

went out to the railway in order to see the region observed the previous evening. I did not go out with great expectation, because the sky was rather cloudy and the weather very windy. To my great surprise, however, I could observe an exceptionally fine specimen of *fata morgana*. It was beyond my expectations in every respect. About a third of the sky was covered with cumulus clouds. The wind blew from north with a force of 3 (Beaufort scale), while it had been continually north, force 3 to 4, in the morning.

Observing the horizon from east through south to west, I saw all objects elevated and in great unrest. (Upper part of fig. 1.) At several places water surfaces appeared in lively movement; for example, immediately behind hut No. 3, as well as half way between this hut and the spot where I was standing. Also before wood No. 5 a water surface appeared and the wood was somewhat raised above it. The *fata morgana* was intense, particularly in that part of the horizon which was east of the sun, but it was most intense in the direction of solar vertical. The *fata morgana* extended thus over the whole southern horizon, but its most intense part moved with the sun. I observed this on several occasions, at noon, at 1.30 p. m. and 4 p. m., when, in the east, the mirage was much weaker.

At 4 o'clock in the afternoon I saw a water surface in agitation. Waves moved from west to southeast, and they were so large and the mirage was so intense that at times the *huts and hills appearing on an elevated position* behind the water surface disappeared. Hill No. 9 was not visible during the whole time. Wood No. 11 was extraordinarily interesting. From time to time parts of this wood disappeared and reappeared again, and the trees seemed to move from west to southeast. A double wavy movement could be discerned; one component up and down and one approaching to, and receding from, the observer. Of all objects, wood No. 11 was lifted most, and behind it a considerably greater distance I saw the church of Etyek aloft.

Beside the water surfaces mentioned, along the whole horizon, a large coherent water surface No. 16, appeared. Before wood No. 5 there was also a small water surface, behind which the wood detached from the ground, was standing entirely in the air. I estimated the elevation at least as high as the tree tops. No inverted image could be observed.

Before hill No. 7 there was a moving water surface. The hill itself showed a sight like that of the rising sun or moon when it is stretched out and extends at the side.² I saw this in the morning as well as in the afternoon, but it was more intense in the afternoon.

² Like Figure 37/c of Pernter's *Meteorologische Optik*, if we imagine the image of the sun, with its reflected image.

Looking northward I could distinctly discern St. Margaret's church, the mountain district of Tokaj, Eger, and Gyöngyös, and even with my feeble eyes I could see the sharp contours. But no *fata morgana* was visible in this direction.

About noon a herd of horses was driven to the draw well 2. When the horses traveled in procession, from time to time one or another of them, or the herdsman himself, disappeared for a moment, and I saw them at times farther forward or farther backward. It was a true cinema picture, rendered more complicated by the approach of the herd. Upon arriving at the watering trough near the well, the horses advanced like waves, then backed, then disappeared again. The herdsman with his horse also seemed to make an undulating movement, whereas in reality he stood at the same spot near the well; at times he seemed to move toward the east with the well for about two horse-lengths; at other times I saw him apparently farther back. This wavy movement was like that of wood No. 11—a very surprising phenomenon. After 2 o'clock the herd left the watering trough, the receding horses disappearing for some moments only to reappear again higher or lower, but I could not discern an inverted image of any object during the entire day. At 7 o'clock in the evening the phenomenon was very weak, the water surfaces disappeared slowly, and the calm view of the Hortobágy appeared once more.

Mrs. Adalbert Rác did not consider the phenomenon described above as of the finest. I consider it as a very interesting fact that on this day there was a lively wind (force 3), at times even stronger than force 4. The temperature was not exceedingly high, 82.4° F. (28.0° C.), and in course of the day the cloudiness increased until three to four-tenths of the sky was covered.

According to the records of the meteorological station at Nagyhortobágy from June 7 to July 31, *fata morgana* was observed on the following dates:

June 7 and 9.....	Very fine.
July 22 and 30.....	Do.
June 8, 18, 21, and 23.....	Fine.
July 21 and 31.....	Do.
June 12, 24, 25, and 30.....	Fair.
July 2, 3, 4, 5, 6, 10, 20, and 29.....	Do.

