THE GEOMETRY OF CIRRUS BANDS AS RELATED TO METEOROLOGICAL CONDITIONS

- Part II: Figures -

By

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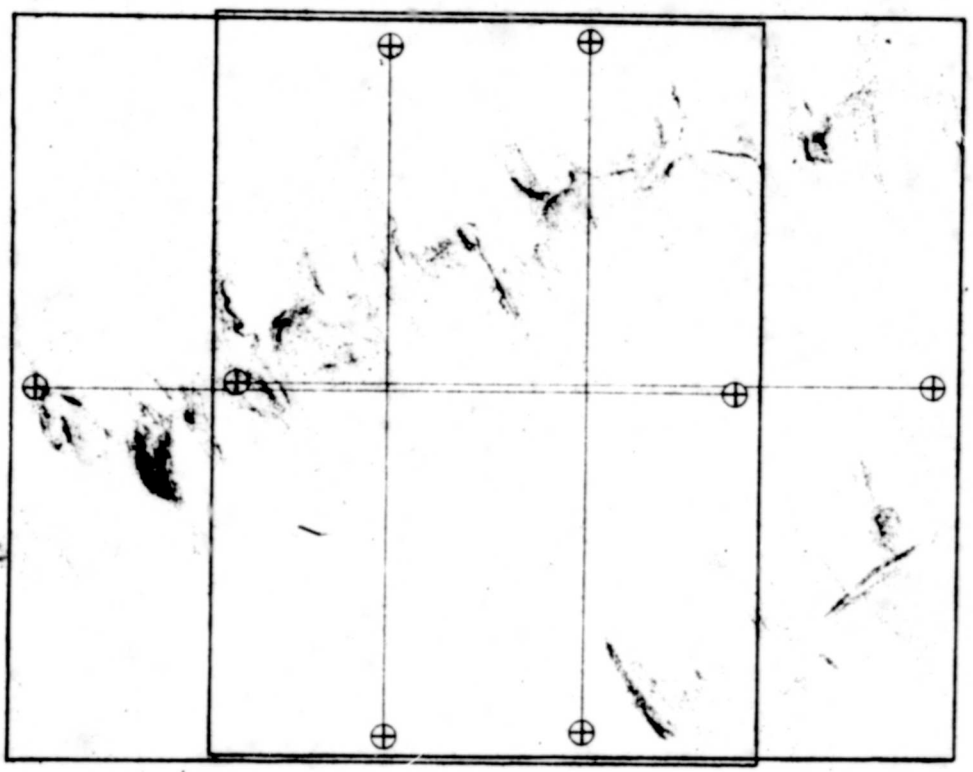
DEUTSCHEN VERSUCHSANSTALT FÜR LUFT- UND RAUMFAHRT E.V. (DVL), Außenstelle Darmstadt



Final, Scientific Report
prepared for the EUROPEAN OFFICE OF AEROSPACE RESEARCH
of the AIRFORCE CAMBRIDGE RESEARCH LABORATORIES
under
Contract AF 61(052)-620 new
contractor: Prof. H. KOSCHMIEDER
July 1964

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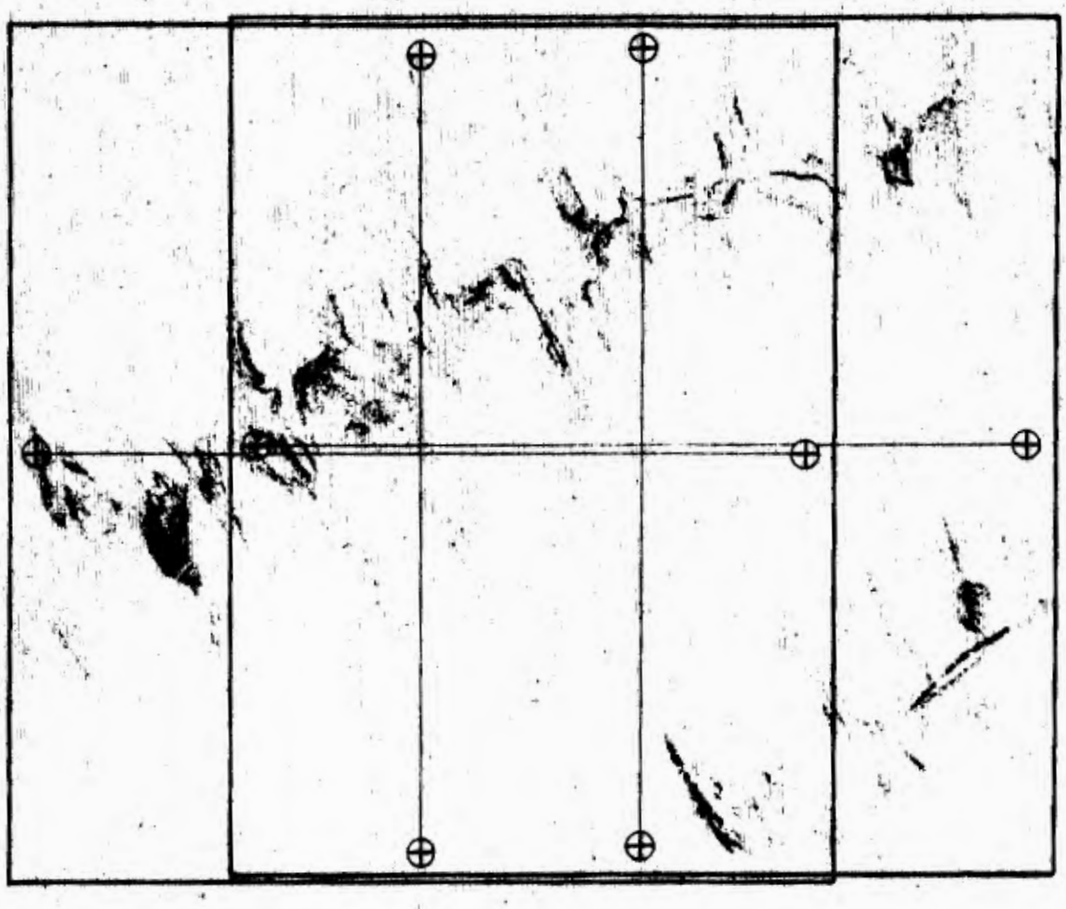

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The report summarizes the results obtained within two years of photogrammetric cloud studies mainly devoted to cirrus bands.

- 1 -

General explanation of the figures in part II of this report.

Figures which refer to the case studies were gathered up in this separate volume in order to facilitate their and the current text's study.

(1) The figures were numbered separately for each case; thus in case study I, Figs. 1 to 39 are involved; case study II involves Figs. 1 to 19, etc.

(2) Cases where stereo viewing yields a good spatial impression, such as in case studies I, II, III, V and VI, were furnished with a total of 10 stereo pair photographs. The mean distance of identical points was chosen 63 mm, equal to common eye distance. Since proper stereo glasses are not everywhere available and - - moreover - - stereo impression is often more clear without them, it is advised to view stereo-pairs with bare eyes, if possible. The method to achieve this is not difficult, yet hard to explain for the individual case. In general, one succeeds by focusing the eyes to infinite, with parallel axes of vision. With some exercise, a stereo view, not sharp yet, is immediately obtained; then, one must focus back to the plane of the photograph, without loosing parallelism of eye axes. If this does not yield a stereo impression, the advice of a photogrammetrist could be asked for.

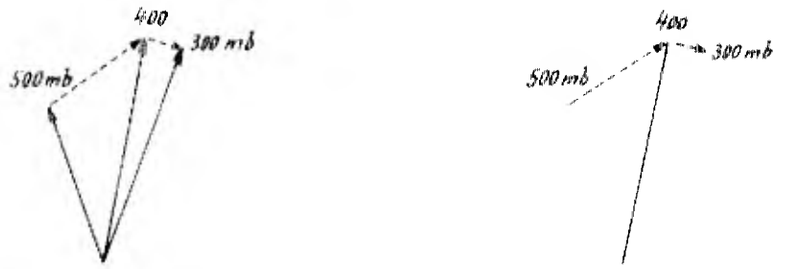
(3) Below maps of weather analysis, the dimensions of the parameters were indicated (e.g. [-°Celsius], [gpm], [$\frac{\text{gpm}}{\text{degree}}$], etc.) in the text, which gives a formal description of the figures.
In each of the weather maps, the location of Darmstadt is marked by a small circle.

(4) In the interest of a uniform treatment, all wind cross sections were charted to lie nearly perpendicular to wind to the effect that - - except for case I - - the wind blows "from the reader into the plane of the figure".

(5) The amount of cloud cover, in isopleth charts, is denoted in units of 1 (= one eights), "8" corresponding to 100% (overcast). In a few cases, cirrus cover could clearly be marked from additional kinds of cloud cover.

(6) Wind hodograms were charted especially to show vertical wind shear and to deduce by them the profiles of the relative wind.
In order to grant a better survey of these wind conditions,

the wind vectors, except for either that of 400 mb or 300 mb, were omitted. This is explained by the following scheme:



original hodogram ⟶ yields this mode of representation

The wind shear thus obtained is of correct direction (within common measurement errors), but naturally not of correct amount; the latter has to be determined seperately for each interval by the well known definition of vertical shear amount,

$$|S| = \frac{|\mathfrak{u}_{i+1} - \mathfrak{u}_i|}{\Delta z},$$

where $\mathfrak{u}_{i+1}$ denotes the wind vector at a level higher by Δz than the wind vector $\mathfrak{u}_i$.

List of aerologic stations and their numbers concerning the wind cross sections:

03 496	Hemsby		10 393	Lindenberg	
03 772	London		10454	Wernigerode	
06 260	de Bilt		10 486	Wahnsdorf	
06 447	Uccle		10 513	Köln	Kö
06 476	St.Hubert		10 618	Idar-Oberstein	
06 610	Payerne		10 633	Wiesbaden	Wi
07 151	Paris		10 639	Darmstadt	Da
07 180	Nancy		10 739	Stuttgart	St
07 354	Chateauvoux		10 866	Munich	Mü
07 480	Lyons		11 036	Vienna	
07 510	Bordeaux		12 840	Buda-Pesth	
10 203	Emden	E	13 274	Belgrade	
10 338	Hannover	Ha	Bi	Bitburg	
10 382	Berlin	B	Dz	Danzig	

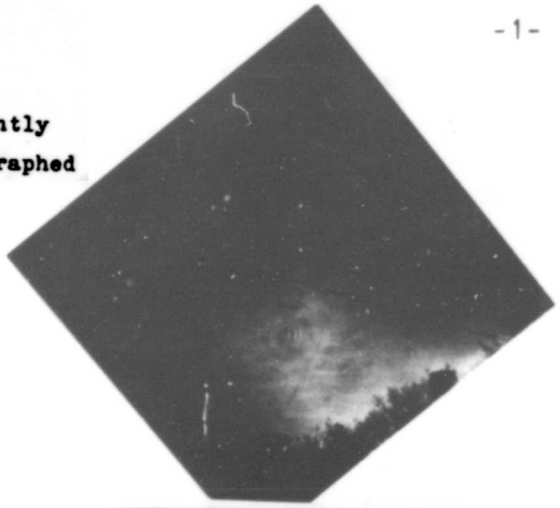


Fig. 1 : 13 May 1963, 7:15 : Faintly visible oi-band, photographed toward North.

Fig. 2 : 13 May 1963, 8:15 : oi-bands, taken toward 172°.

Fig. 3: 13 May 1963, 8:45 : Part of photograph taken toward 153°. Arrow marks same point as in Fig. 2.

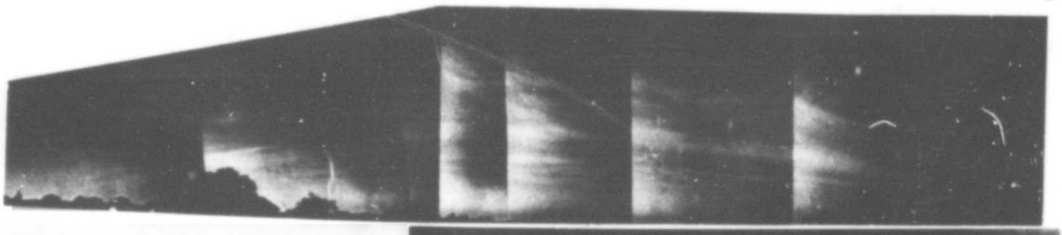


Fig. 4: 13 May 1963, 8:30 : S → W → N - panorama.

Fig. 5 : 13.May 1963, 9:00 : Photograph toward ENE.

Fig. 6a,b : 13 May 1963, 9:15 (center), 9:30 (below): Photographs toward 332°.

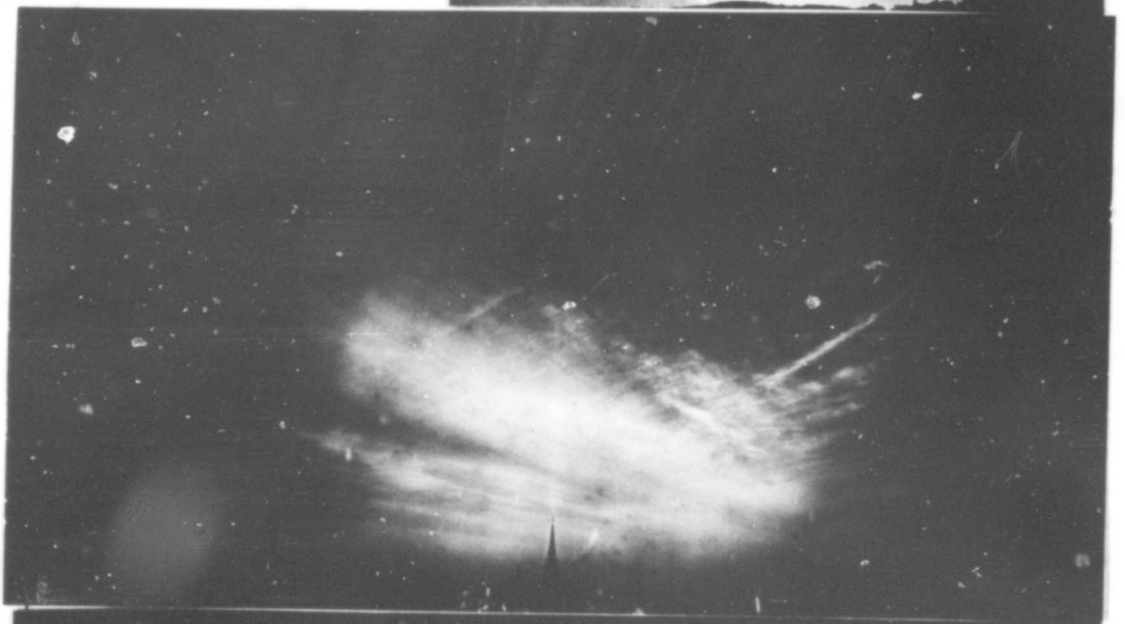


Fig.7a: 13 May 1963 10:00 : Photograph toward zenit, taken with eastern camera.

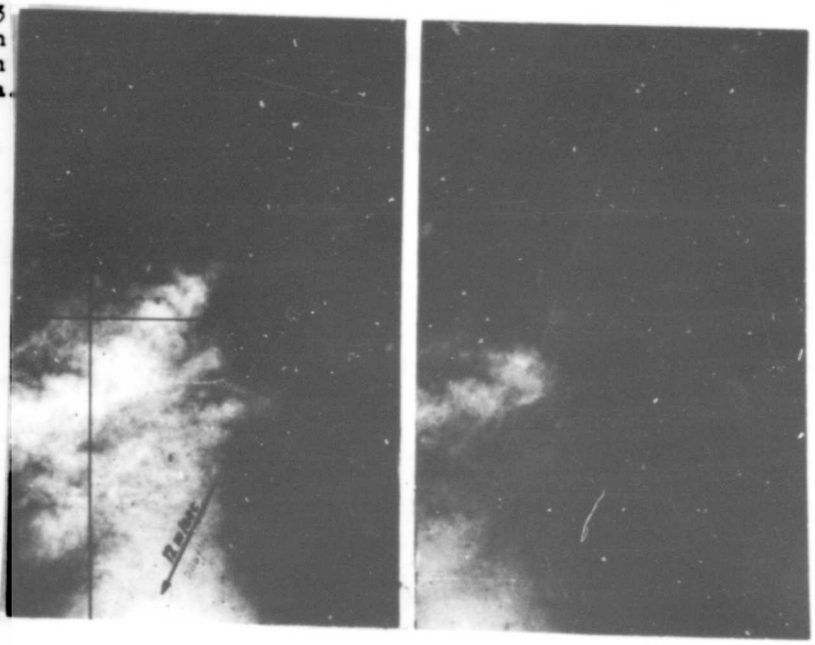
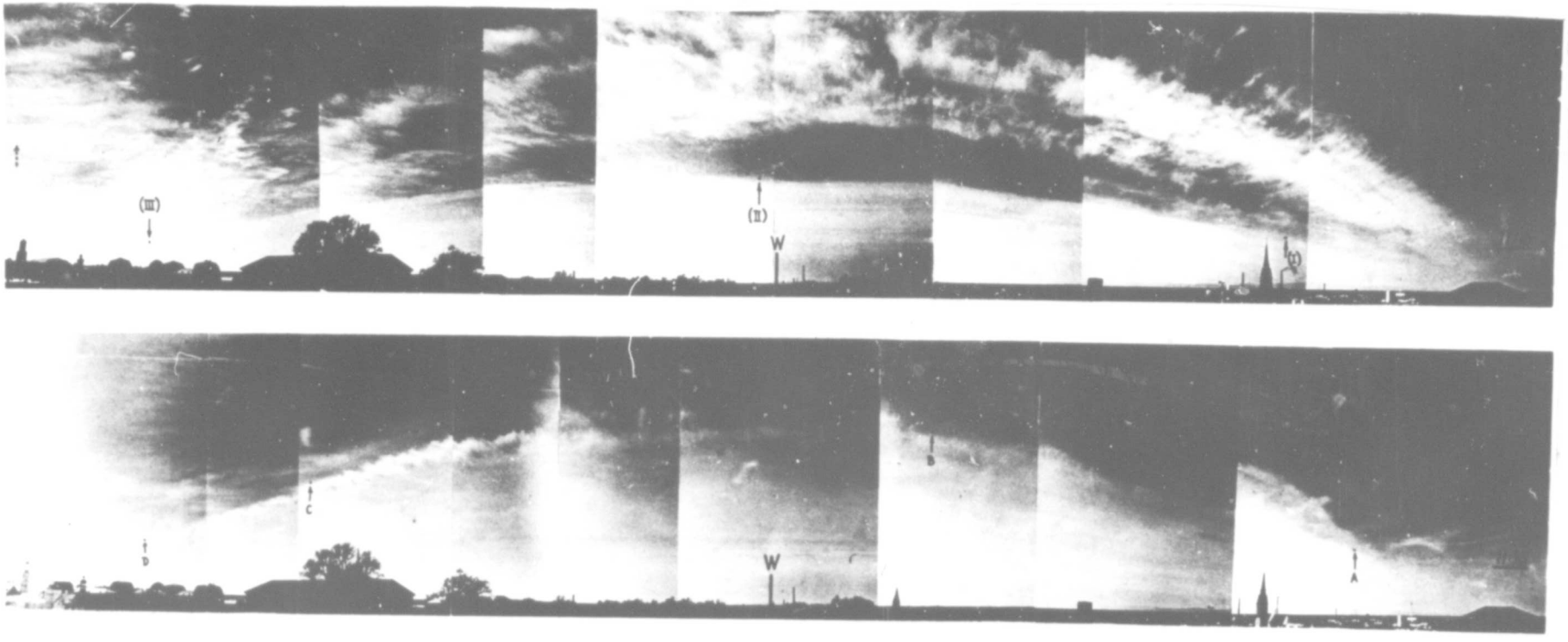


Fig.8: 13 May 1963, 11:00 : Stereo-photograph toward zenit, narrow ci-bands at 10.65 km.

