of $-5.8°$ C km^{-1}, but the gradient in the layer below the tropopause is $-7.3°$ C km^{-1}. It is thus a marked difference between the layers. It must not be forgotten that the definition of the tropopause used by the Meteorological Office in the daily service is to some extent arbitrary and formal and may sometimes lead to wrong conclusions.

Finally I want to thank Dr Bannon for the interest he has shown in my paper and I am glad that a discussion has arisen out of it.

ROY BERGGREN

REFERENCES

PALMÉN, E., 1951: The Aerorology of Extratropical Cyclones. Compendium of Meteorology, *Am. Met. Soc.*, Boston, p. 599—620.

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Dear Sir,

The article "The Distribution of Temperature and Wind Connected with Active Tropical Air in the Higher Troposphere and Some Remarks Concerning Clear Air Turbulence at High Altitude" by Roy Berggren in the February 1952 issue of Tellus, has recently been drawn to my attention.

I do not wish to comment here on Mr Berggren's claim that clear air turbulence is essentially associated with the presence of a frontal system in the upper air, as I understand that this will be covered in a separate communication from Mr Bannon.

However, I would like to point out that in my view figure 10 in my paper to the Royal Aeronautical Society (mentioned on page 52 of Mr Berggren's paper) does not give the impression that the turbulent area is associated with anticyclonic wind shear. In fact, my interpretation of the figure is that, if anything, the shear is cyclonic. In any case, no mention of the character of the wind shear is mentioned in the text. The figure shown is merely illustrative of typical conditions and rather than show a chart which we might have prepared specially, I preferred to use the chart as published in the Daily Weather Report.

Yours faithfully,
G. S. HISLOP.
Ruislip, Middlesex
11 September 1952

Reply

Dr Hislop is opposing to my comments on one of his figures of the paper cited by me. I do not quite understand his objections and for this reason I shall give a short discussion of the sign of the horizontal wind shear on his figure.

The radiosonde station Liverpool (03322) gives the wind 200° 129 knots at 300 mb at a height of 29,200 feet. Station Larkhill (03743) gives 200° 115 knots and the height 29,700 feet. Isotach analyses by many authors (e.g. NEWTON, PHILLIPS, CARSON, and BRADBURY, 1951) give as a rule the jet centre quasi-parallel to the isohypses, in cases without strong accelerations. Thus, in this case, the centre of the strong winds must pass to the west of the indicated turbulent area. In any case, I consider it impossible to get cyclonic shear through this area.

The most serious objection, however, to the discussed figure is the time difference between the chart and the observation of clear air turbulance. As I pointed out in my paper the chart time is 0300 GCT, while the observation was made at 1300 GCT. Studying the change of the wind from 0300 to 1500 GCT one gets the following interesting values. At 350 mb the Liverpool wind changed from 200° 122 knots to 230° 78 knots, while the corresponding values for Larkhill were 200° 111 knots and 200° 102 knots, respectively. The Downham Market (03476) sounding gave at 1500 GCT 210° 109 knots (unfortunately the 0300 GCT sounding did not reach the 350 mb level).

This distribution of the wind makes it quite clear that the horizontal (isobaric) wind shear was cyclonic at the time of observation over the area where clear air turbulence was observed.

I cannot quite understand the reason to publish a 0300 GCT chart to illustrate the conditions at 1300 GCT, when there are soundings made at 1500 GCT. I know that the 300 mb charts for that time were not published in the Upper Air Section, but that is not a sustainable explanation for the choice.

It is quite true that nothing specific is said in Hislop's paper about the sign of the shear, but this question has been brought up in later papers. For that reason I considered it important to make these remarks, as Hislop's paper will be classic in this field and is and will be read by many persons.

ROY BERGGREN.

REFERENCE

NEWTON, C. W., PHILLIPS, N. A., CARSON, J. E. and BRADBURY, D. L., 1951: Structure of Shear Lines near the Tropopause in Summer. *Tellus*, **3**, p. 154—171.