The *fata morgana* of July 22 was extraordinarily fine and lasted from 9 a. m. to 6 p. m. with a maximum temperature of 86° F. (30.0° C.), feeble east wind, relative humidity 25 per cent.

On July 30 from 10 a. m. to 5 p. m. a splendid *fata morgana* was seen, highest temperature 76.1° F. (24.5° C.), partly dull weather, brisk north wind, relative humidity 39 per cent.

MIRAGE IN LOWER CALIFORNIA.

Below is an account of a mirage seen by Observer James H. Gordon while on a trip to Lower California from Yuma, Ariz., his station, on June 26, 27, 1923:

"From Volcano Lake return was made to Mexicali for directions to reach Laguna Salada. Laguna Salada is a little known feature of this country. At its best it is a salt lake some seventy miles long and ten or twelve wide at the widest part. At its worst we judge it is a great salt flat of the same dimensions. It is fed by the drainage from the east slope of the Coast Range and the west slope of the Cocopahs and also, it is said, by occasional inflow from the Colorado at high water and from the Gulf at very high tides. Perhaps I should say that it lies in a

valley hardly bigger than itself, with the Coast Range on the west and the Cocopahs on the east. We had little difficulty in finding it. Coming over a saddle in the Cocopah Range, the Laguna Salada springs into view. As we saw it there was a fringe of white salt flat a mile to a mile and a half wide about a very blue lake that stretched away farther into the south than we could follow. Far to the south there was much mirage, floating mountains with the inverted image below, distorted shore lines, etc. But the lake was a lake, unquestionably.

"This view was from a point fully two hundred feet above the lake bed. We drove down to the northern end

of the lake bed and left the car, intending to walk out to the water. The moment we dropped down onto the white salt surface the water disappeared. We walked out nearly a mile. There was no sign of water. The glaring white salt beds seemed to stretch away for miles, far in the south mountains floated in the air upheld on their inverted images. We gave it up at last. The lake had been a mirage, of course. From the car it was again visible and as we climbed up the steep grade it took on the same outlines we had first seen. Stopping the car at the crest of the hill, we walked south along the ridge for half a mile. The lake seemed immovable and of exactly the same shape. It was a mirage, of course, but I wanted to be sure, so climbed down the hill again, across a mile of sand dunes, lake still there, and down onto the salt, and there was no lake—just the mocking distant mirage. I walked out for three quarters of a mile. Underneath the salt crust there is a black alkali composition, greasy. It got softer as I went out, walking was very hard, temperature was 106 or more, not a breath of wind. I had to give it up. Coming back I passed a gasoline launch securely tied to a post fully a mile from the apparent water. The minute I was back on the dunes there was the lake. Fellows who had watched me from the top said I had gone but half way to it.

"We were getting short of time so turned back to Calxico. Stopping at the office of the Imperial Irrigation District there, I talked with Mr. Maddox, the assistant engineer. He said that there was almost certainly water in the Laguna Salada and just about where it had appeared to us to be, and not to be, as that was the lowest part. Apparently it was water. The white salt surface seems to have created a mirage of its own, and hidden the water."

SMALL TORNADES NEAR CHEYENNE, WYO.

By GEO. W. PITMAN.

[Weather Bureau, Cheyenne, Wyo., June, 1923.]