Fig. 9a :
13 May 1963, 11:33 :
Topography of narrow ci-band and fallstreaks, and cloud parts at higher altitudes [km above sea level].

Fig. 9b :
Stereo-pair of band portion depicted in Fig. 9a.



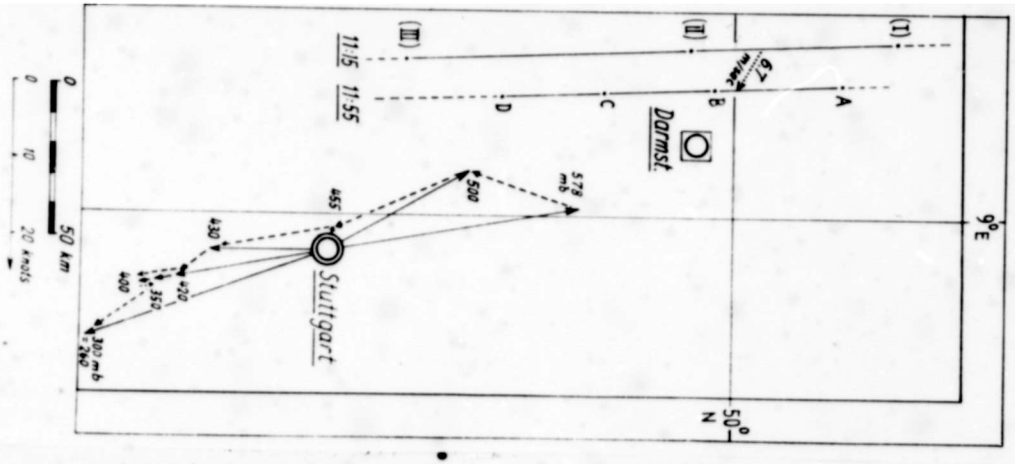
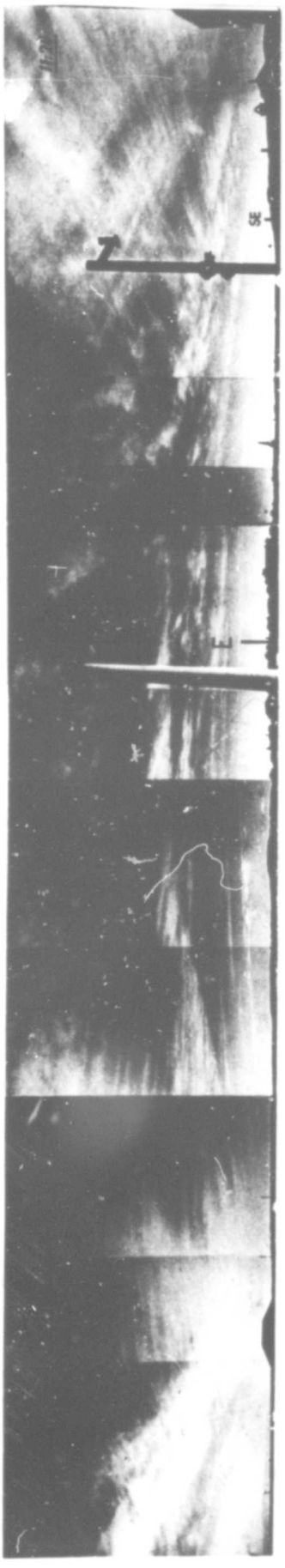


Fig. 10: 13 May 63, panoramas at 11:15 (above) and 11:55 (center): Points I, II, III and A, B, C, D at the edge of slowly (6.7 m/sec) approaching ci band system (7.0 km altit.) were mapped (below, for rectification, the earths curvature was taken into account). Although the identity of the edge is not quite certain, the good agreement of its measured motion velocity with that obtained from the subsequent stereo measurements suggests that no essential changes, e.g. due to convection, took place within the 40 minute interval.

The map also contains wind vectors of the original ascent at Stuttgart, 12:00; shear directions dashed.



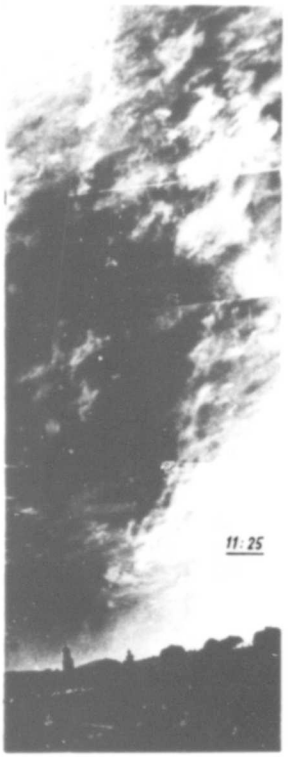


Fig. 12 : 13 May 63, 11:25 : Part of zenit-to-south panorama.

Fig. 11 : 13 May 63, 11:20 : N → E → S panorama.

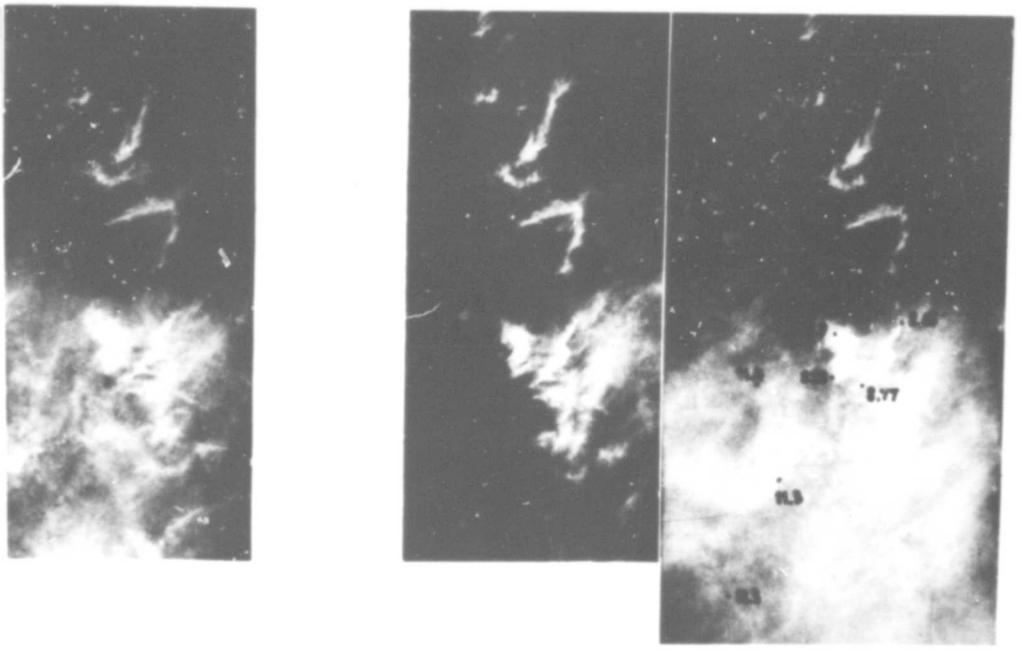


Fig. 13: 13 May 1963, 11:50: Stereo pair and topography of single narrow band.

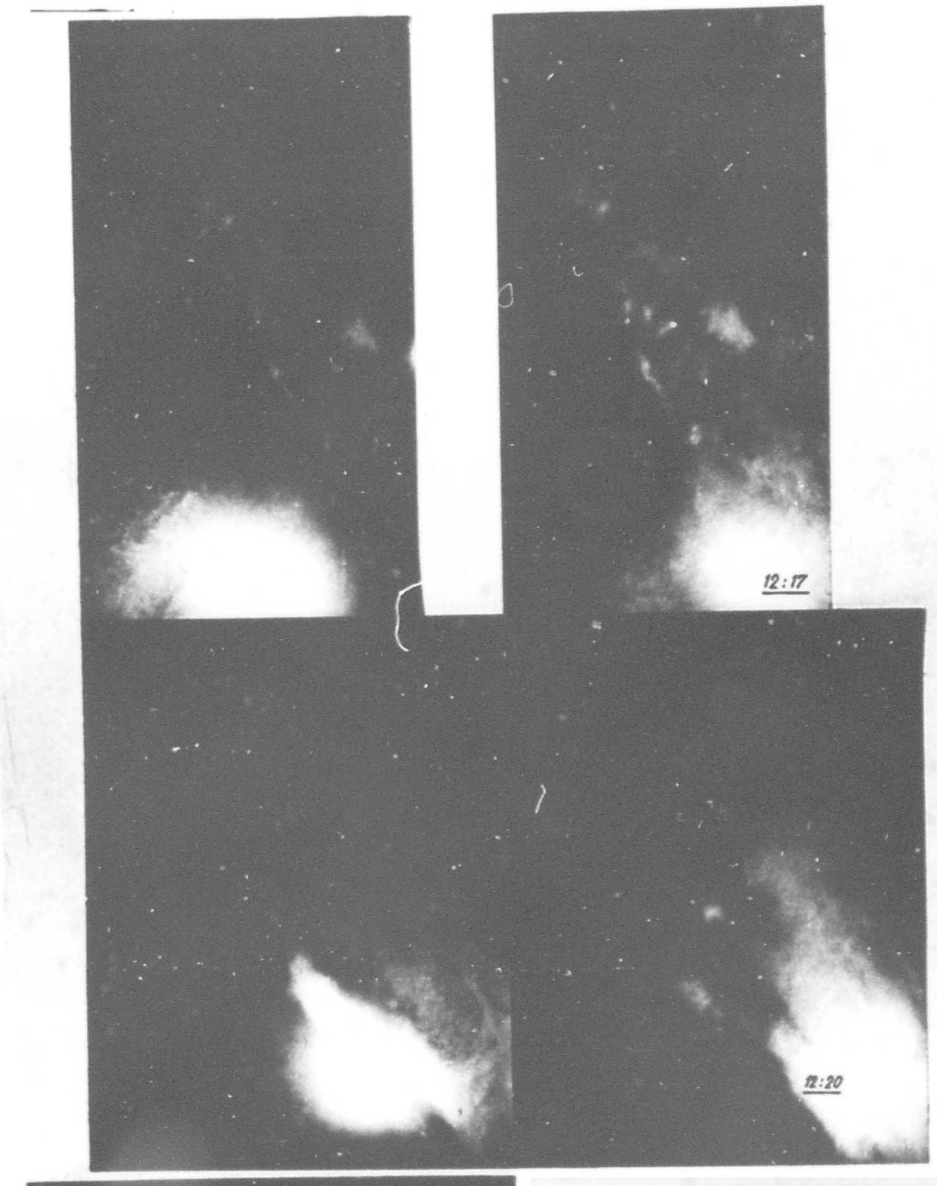


Fig. 14a: 13 May 1963: Stereo pairs toward zenit, depicting the same cloud portions three minutes apart. Note the rapid change in the lower cloud (at 7.0 km).

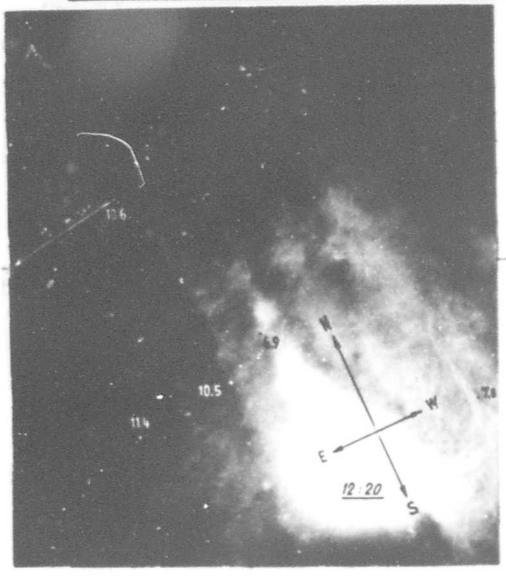


Fig. 14b: Topography of three different clouds at levels 7.0, 10.5 and 11.4 km, with motion vectors.

0 scale at 10.0 km altitude 5 km

Fig. 15a: 13 May 1963, 13:40: Photograph toward 120°.

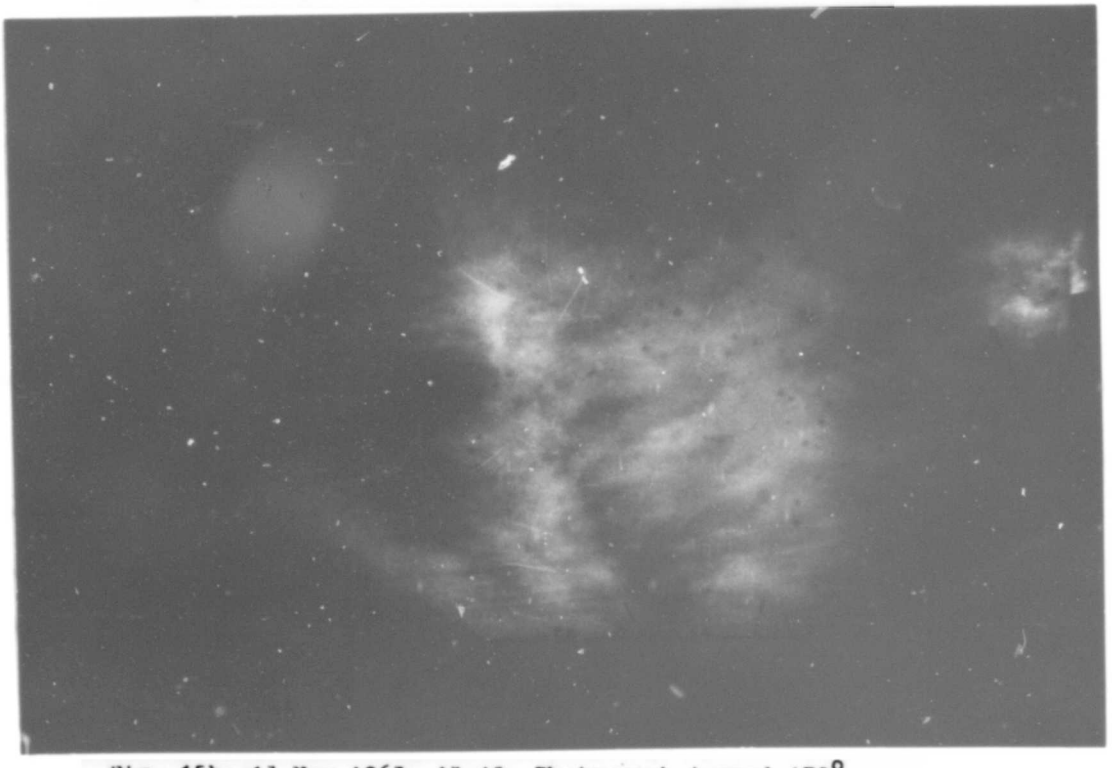
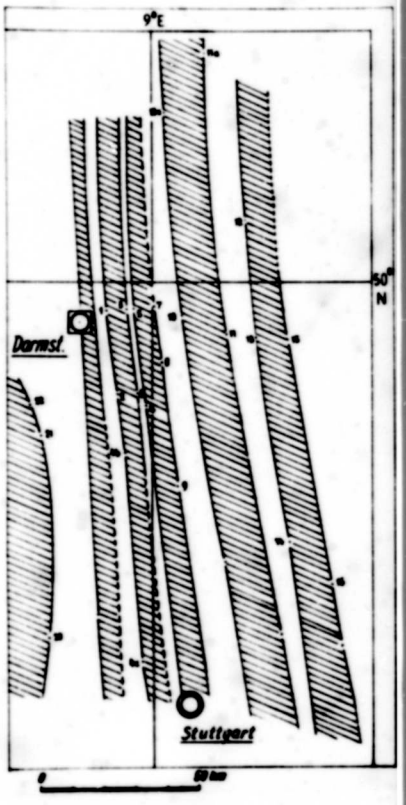


Fig. 15b: 13 May 1963, 13:40: Photograph toward 170°.



