

## Reply

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I thank E. W. Ferguson for the corroborative evidence he uncovered regarding both the intensification of the unnamed August 1970 hurricane and the size of the area of maximum winds associated with the hurricane.

I am pleased to note that the National Weather Service now officially recognizes an intermediate cyclone category between tropical and extratropical. The implication in Ferguson's correspondence is that the August 1970 hurricane belonged to the intermediate category. For reasons already discussed (Spiegler 1971), I believe the storm should have been classified as tropical for most of its life.

I am in basic agreement with the suggestion that intensification of semitropical cyclones is due partly to baroclinic energy sources and that the further increase in intensity of the storm on Aug. 18, 1970, from that of the previous day may have been both a baroclinic and tropical development. However, the main point from my analysis of the storm is that all available data indicates that the initial strengthening to tropical storm and hurricane intensity on August 17 and early on August 18 was due primarily to release of latent heat associated with the organized convection that was apparent from satellite pictures. On that day, the storm was located entirely within a maritime tropical air mass with no baroclinic zone in evidence in the vicinity of the storm. Thus, data through early on August 18 supports the conclusion that the storm was tropical in nature. During the day of August 18, the sequence of pictures from the ATS 3 satellite showed the storm as a separate entity in the morning, but it began to merge with a weak cold front by midday; that is, it was gradually losing tropical characteristics during the day.

The piece of information that is apparently an absolute requirement of the National Hurricane Center (NHC) before the occurrence of a tropical storm is "officially" recognized, is data showing the thermal structure of the storm in the low and midtroposphere to be warm core. Unfortunately, no aircraft reconnaissance was scheduled to fly into this "strong tropical depression"<sup>1</sup> that was predicted by NHC to move east-northeastward over the

warm waters of the Gulf Stream off the east coast of the United States on the afternoon of August 17. Sometimes, even with aircraft reconnaissance data indicating a warm core system for a period greater than 24 hr (as in the case of the unnamed October 1970 hurricane I discussed), NHC does not designate the system as a tropical storm.

One other comment with regard to Ferguson's correspondence is related to the inference (in his last sentence) that hybrid-type cyclones are necessarily small. There are no physical or dynamical reasons why the atmospheric processes that initiate and sustain development of intermediate-type cyclones should be limited to the small end of the synoptic scale. This is borne out by documentation of past occurrences of semitropical cyclones; for example, hurricane Jenny (Dunn and Staff 1962) which was described as "only quasi-tropical". It had "winds of hurricane force near the center but gales extended outward as much as 600 miles to the north and 300 miles to the south. This was evidently due to reflection in the surface pressure gradients of the upper Low, and not to a true tropical development." Also, unnamed storm number 2 (Spiegler 1971) was described in an NHC bulletin as a "large subtropical storm" (gales covering an area 300 n.mi. in diameter). Tropical, frontal, and intermediate-type cyclones have been known to occur within a broad spectrum of sizes ranging from less than 100 n.mi. to greater than 1000 n.mi. across. Thus, size should not be an integral part of the definition of the intermediate-type cyclone.

In the future, more reconnaissance data on the intense, circular ocean storms that form primarily in the subtropics will allow specific determination as to which storms are really tropical and which ones are only semitropical.

### REFERENCES

- Dunn, Gordon E., and Staff, "The Hurricane Season of 1961," *Monthly Weather Review*, Vol. 90, No. 3, Mar. 1962, pp. 107-119.
- Spiegler, David B., "The Unnamed Atlantic Tropical Storms of 1970," *Monthly Weather Review*, Vol. 99, No. 12, Dec. 1971, pp. 966-976.

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<sup>1</sup> This description was given by NHC in the tropical weather outlooks for Aug. 17, 1970.