Two small storms, evidently tornadoes, occurred near Cheyenne, Wyo., on the afternoon of June 2, 1923. The one that passed about 2½ miles to the southeastward of the city was seen by dozens of people, some of whom became much excited.¹ When first observed the funnel was at an altitude of about 40°, probably 45°, almost directly southeast of the local office. This was at 2:55 p. m., local time, and it had then the appearance of a long needle extending straight downward from the clouds, which soon assumed the shape of a long radish or carrot about 40 feet long and 2 feet in diameter, dangling from the clouds above. The storm moved north-northeastward over a path about 10 to 30 feet wide and about 3 miles long. At 3:10 p. m. the funnel was about 10° long, the bottom not reaching the ground, and the top approximately 35° above the horizon, and at 3:16 p. m. the clouds were apparently quiet. The funnel changed its appearance several times during its march. During the first and last parts of the storm it looked like a long smoky-black pillar standing almost vertical and reaching from the clouds to the earth. At another time when about one-third way in its march, it had the appearance of two cones set point to point, the bottom cone being nearly twice the size of the upper one and moving about 5° or 10° in the rear of the upper part of the upper cone.

As the storm moved over open country, the only damage was gaps torn in a few fences. At one point a barbed

wire was wrapped six times counter-clockwise around a post and an end about 15 feet long left dangling. A light southwesterly wind of 13 miles an hour prevailed at the local office during the passing of the storm. A special observation at the time showed a barometer reading of 29.78 inches and a temperature of 70°, with a temperature of 73° at 2:00 p. m., and the temperature returned to 73° at 4:00 p. m. The barograph trace showed a gradual fall of 0.03 inch from 2:00 p. m. to 4:00 p. m. there being no surge whatever. A light sprinkle fell for about 15 minutes previously to the forming of the funnel, but very little during its passing, and the few drops of rain and hail that then fell were quite large, averaging from filberts to English walnuts in size. The first thunder heard was about the time or a little after the formation of the funnel and was apparently nearly overhead. The clouds immediately preceding the thunder were a smoky-black strato-cumulus type, with many individual clouds that gathered quickly, and a background of lower clouds, but higher, of a gray color. (Some state greenish but the writer saw no green.) No peculiar noises were heard, but these may have been counteracted by the railroad yards that lay in the southeast part of the city.

Another storm preceded this one by a few minutes. The few who saw it stated it moved east-northeastward over a path about 10 miles long and less than 40 feet wide, breaking up in the low hills about six miles northeast of Cheyenne. This storm also had a well defined funnel. It struck the barn on the Ever's ranch, doing about \$200 damage.

TORNADES IN NEW MEXICO, JUNE, 1923.

CHARLES E. LINNEY, Meteorologist.

[Santa Fe, N. Mex., July 16, 1923.]

Two small tornadoes occurred in the State during the month of June, 1923. The first, on the afternoon of the 7th, was observed at the ranch of Mr. A. R. Gray, 6 miles southeast of the village of Moriarity, Torrence County, N. Mex. The day was reported very cloudy, with rain to the west and a hard east wind during the forenoon. A cloud, which seemed to be different or separate from that from which the rain was falling, came up from the southwest at 1:35 p. m. Apparently there was no thunder, lightning or rain, but the pendent-shaped cloud was plainly visible and it left a plaster of mud over everything in its path. It traveled a distance of 7 or 8 miles, hit one farm house (country is very thinly settled), that of Mr. Gray, destroying it, with all household goods and some outbuildings. The loss is given as about \$2,000. Mr. Gray reports that he only saw it strike the ground twice before it reached his place, when it moved on the ground for about a half mile. Hail occurred to the west of his place and a hard rain in the foothills far to the west.

The second storm occurred at Roswell on the afternoon of the 8th.

It has been the opinion of the people of the State that tornadoes do not occur within its confines, but two (or more) well-defined tornadoes were reported last year and thus far two have occurred this season, so that public opinion is in error in this matter.

(See following account by Mr. Cleve Hallenbeck.)

¹ Mr. Pitman's account of the two tornadoes observed near Cheyenne is welcomed, since it shows, first of all, that these storms in the dry regions of the West are much like overgrown whirlwinds and have none of the destructive characteristics of those which occur in more humid climates. The occurrence of similar storms in eastern Colorado and eastern New Mexico seems to fix definitely the western limit of tornadoic storms along the eastern foothills of the Rocky Mountains.—EDITOR.