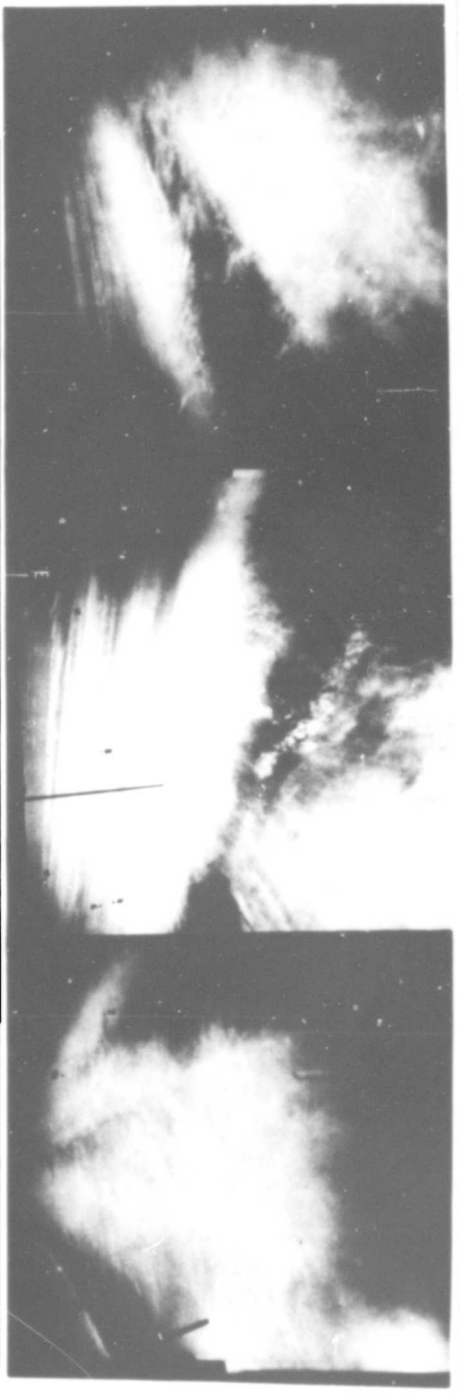
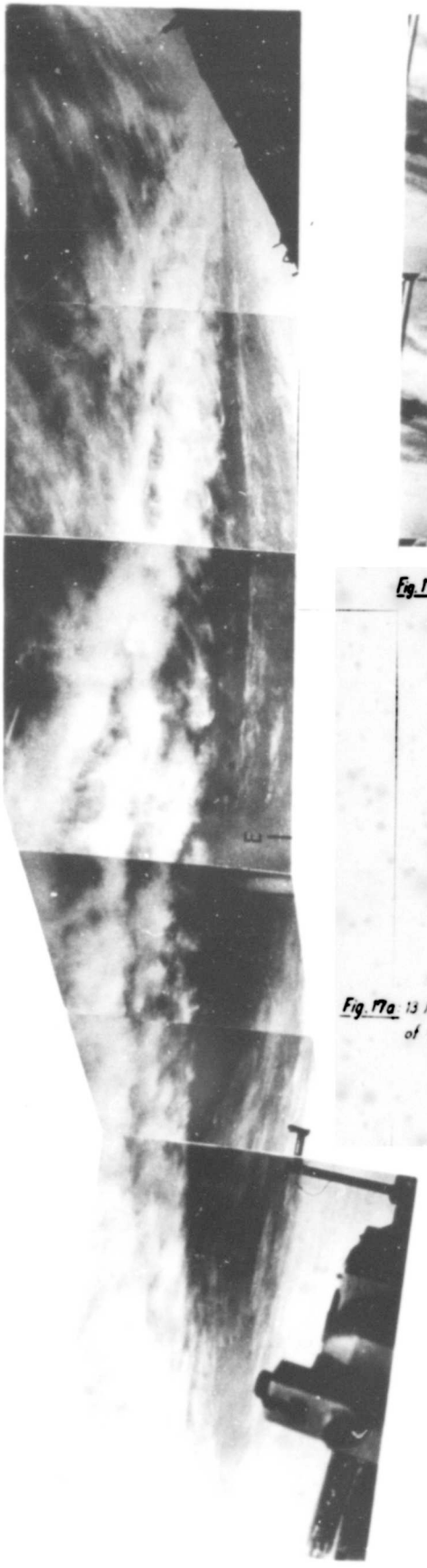


Fig. 16 : 13 May 1963 : N→E →S panorama, taken by the western camera at 13:40. At this time, bands moved at right angle with respect to their orientation.
For identification, some of the cloud points used for rectification were numbered both in photographs and map.



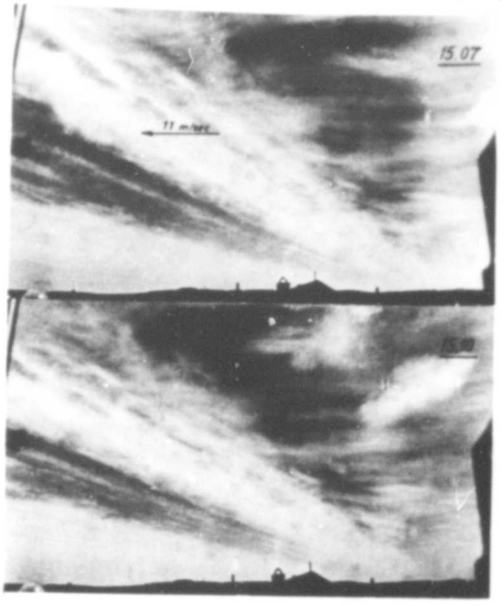


Fig. 17b: 13 May 1963 : Part of a single picture sequence, taken toward 156°, 15:07 through 15:16, at 3-minute-intervals.
Motion vector of large bands at 6.8 km : 251°, 11 m/sec
" " " ac lent " ≈ 3.3 km : 210°, 5 m/sec

Fig. 17a 13 May 1963 : N→E→S panorama, 15:05 : Note the existance of strong convective activity within the band in the foreground

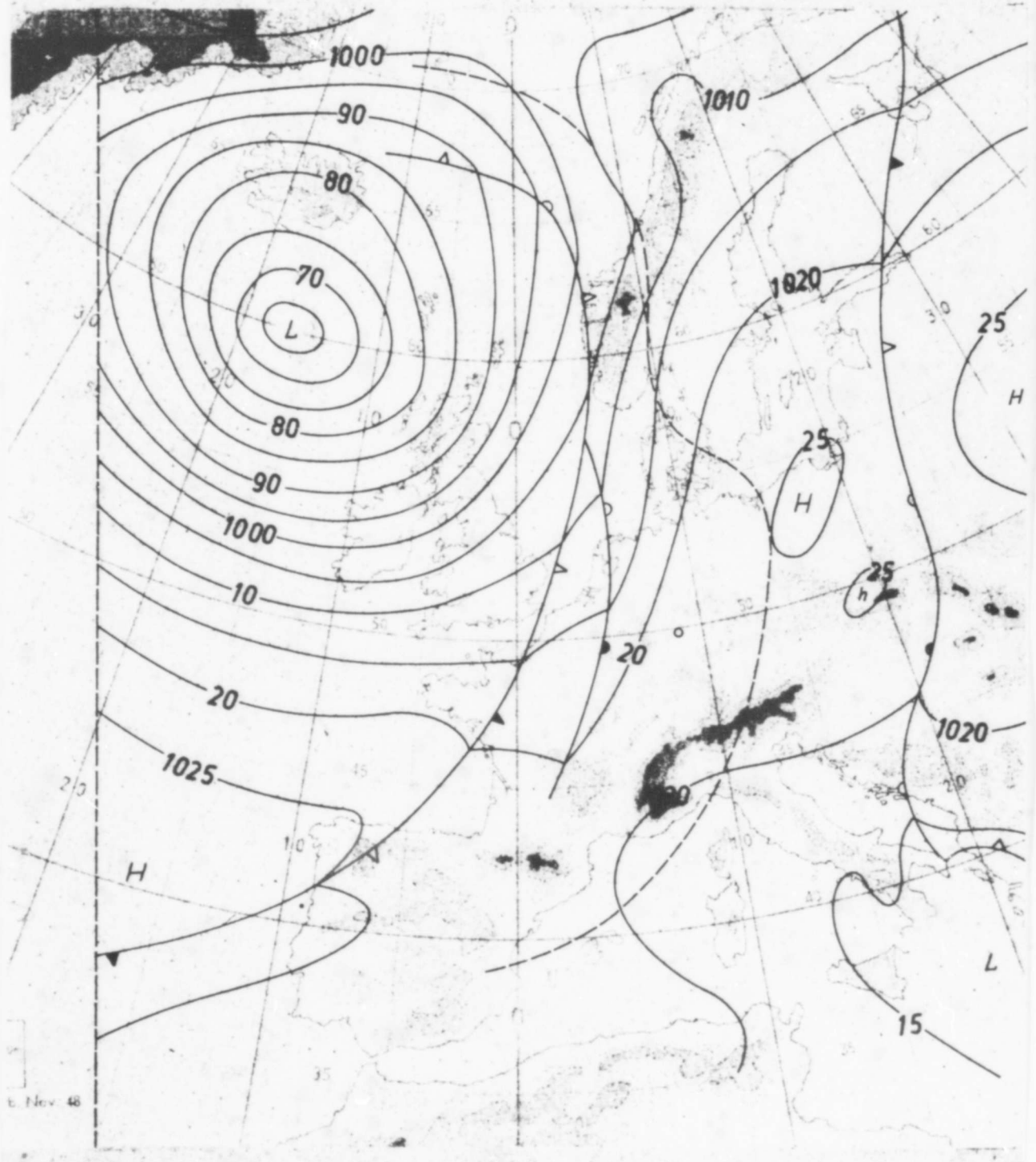
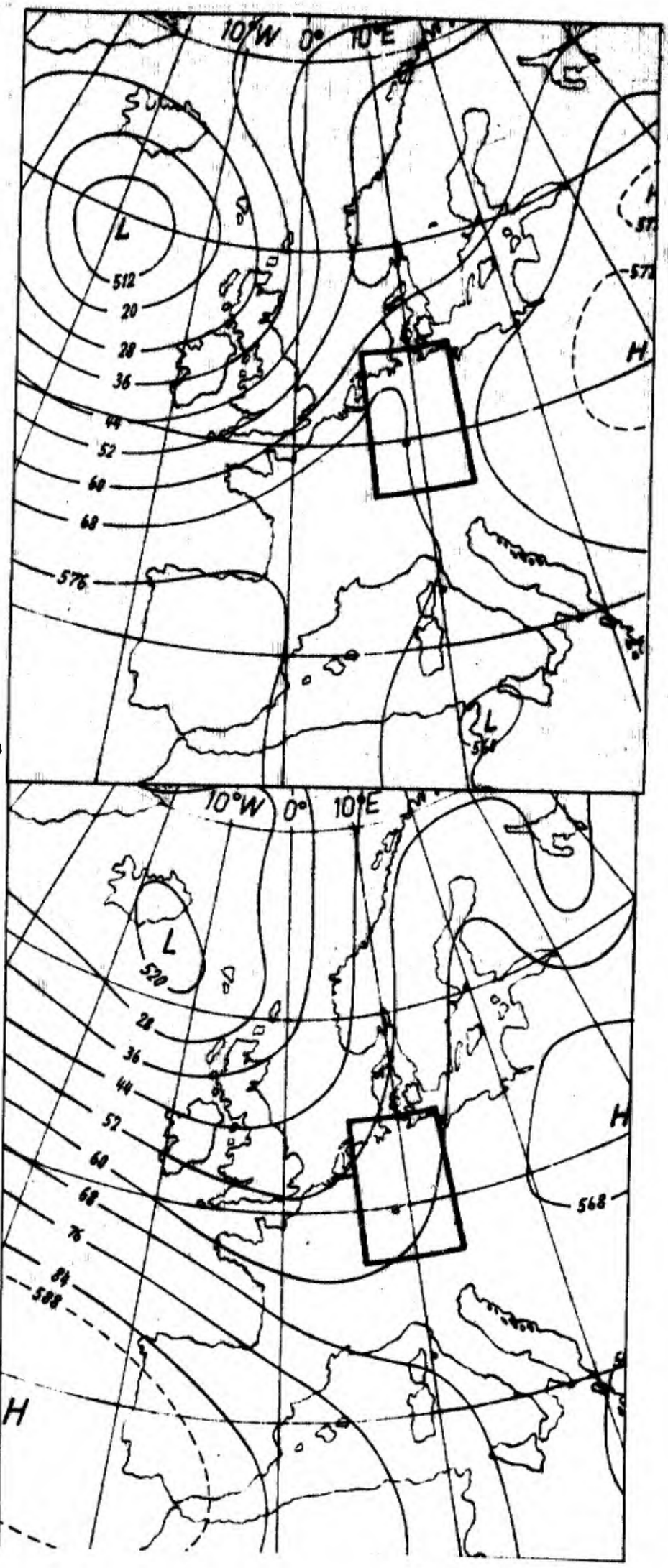


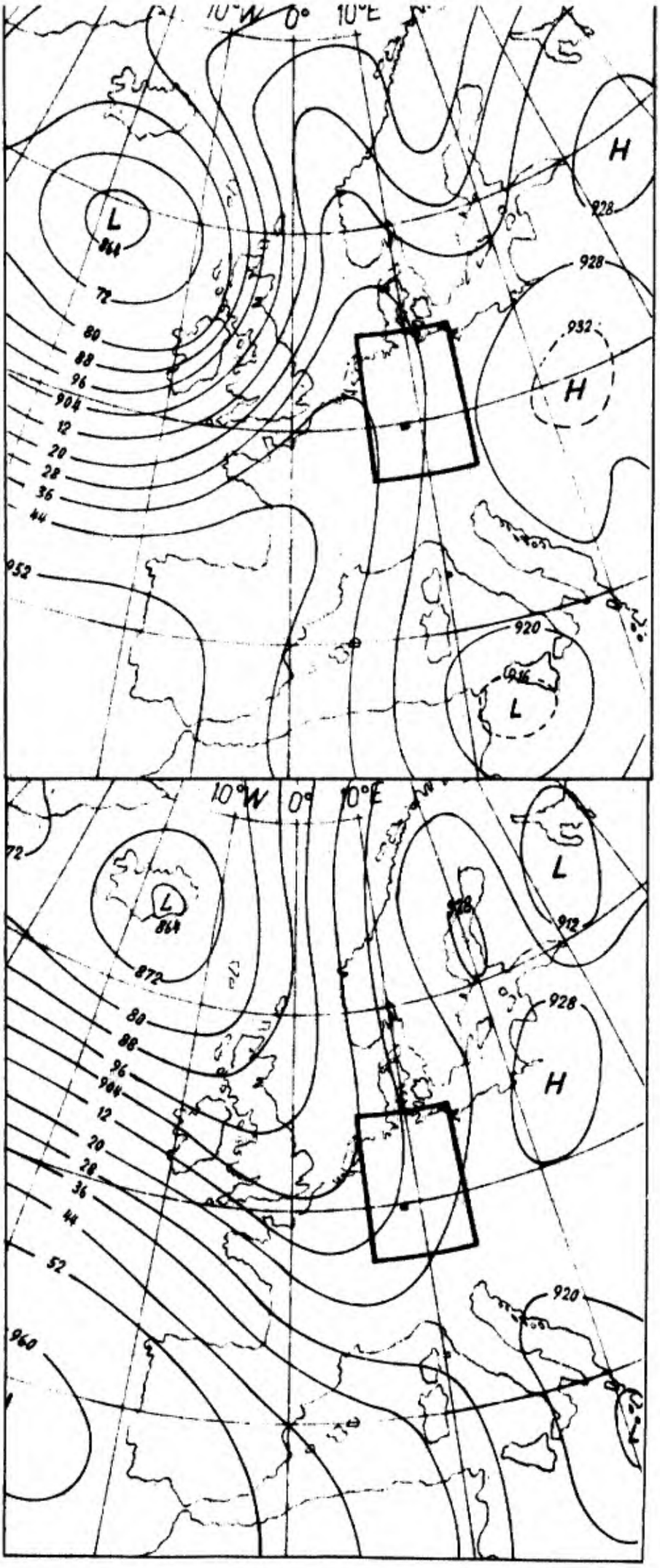
Fig. 18: 13 May 1963, 06:00 : Sea level isobars [mb]; dashed line denotes surface position of cold front at 24:00.



(a) 13 May 1963, 0100: 500 mb contours

(b) 13 May 1963 2400: 500 mb contours

Fig.19: 500 mb High ridge (a) was within 24 hours substituted by a trough.



(a) 13 May 1963, 0100 ↓ 300 mb contours.

Fig.20: 300 mb contours undergo same, yet more pronounced changes as 500 mb contours do (comp. Figs. 19a,b).

(b) 13 May 1963, 2400↓ 300 mb contours.

