047 2.2
28 A 1821 263 4.7
23 A 1825 263 4.3
29 C 1823 302
27 a 1825 286 4.8

Fig. 5.

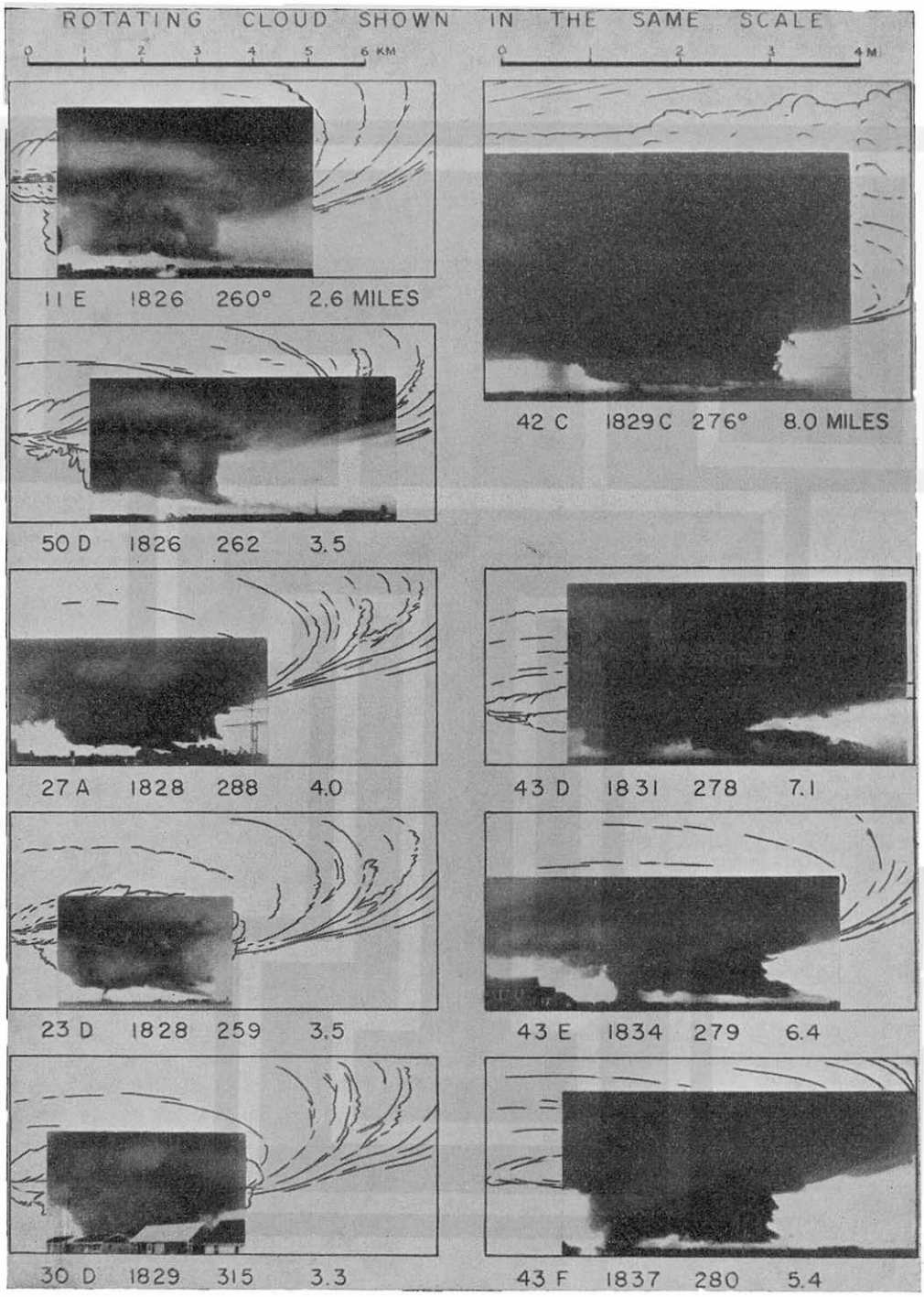
ROTATING CLOUD SHOWN IN THE SAME SCALE
0 1 2 3 4 5 6 KM
0 1 2 3 4 M
11 E 1826 260° 2.6 MILES
42 C 1829 C 276° 8.0 MILES
50 D 1826 262 3.5
27 A 1828 288 4.0
43 D 1831 278 7.1
23 D 1828 259 3.5
43 E 1834 279 6.4
30 D 1829 315 3.3
43 F 1837 280 5.4

Fig. 6.

about 10 miles west of Fargo. The sequence reveals that the stratus tail was developing during that period. Of interest is the shape of the tail in picture 20A, looking toward 051 degrees, which shows the stratus extending far away from the photographer, with its base lowering perspectively toward the northeastern horizon.

The stratus tail under discussion is again seen in picture 21B of Fig. 5. It was observed when looking toward 021 degrees. Between 1821 and 1825 CST the tail disintegrated and by 1828 CST it was almost gone.

The dramatic appearance of the Fargo tornado, at 1828 CST, was witnessed by many citizens. The funnel dropped to the left (south) of the cloud center (27A) and then gradually moved left, away from the rotation center of the cloud system. The last pictures of the series, 43E and 43F, reveal that the cone-shaped funnel reached the southern edge of the base of the rotating cloud.

CONCLUSIONS

The present paper shows photographic evidence of tornado-related circulation aloft, the diameter of which is much larger than a tornado itself and is comparable to the dimensions of hook-echo circulation frequently observed on PPI scopes.

Although an expected hole or eye at the center of the rotating cloud was not visible in the collected pictures, it is very likely that this rotating cloud possessed an eye at its center. Unfortunately, no radar picture or observation was made at any station close enough to reveal the existence of a hook-echo. It is assumed that a very low and dark cloud, about two miles in diameter, beneath the circulation center could be the one appearing as a hook or ring on PPI scopes.

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4. S. G. Bigler. Personal correspondence.

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