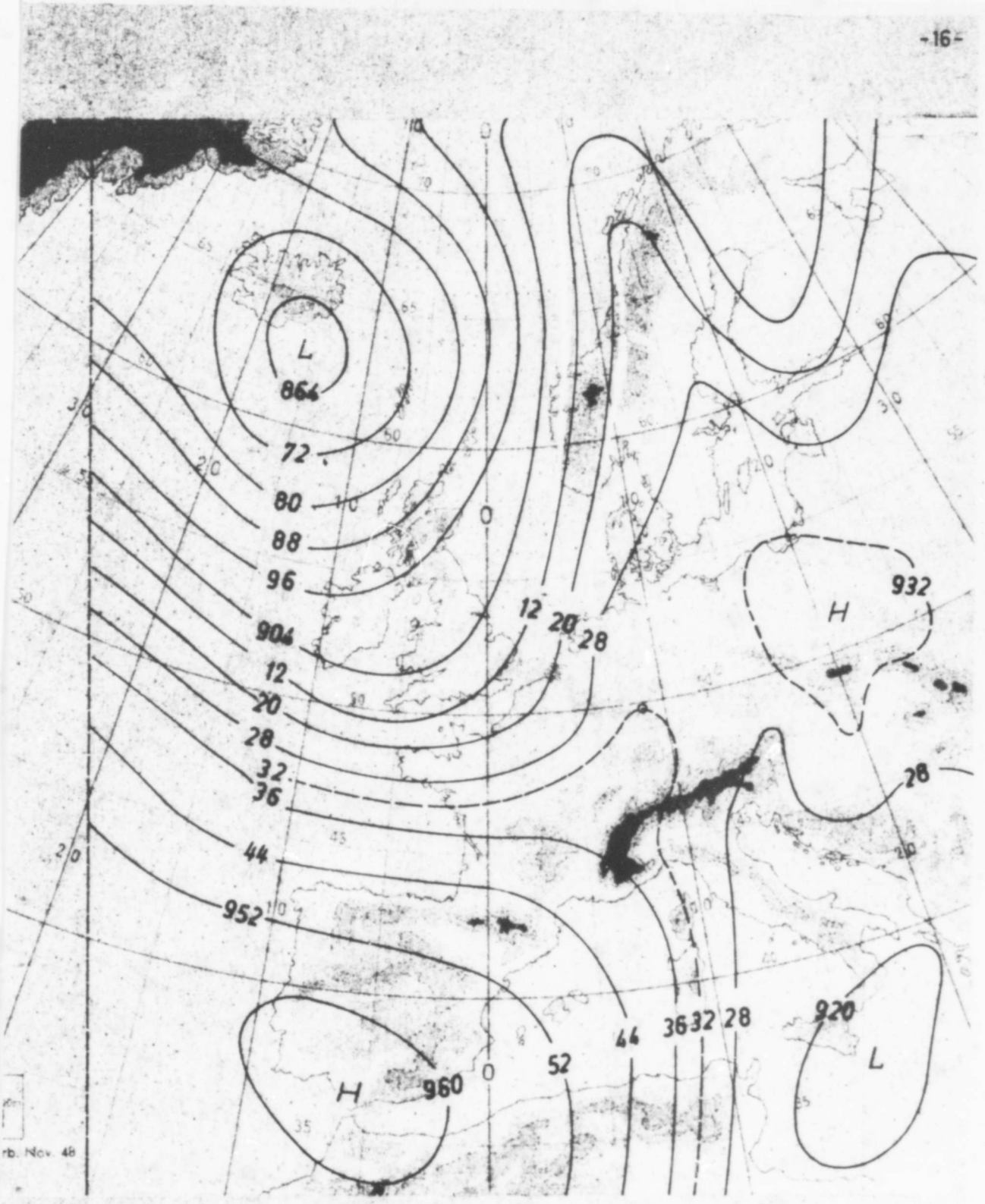


Fig. 21 : 13 May 1963, 12:00 : 300 mb contours [10 gpm]

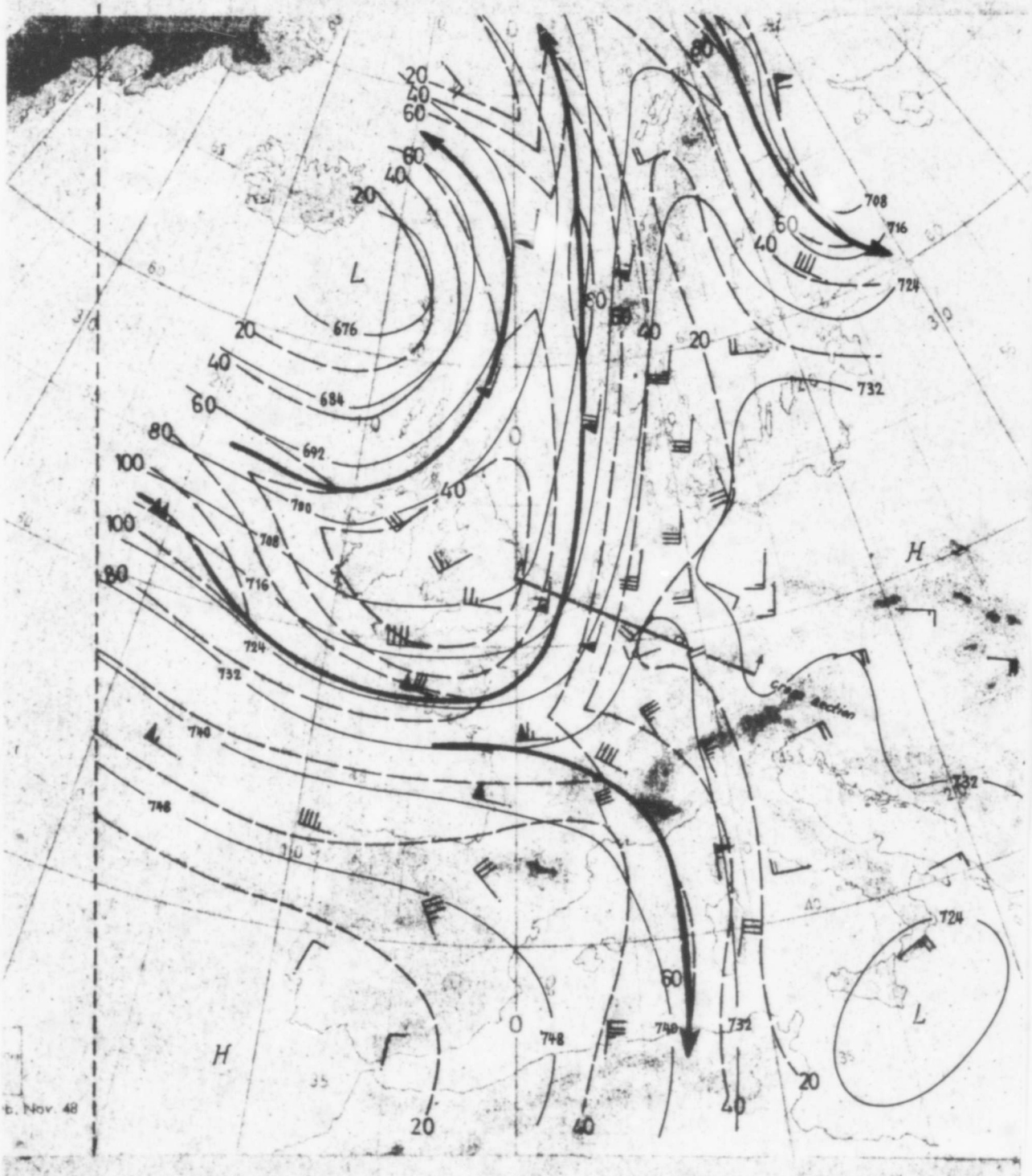


Fig. 22: 13 May 1953, 12 GMT: 400 mb contours [gpdm], with 400 mb jet axes; isotachs [knots] dashed. Position of cross section dash-dotted.

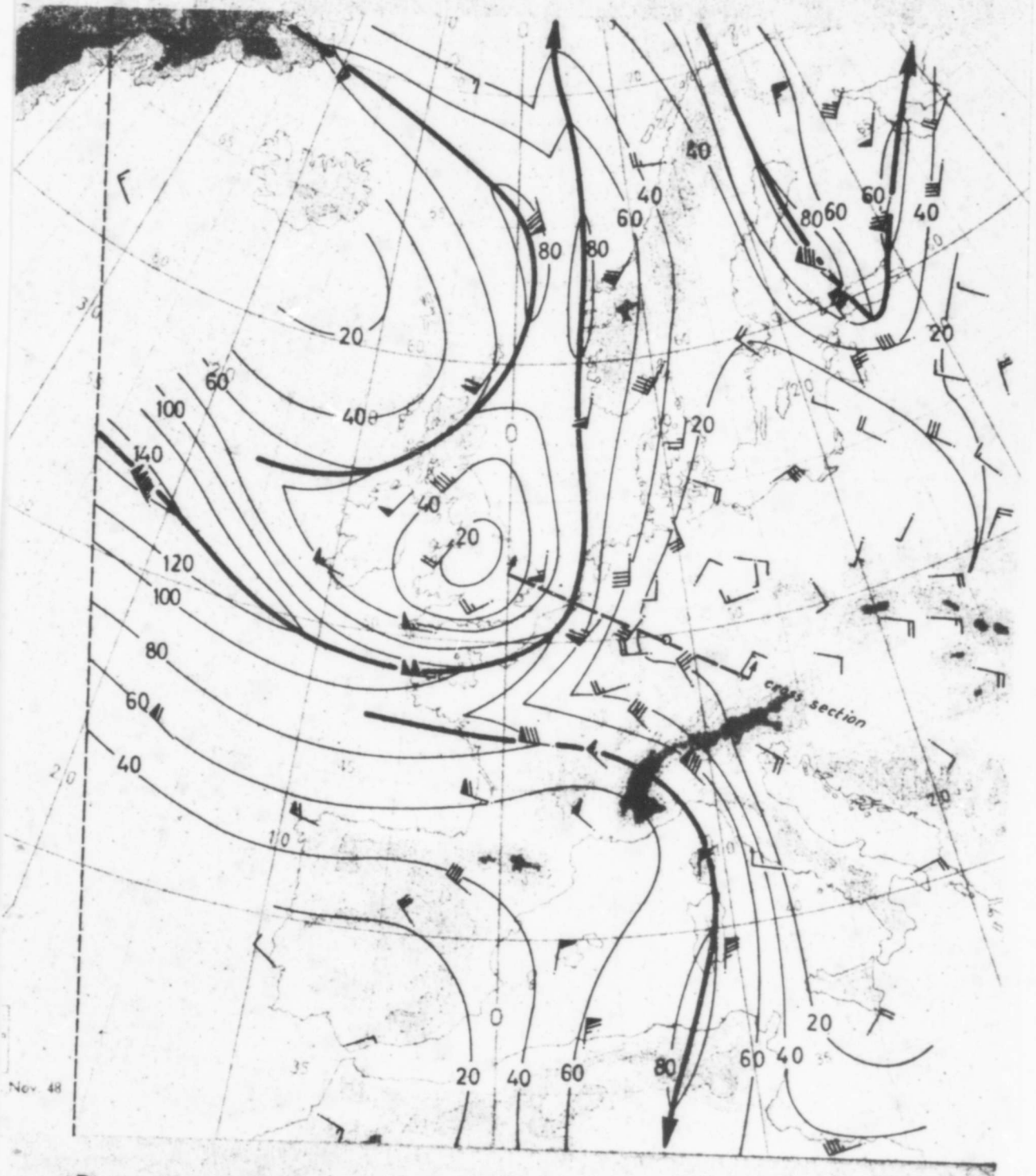


Fig. 23: 13 May 1963, 12:00 : 300 mb isotachs [knots] and 300 mb jet streams.

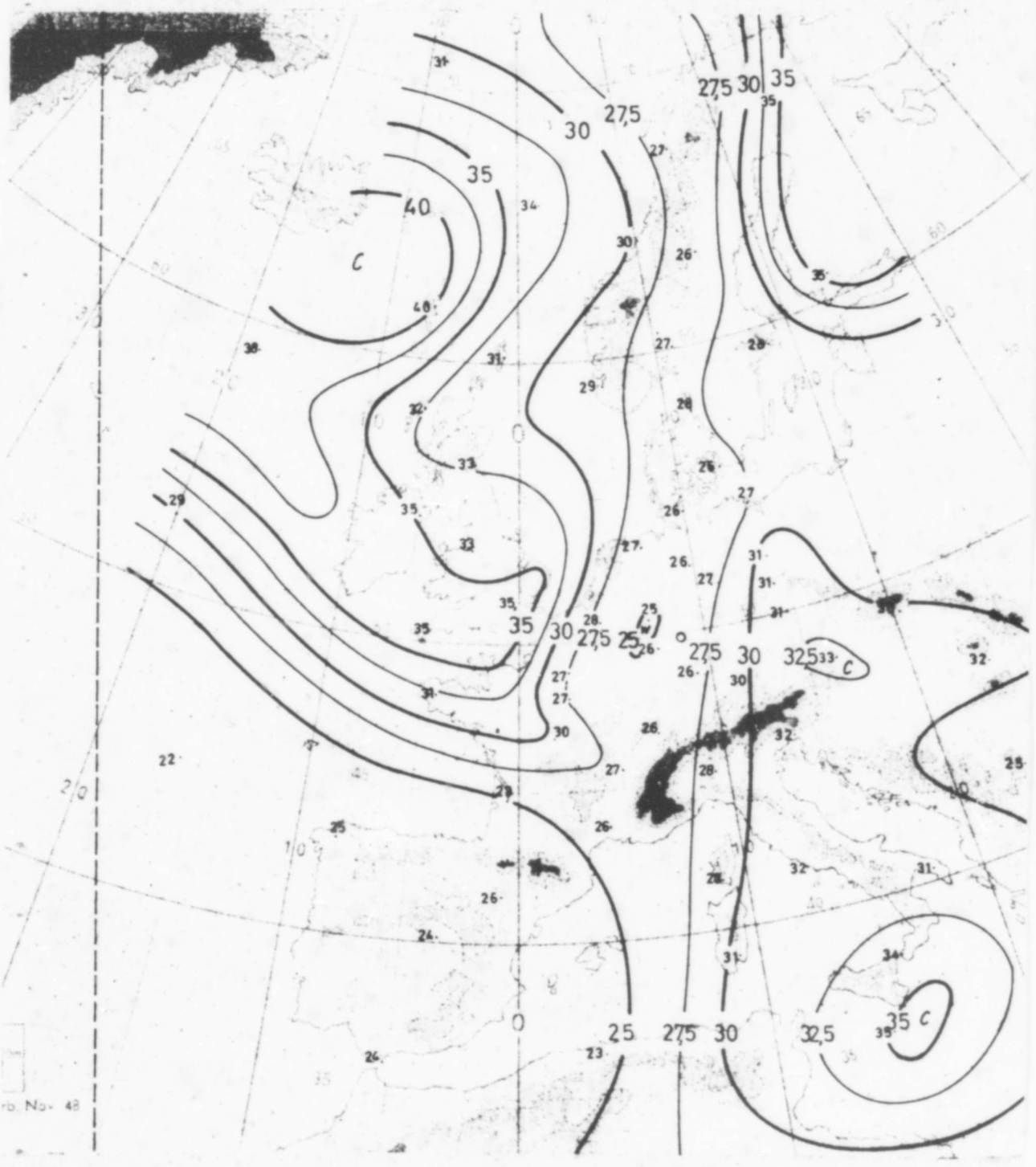


Fig. 24 : 13 May 1963, 12:00 : 400 mb isotherms [- °C].

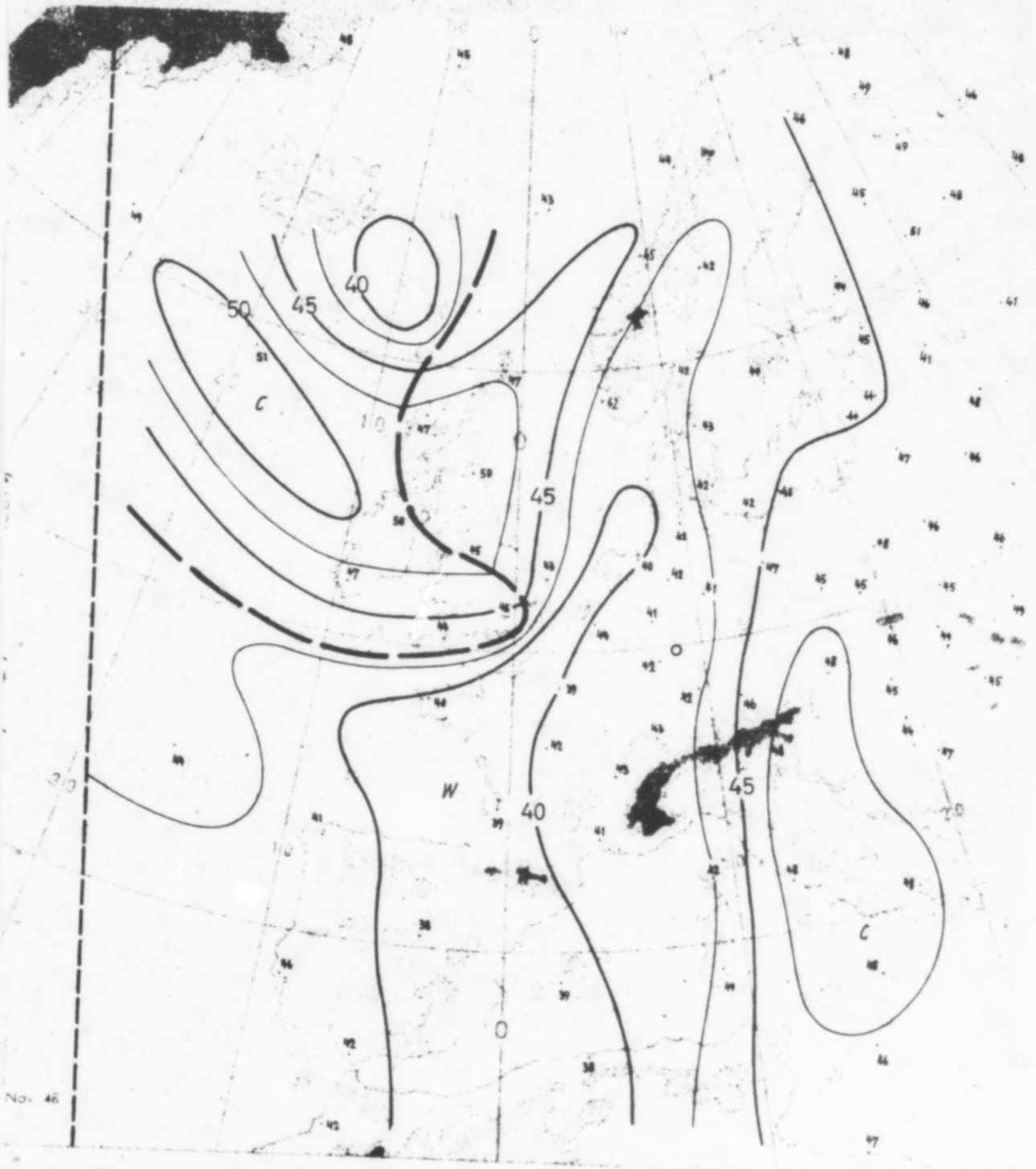


Fig. 25: 13 May 1963, 12:00 : 300 mb isotherms [-°C].

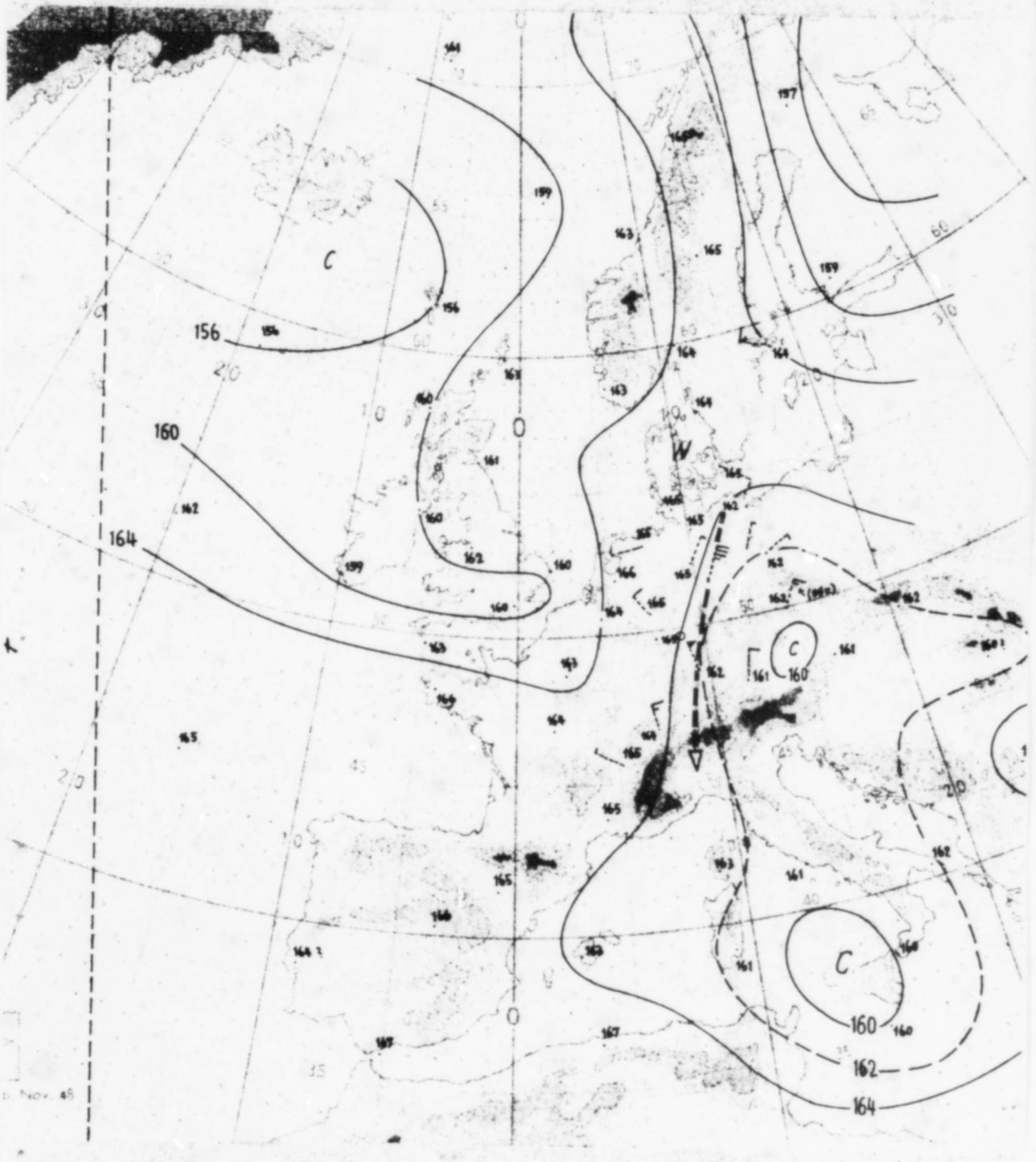


Fig. 26: 13 May 1963, 12:00 : 400/500 mb relative topography [10 gpm], and approximate position of 400/500 mb thermal jet stream ----▷

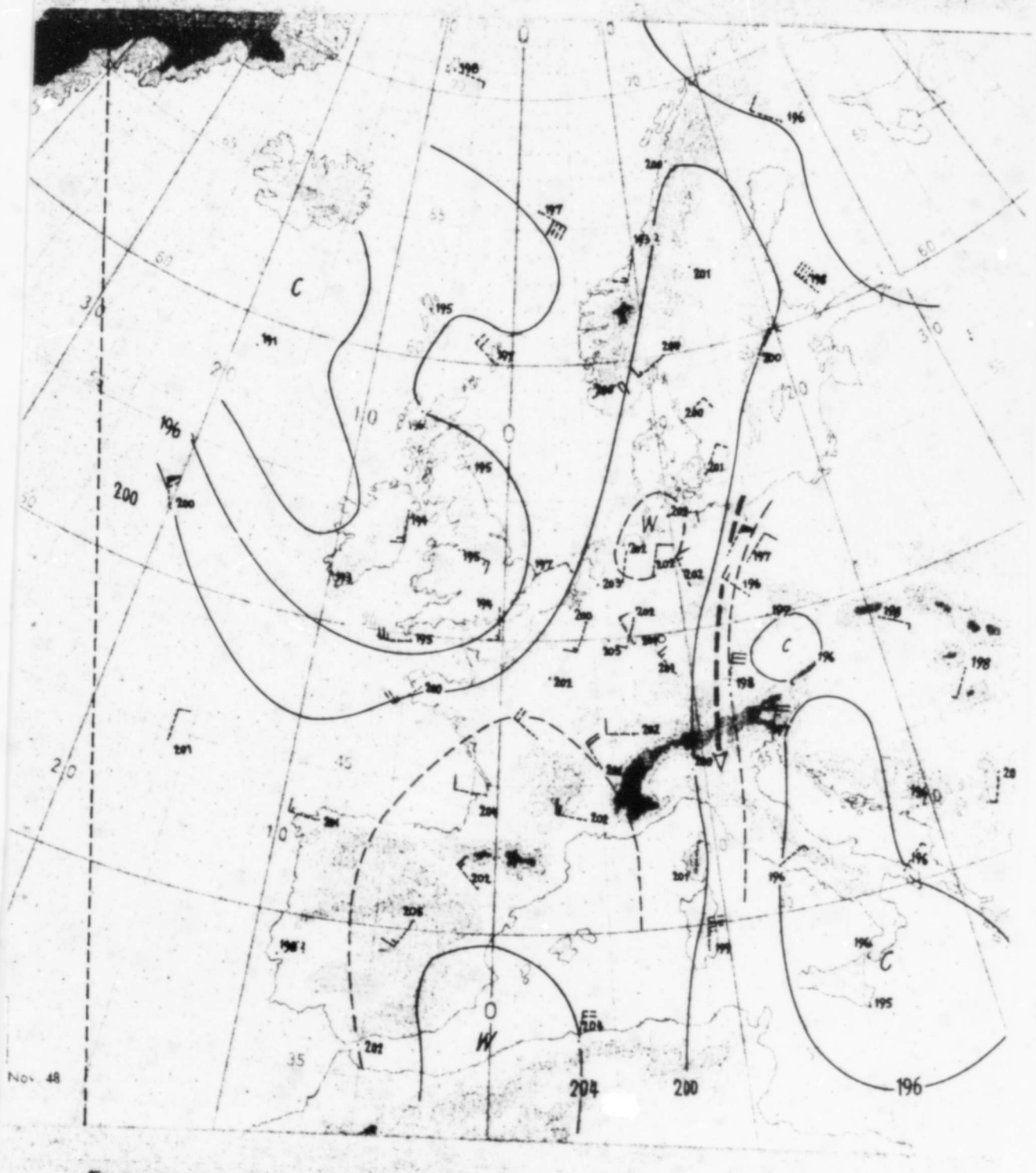


Fig. 27: 13 May 1963, 12:00: 300/400 mb relative topography [10 gpm], and approximate position of 300/400 mb thermal jet stream ----->

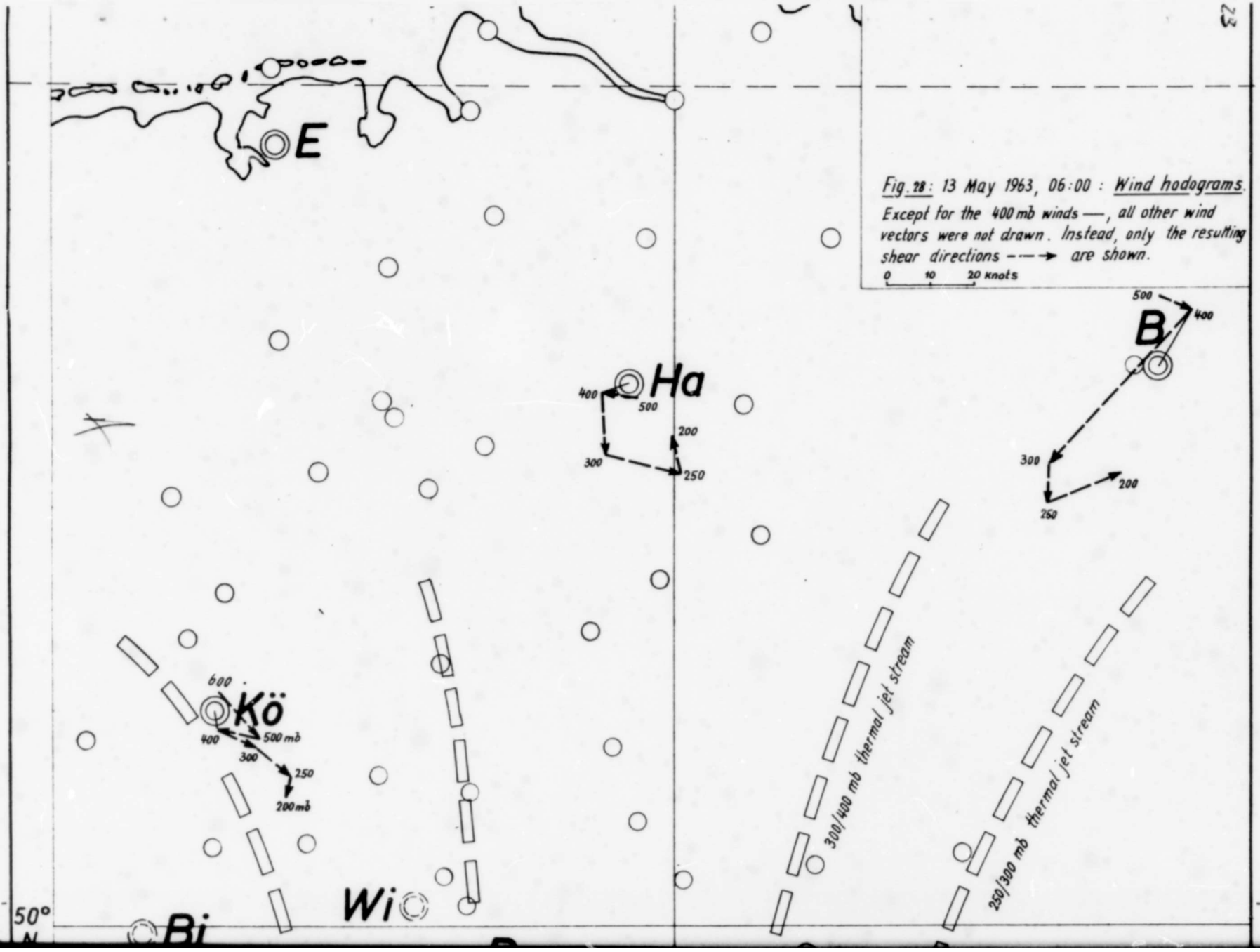
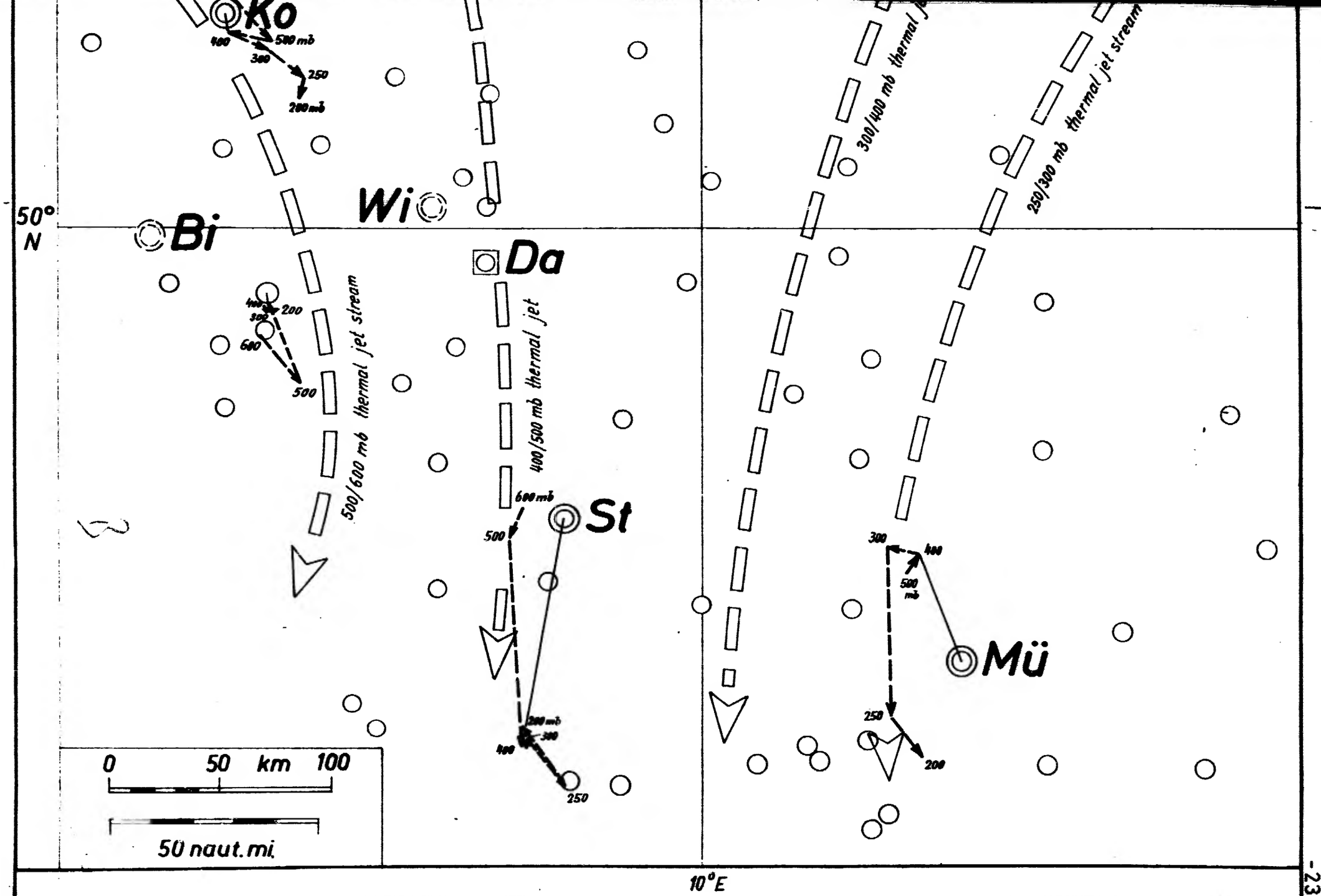


Fig. 28: 13 May 1963, 06:00 : Wind hodograms.
Except for the 400 mb winds —, all other wind vectors were not drawn. Instead, only the resulting shear directions ---→ are shown.
0 10 20 knots


Ko
400
500 mb
300
250
200 mb
Wi
Bi
Da
St
Mü
50° N
10° E
500/600 mb thermal jet stream
400/500 mb thermal jet
300/400 mb thermal jet
250/300 mb thermal jet stream
600
500
200
600 mb
500
400
300
250
200
0 50 km 100
50 naut. mi.

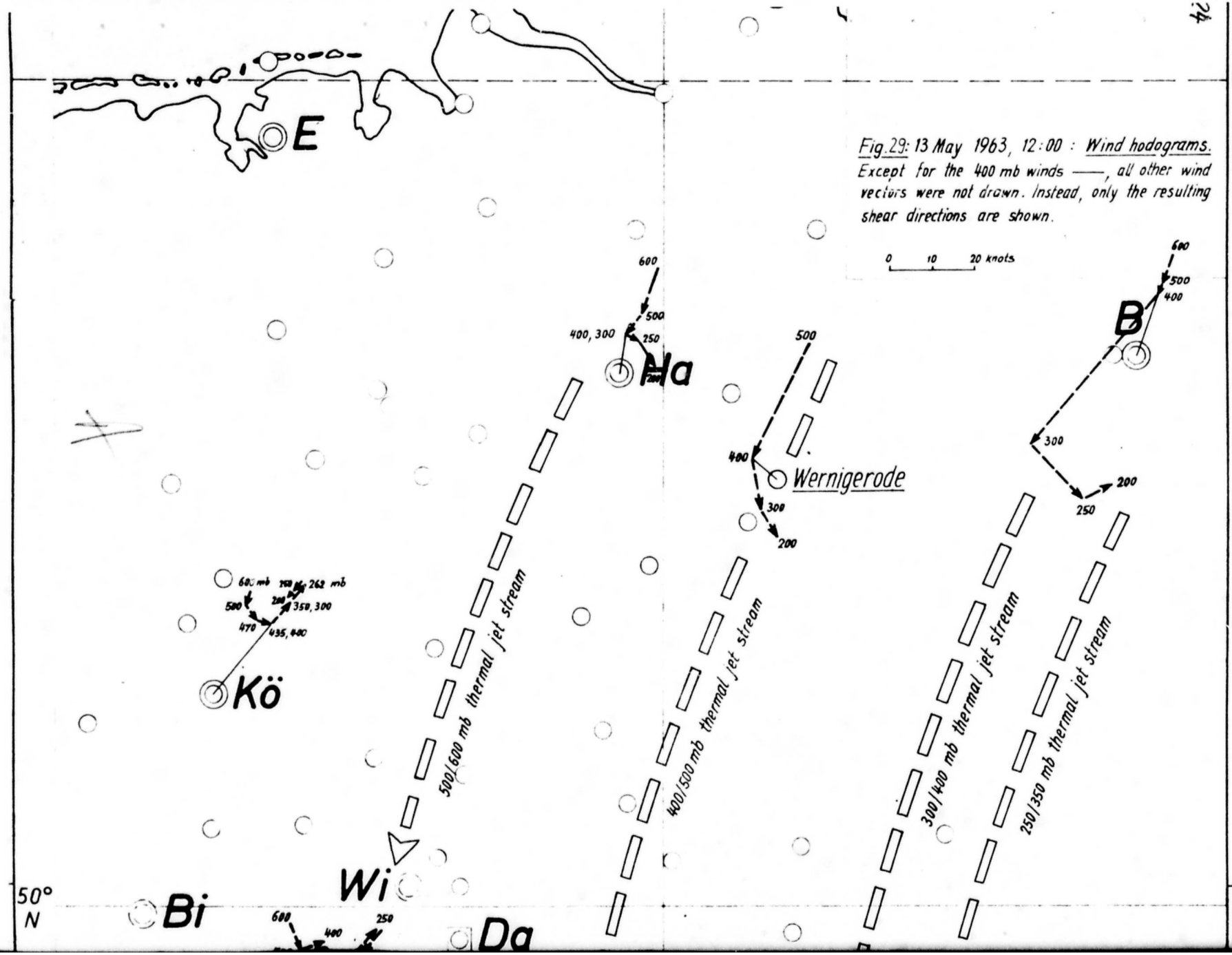
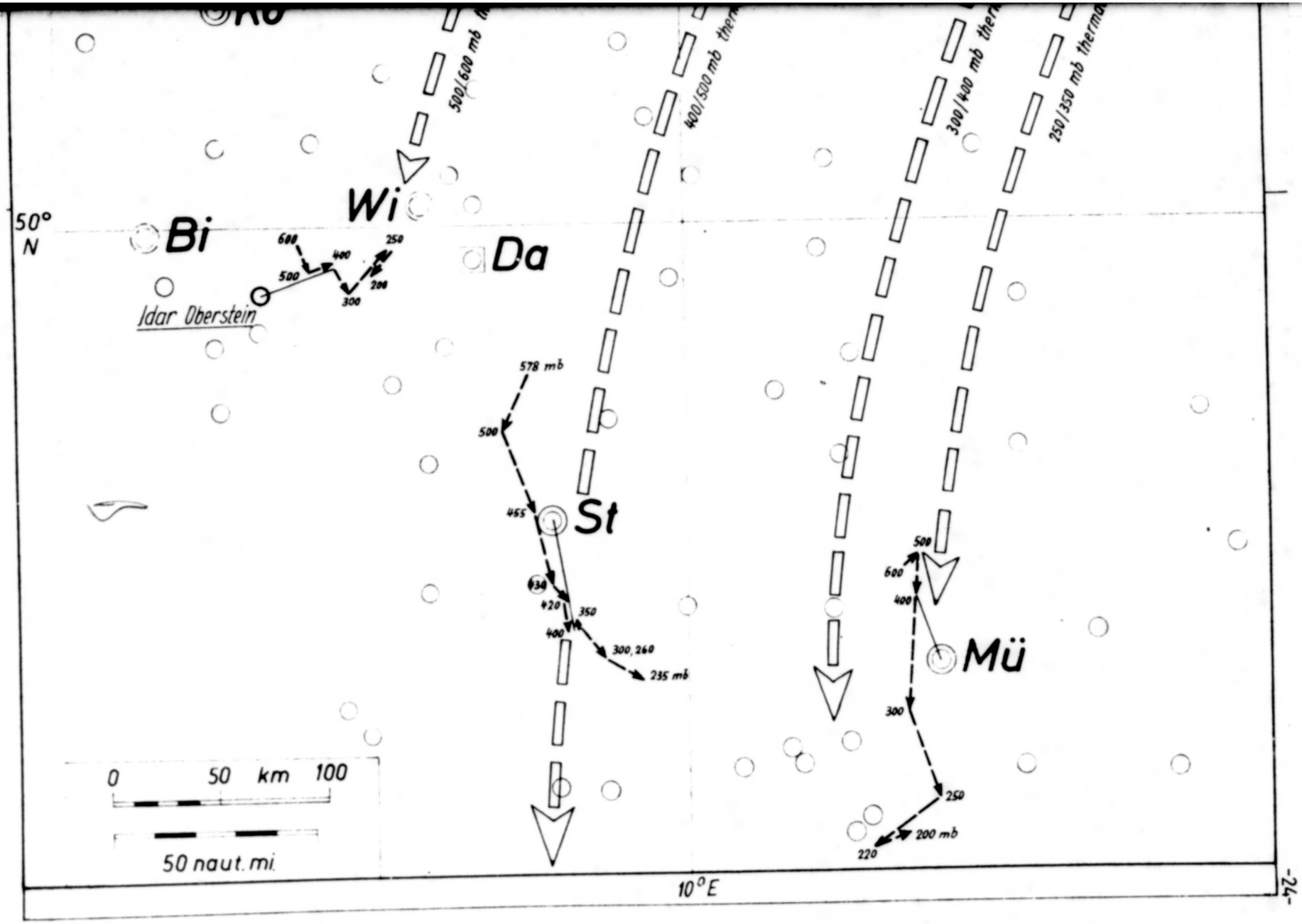


Fig. 29: 13 May 1963, 12:00 : Wind hodograms. Except for the 400 mb winds ——, all other wind vectors were not drawn. Instead, only the resulting shear directions are shown.


500/600 mb
400/500 mb
300/400 mb
250/350 mb
50° N
Bi
Wi
Da
St
Mü
600
400
500
250
300
200
Idar Oberstein
578 mb
500
455
430
420
350
400
300, 260
235 mb
500
600
400
300
250
200 mb
220
0
50 km
100
50 naut. mi
10° E

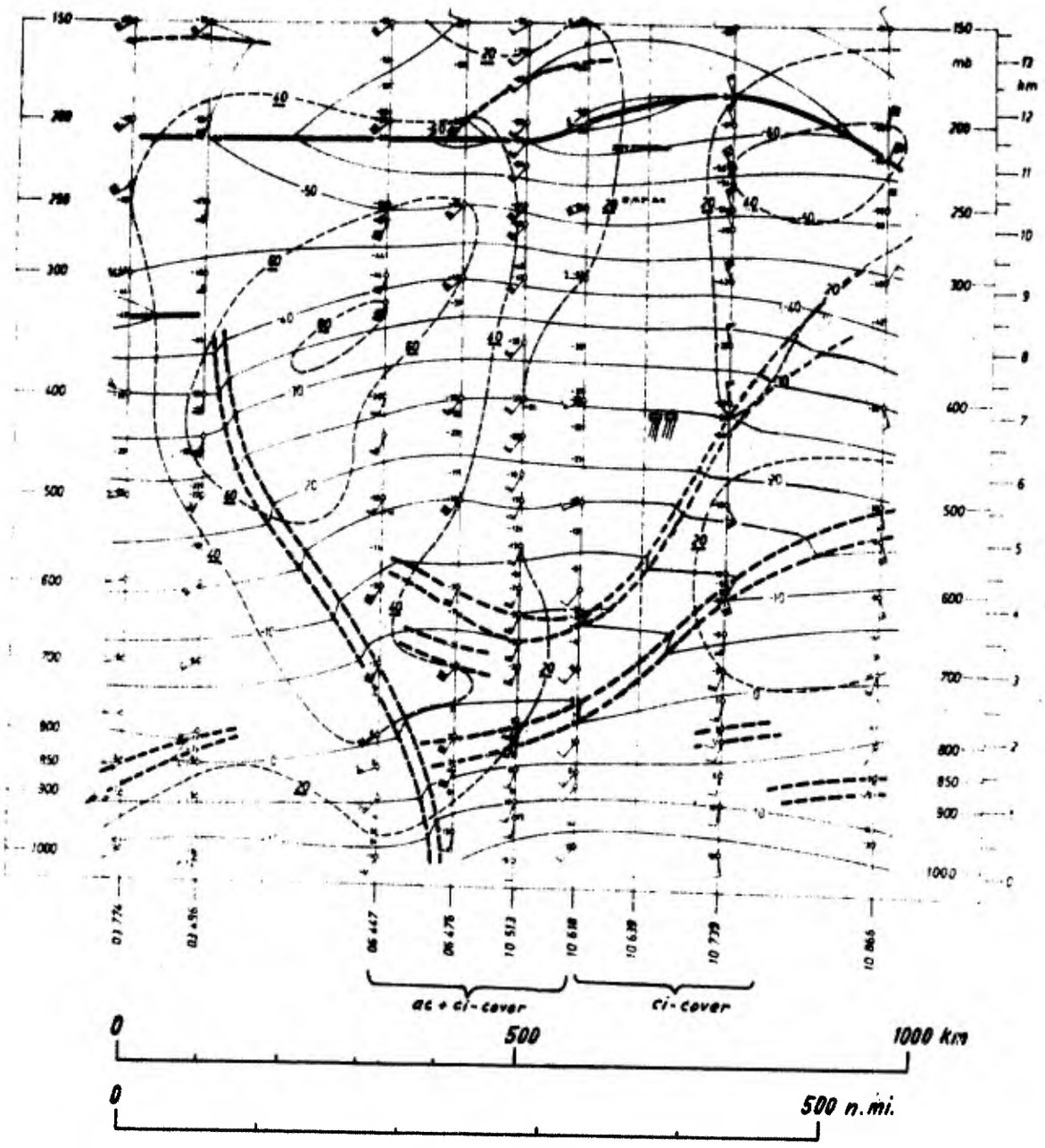


Fig. 30: 13 May 1963, 12:00 ; Cross section of wind [knots] and temperature [°C]; for position, see Fig. 22.
Vertical line over Darmstadt (10 639) dashed; small rectangles denote ci-band position near 420 mb; ci layers near 250 mb and 220 mb also marked.
Thick line marks base of tropopause; thick dashed lines mark boundaries of layers of increased thermal stability.
velocity amounts were underlined.

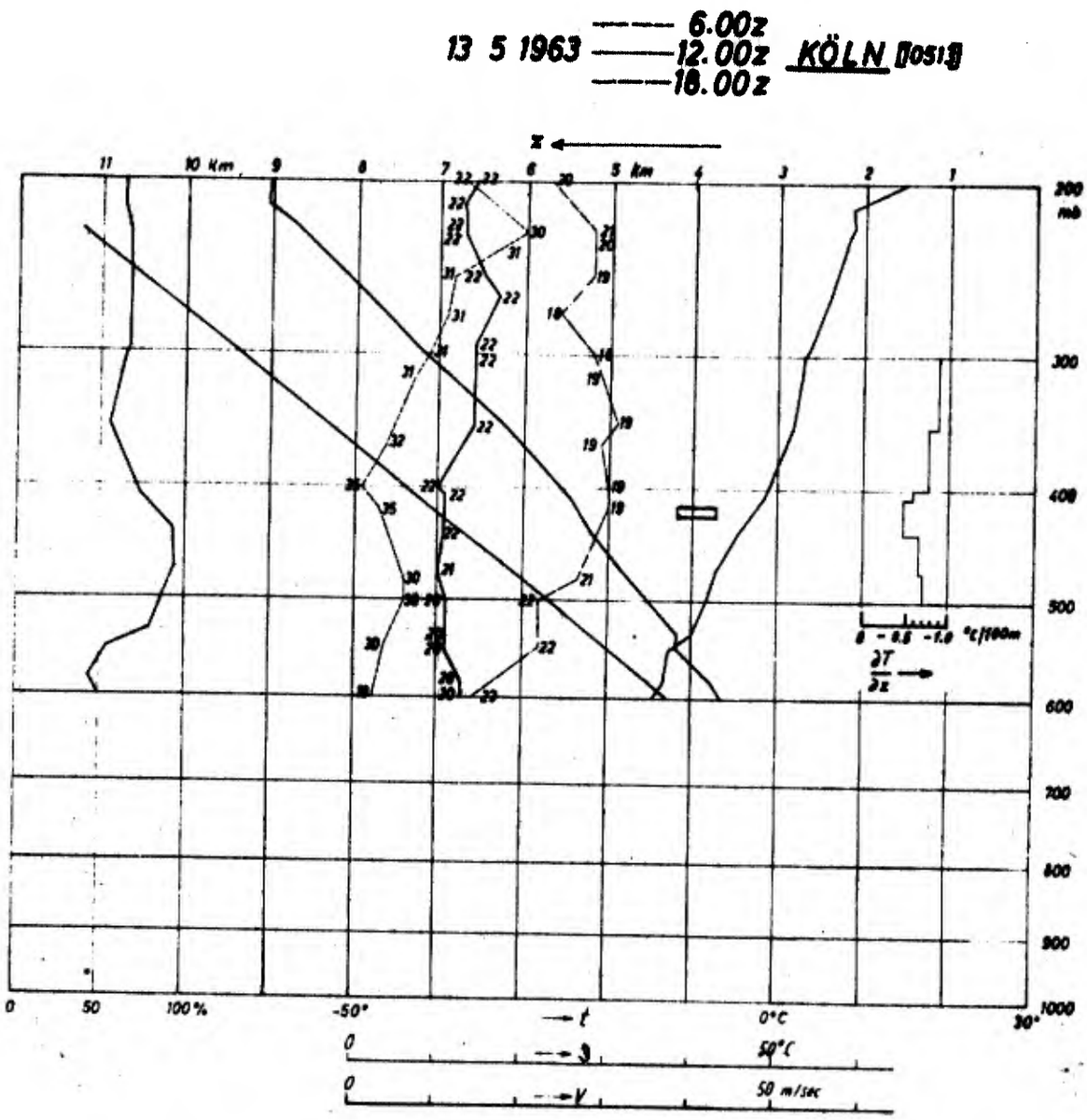


Fig. 31: 13 May 1963 : Aerological ascents of Köln :
Wind soundings at 06:00, with velocities defined by scale below, and directions in units of $[10^{\circ}]$;
actual and potential temperature, humidity (outer left) and p(s) sounding at 12:00; $\partial T/\partial z$ at outer right.
Rectangle marks altitude of large-scale ci-bands over Darmstadt for comparison.

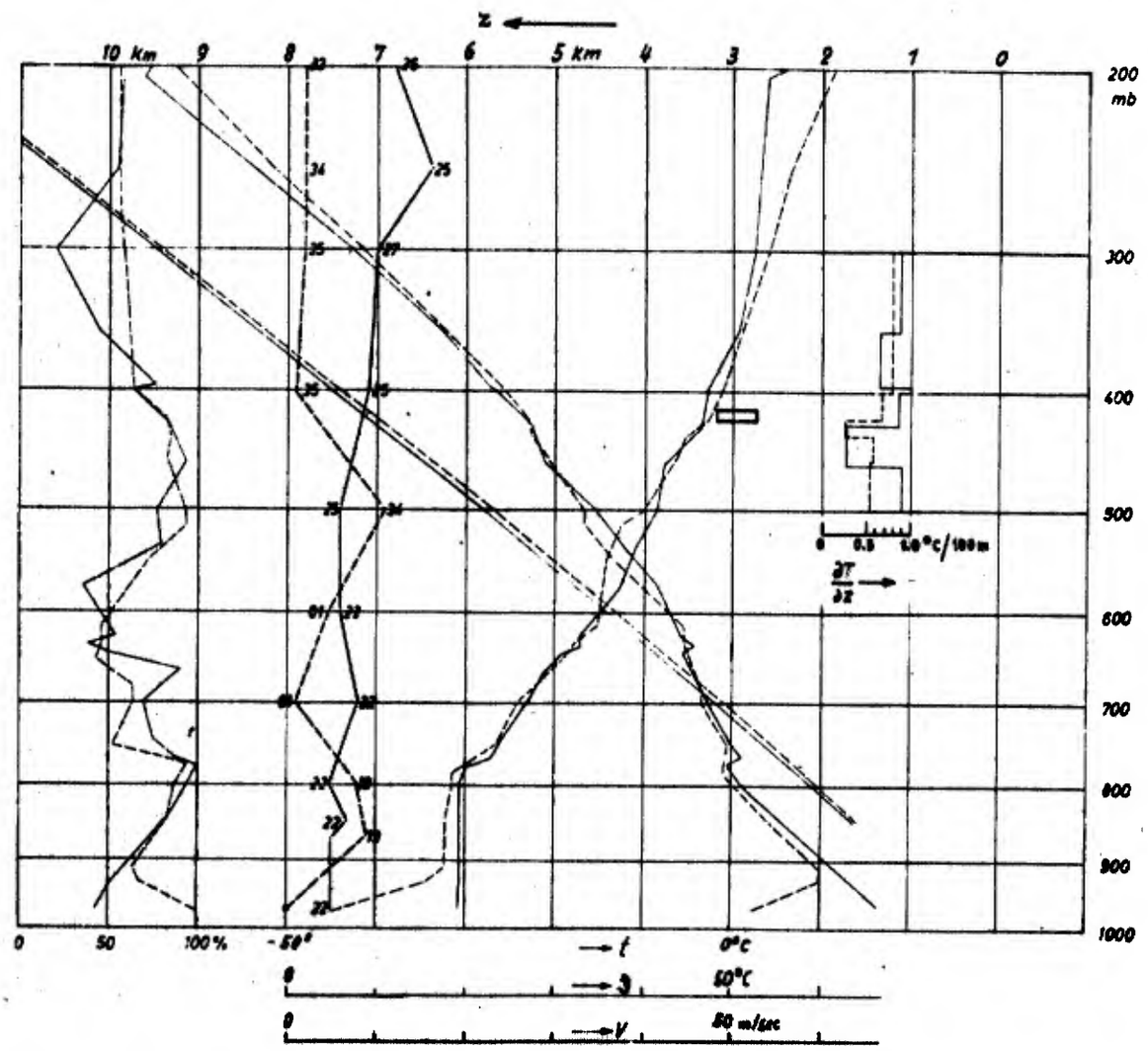


Fig. 32 : 13 May 1963 : Aerological ascents of Idar-Oberstein : Wind, actual and potential temperature, humidity and p(z) soundings at 06:00 and 12:00; dT/dz at outer right.
Rectangle marks altitude of large scale ci-bands over Darmstadt for comparison.

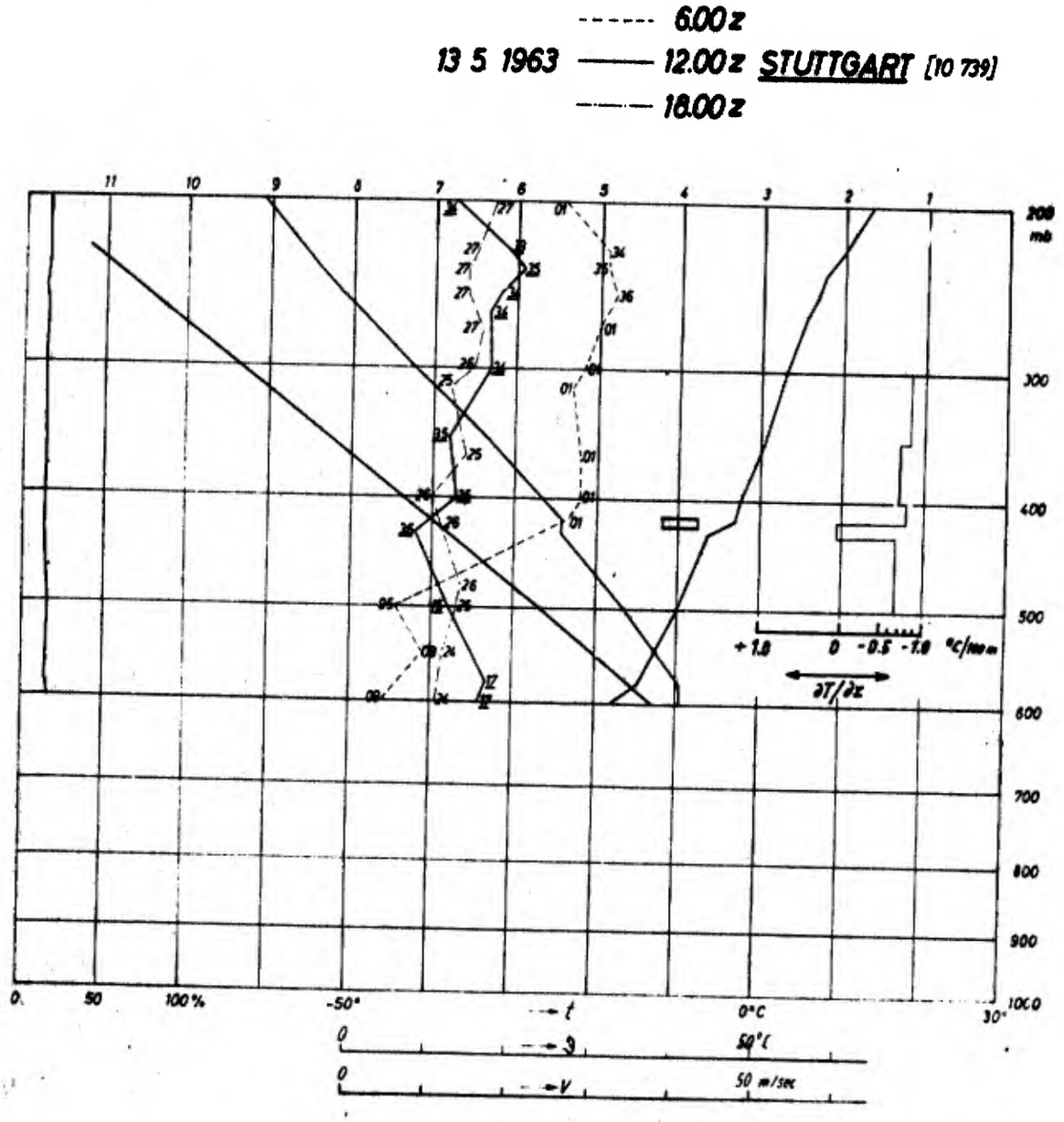


Fig. 33 : 13 May 1963 ; Aerological ascents of Stuttgart; Winds at 06:00, 12:00 (directions [10°] underlined), and 18:00; actual and potential temperatures, humidity and p(s) of 12:00; ∂T/∂s at outer right. Rectangle marks altitude of large scale oi-bands over Darmstadt for comparison.

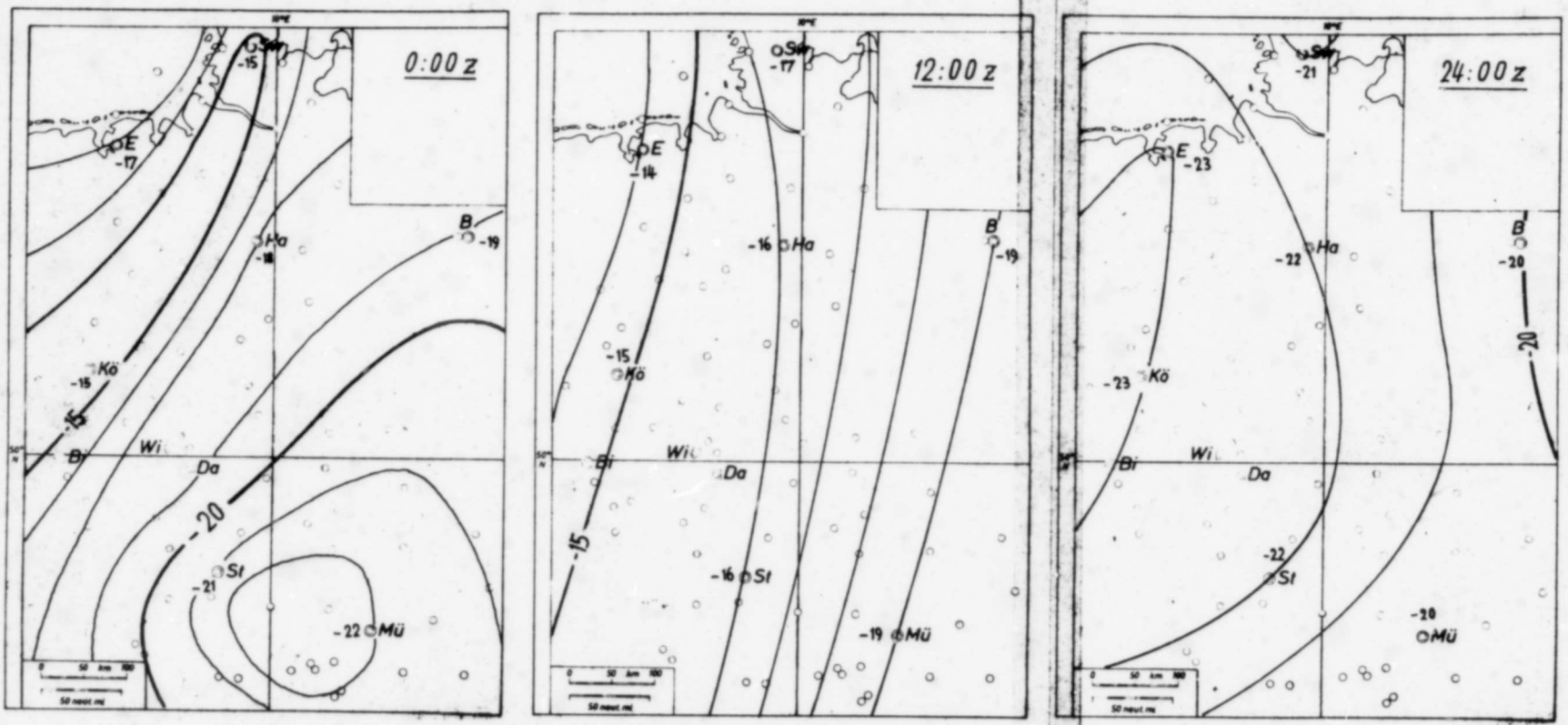


Fig. 34 : 13 May 1963 : 500 mb-isotherms.

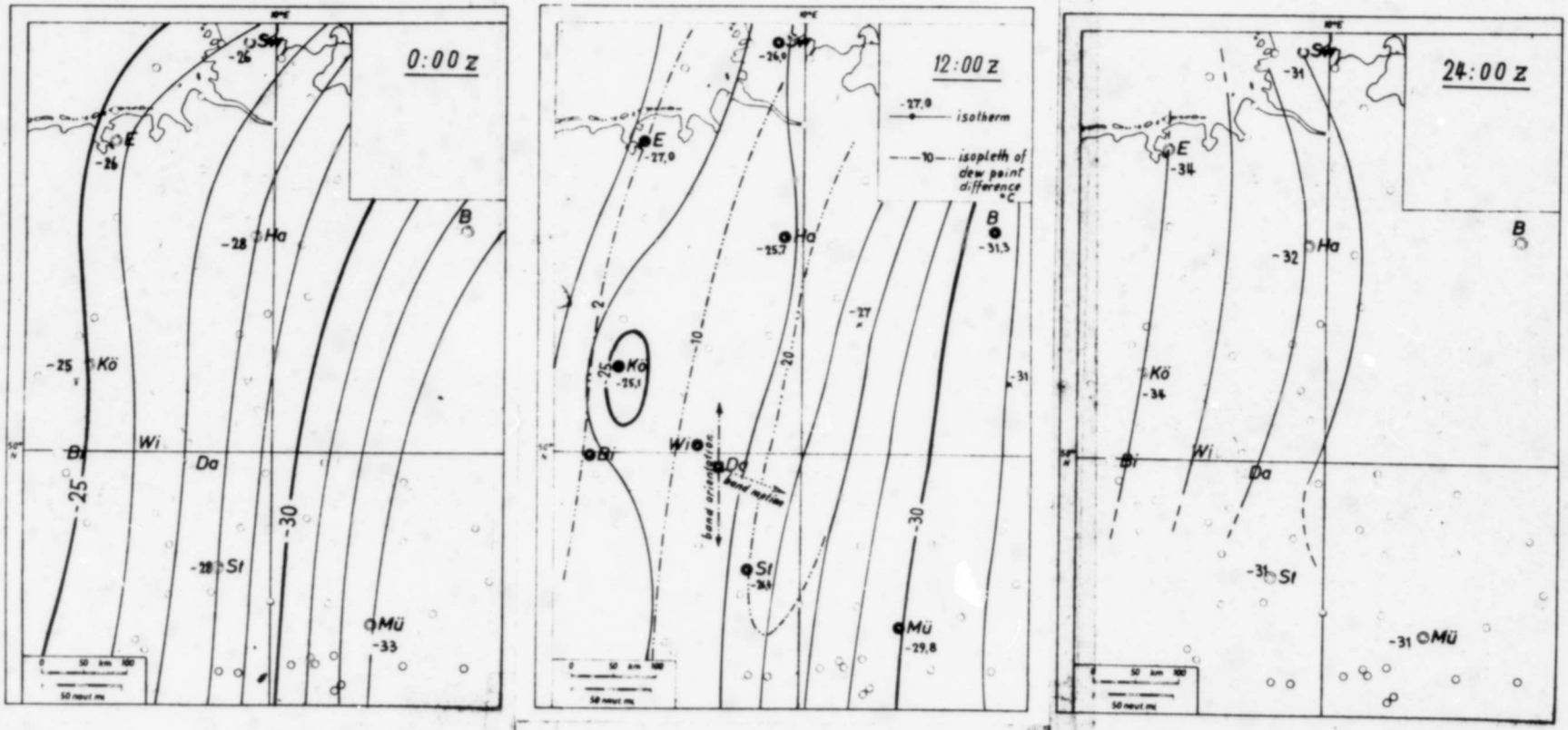


Fig. 35: 13 May 1963 : 400 mb-isotherms. Note that the 12:00 Z chart is most similar to the 500 and 300 mb charts of the same time in Figs. 34, 36. 24:00 Z chart is uncertain. Dash-stippled: isohumids (dew pt.diff., [°C]).

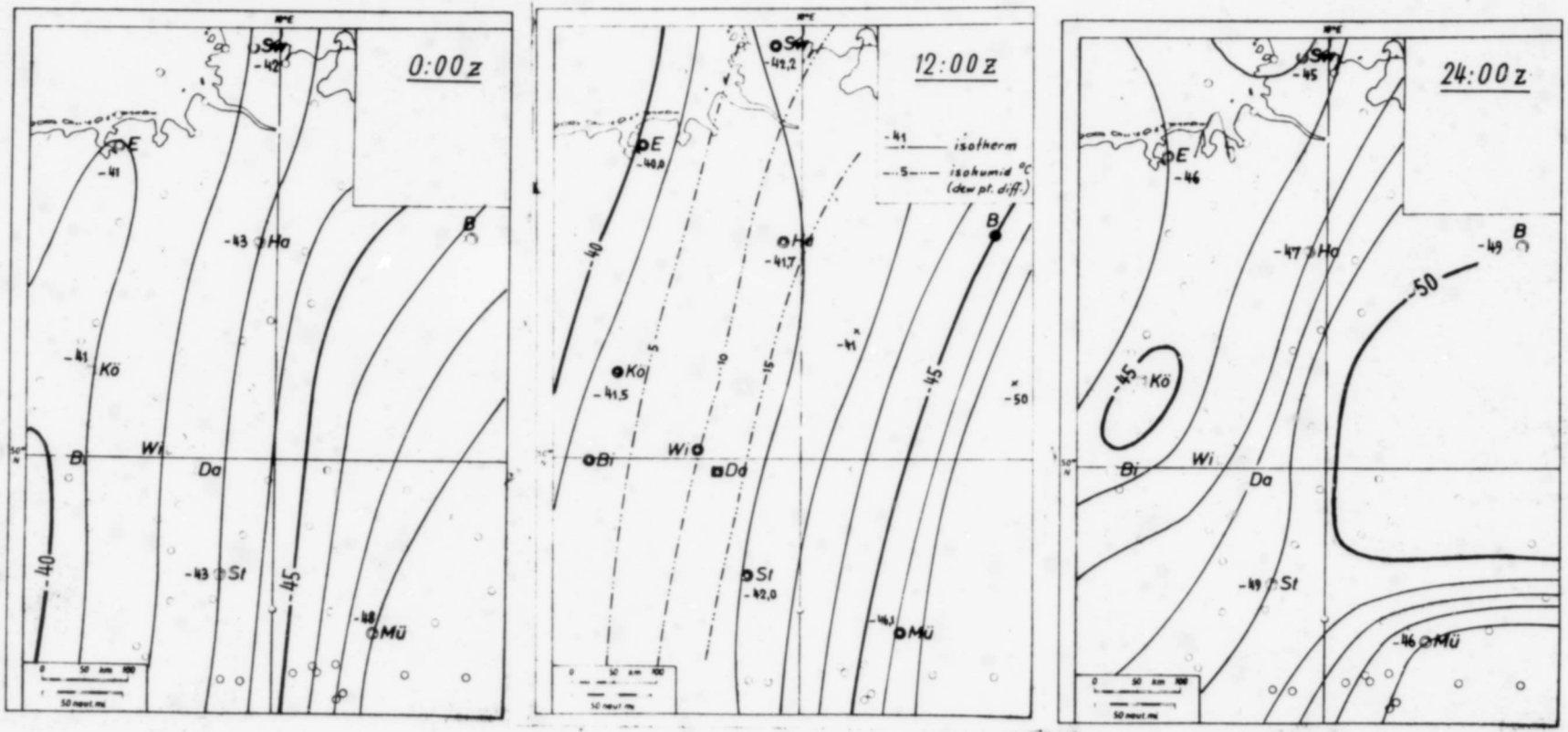


Fig. 36 : 13 May 1963 : 300 mb-isotherms. Dash-stippled : Isohumids (dew pt.diff.[°c]).

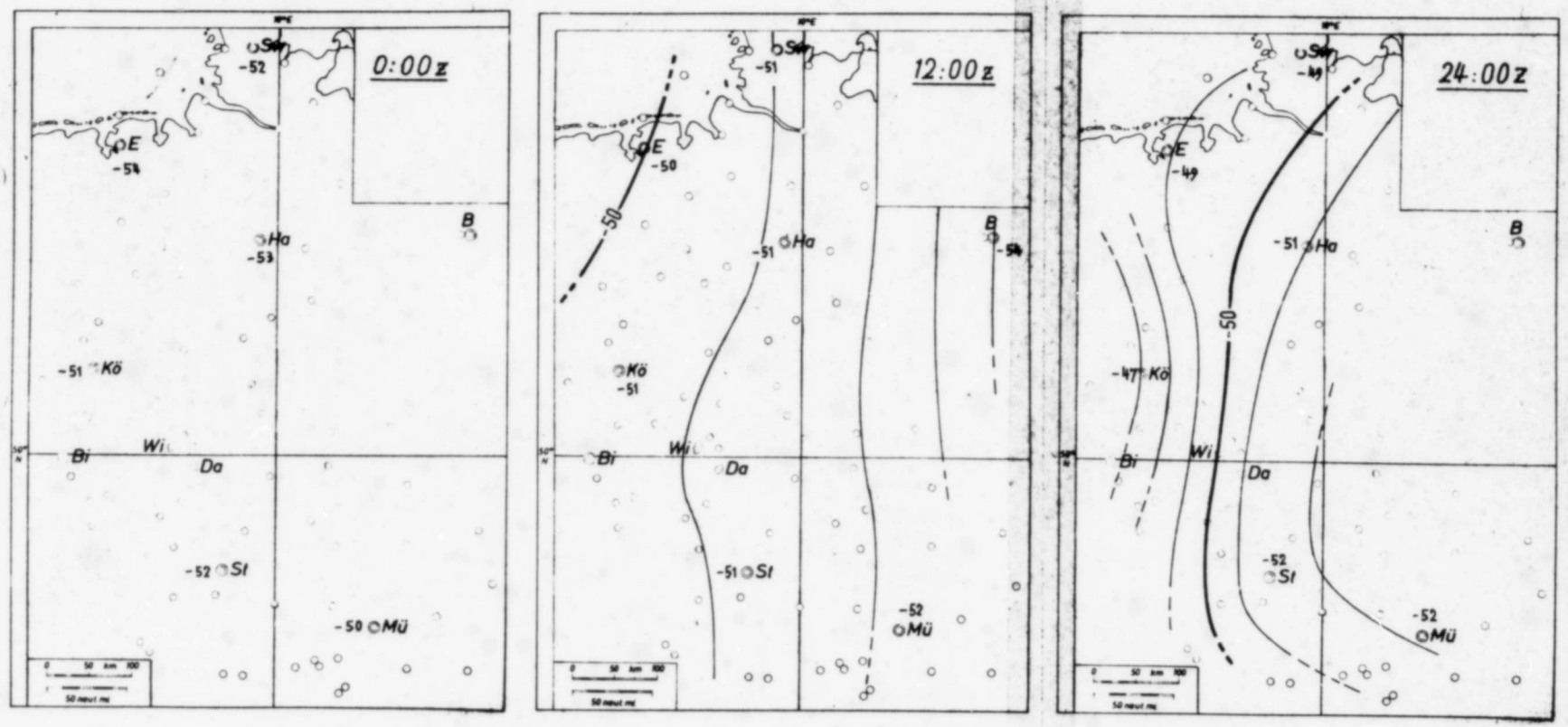


Fig. 37 : 13 May 1963 : 250 mb-isotherms. Isotherms of left chart were omitted due to uncertainty; right chart not very reliable either.

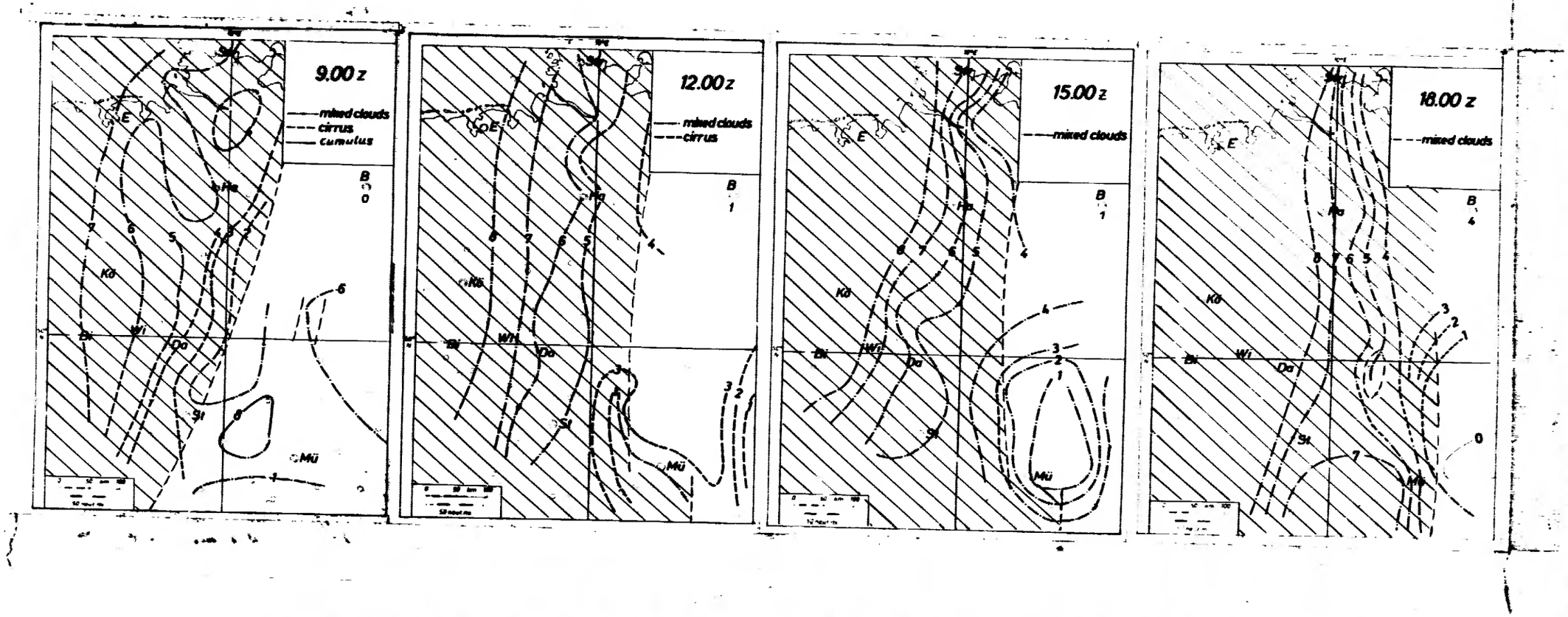


Fig. 38 : 13 May 1963 : Cloud cover (8 ≙ 100%); Note that the lines of equal cloud cover parallel the general orientation of the isotherms in Figs. 34, 35, 36, 37, while, except for mountainous regions, the decrease of cloud cover toward east is nearly independent of time at least within 9:00 til 18:00 Z.
The shaded area is covered with cirrus of at least 70% of the cloud amount (No ci were recorded over non-shaded area).

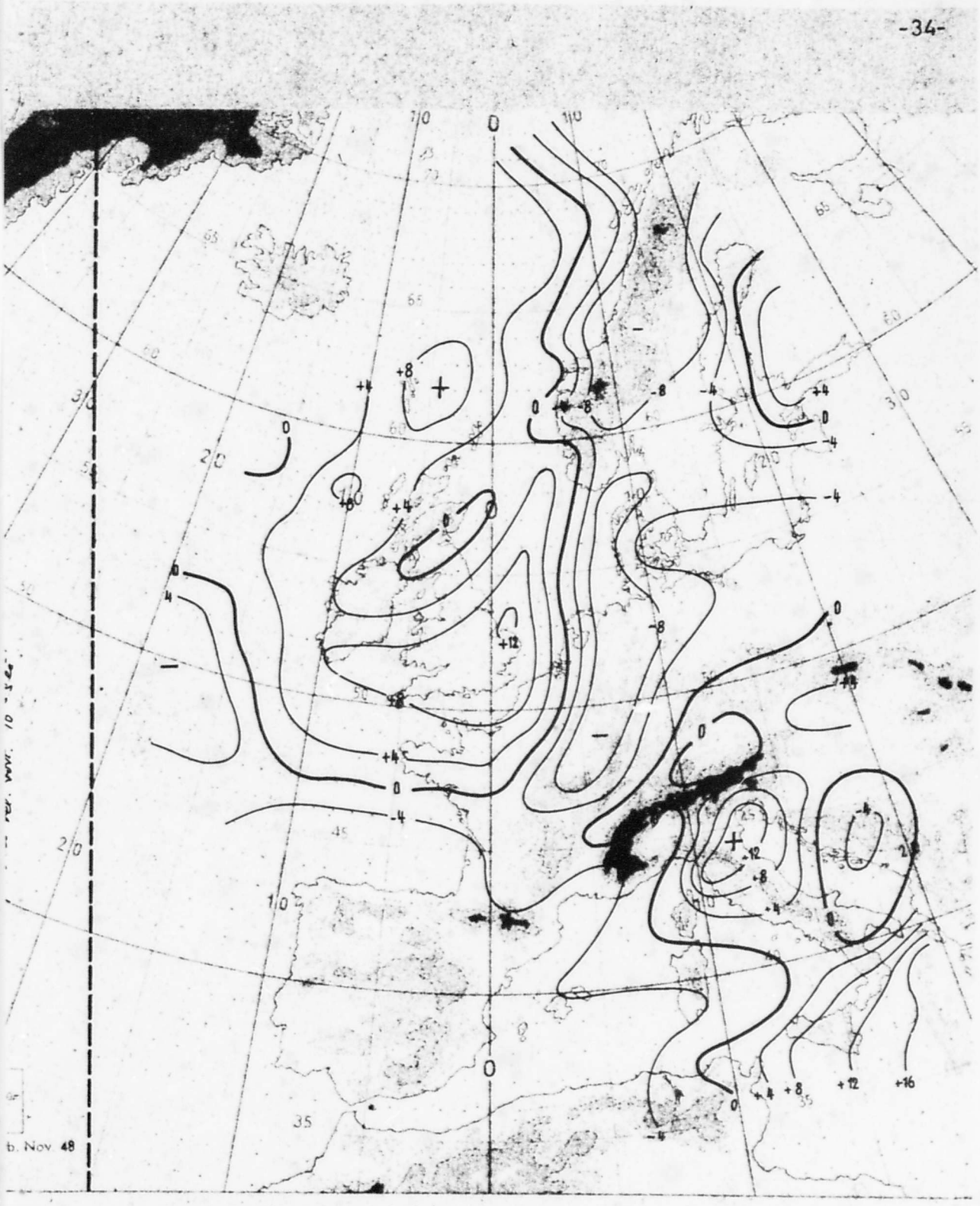


Fig. 39: 13 May 1963, 12:00 : 400 mb relative vorticity $\left[10^{-5}\ \mathrm{sec}^{-1}\right]$.

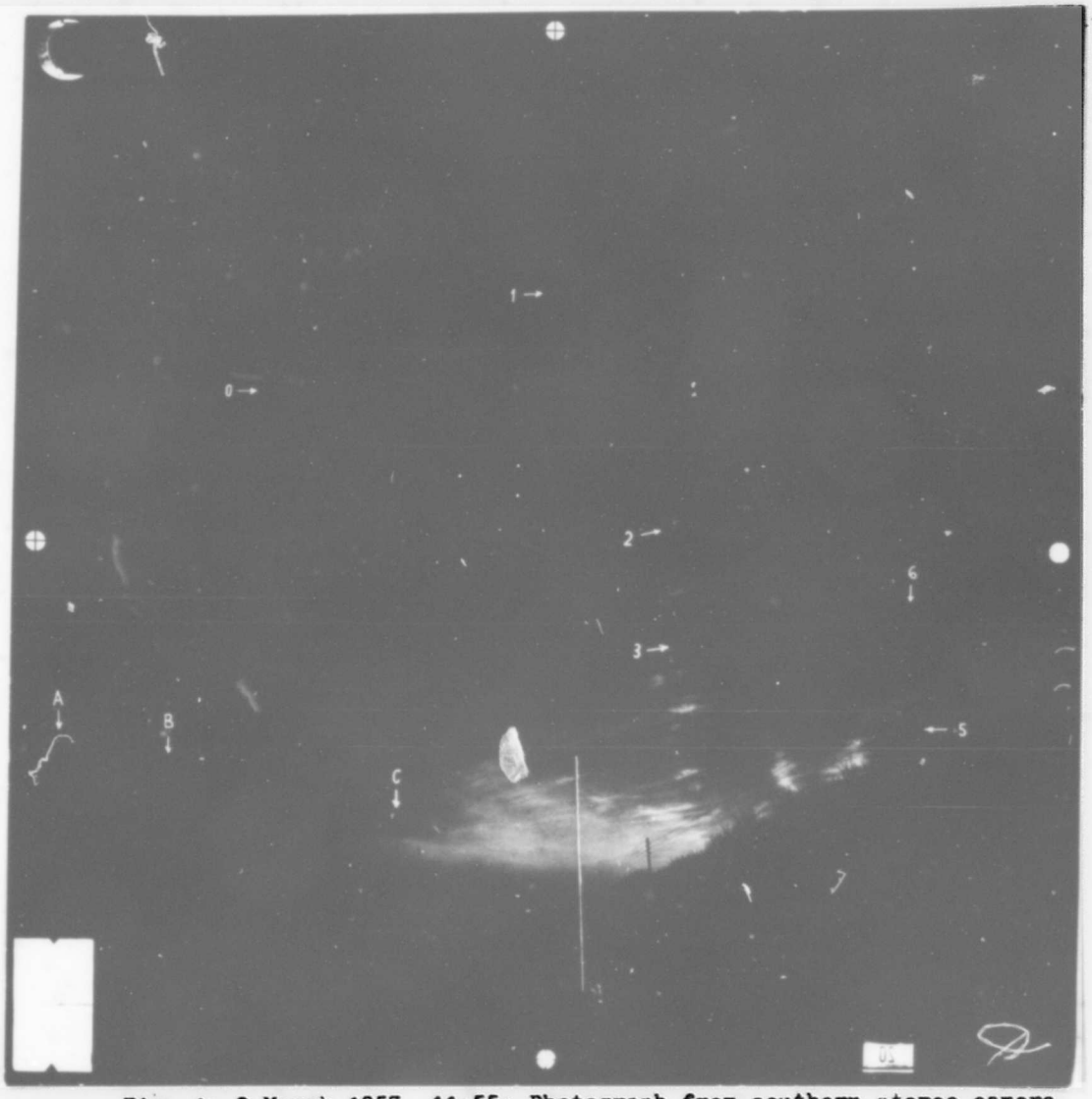


Fig. 1: 2 March 1957, 11:55: Photograph from southern stereo camera, toward 350°; band approaching from N.

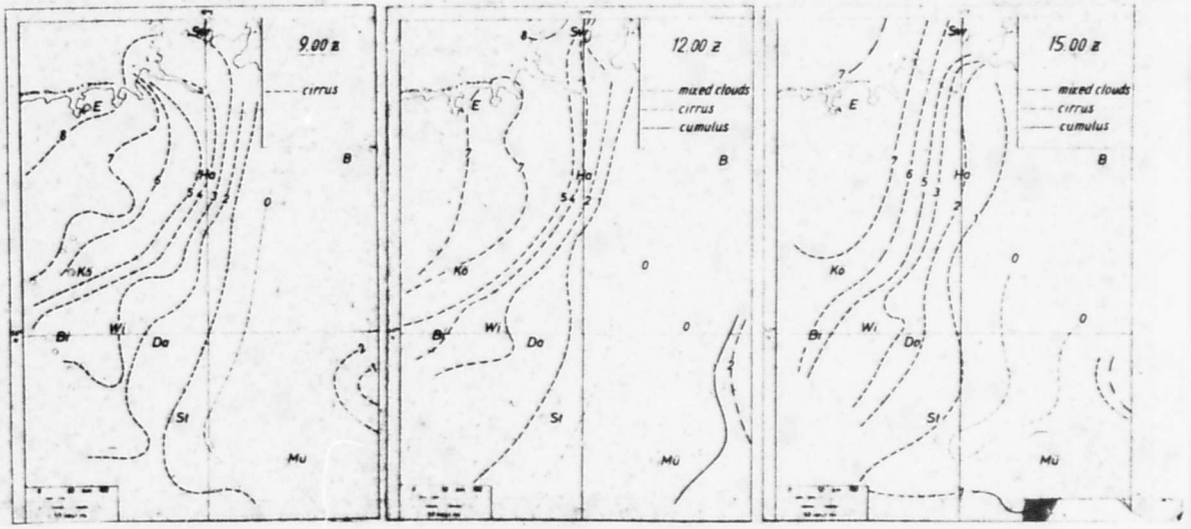


Fig. 2: 2 March 1957: Isonephs at 3 hour intervals; "8" corresponds to 100 % cloud cover

Fig. 3: 2 March 1957: Plan of bands depicted in Fig. 1; points A B C, 0, 1, 2, 3, 4, 5, 6 for identification.
Photographic taking axis dash-stippled.

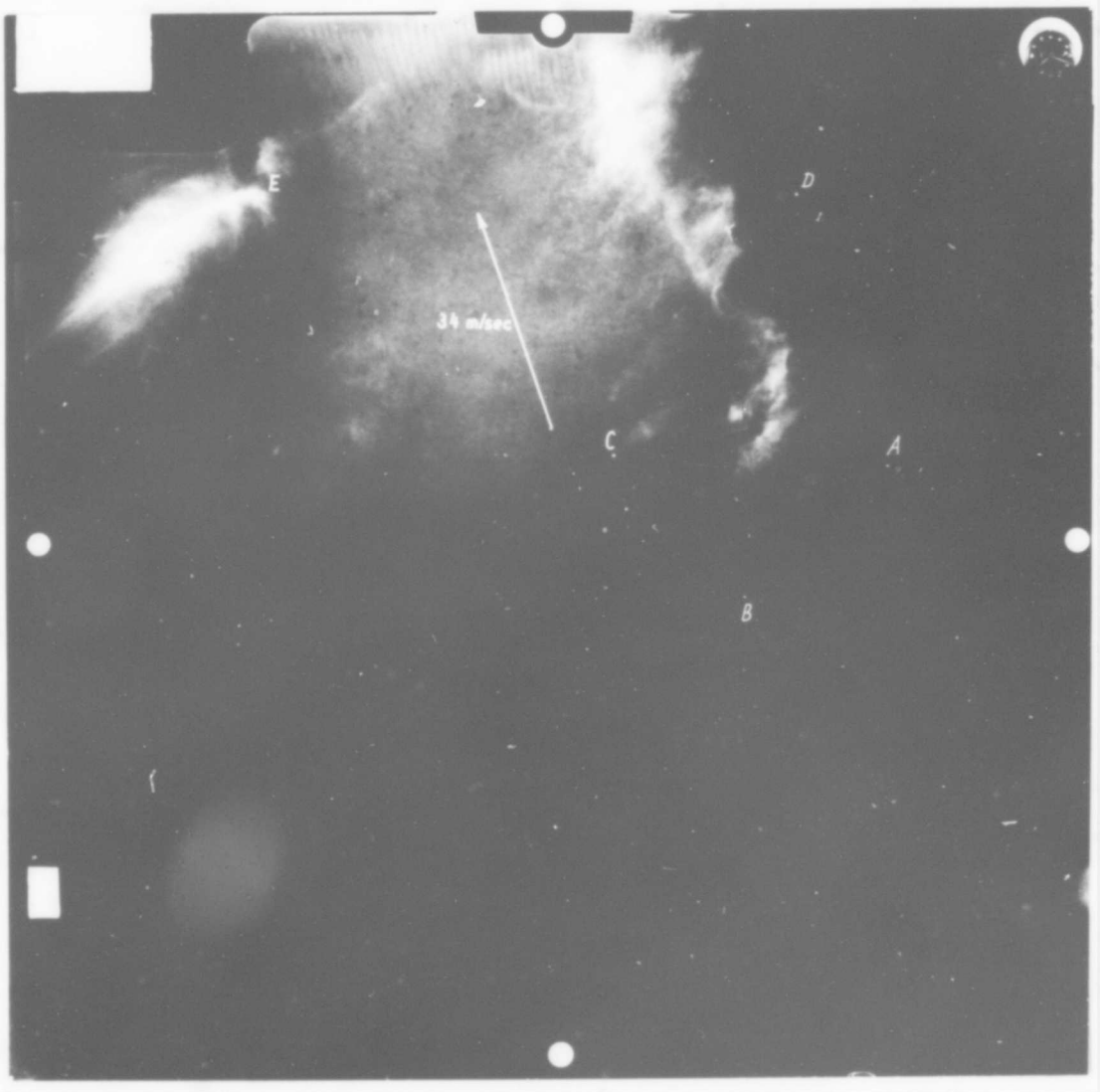


Fig. 4: 2 March 1957, 12:26: Photograph of right (northern) camera, toward zenit, depicting portion of the band. Capital letters refer to Fig. 5a.

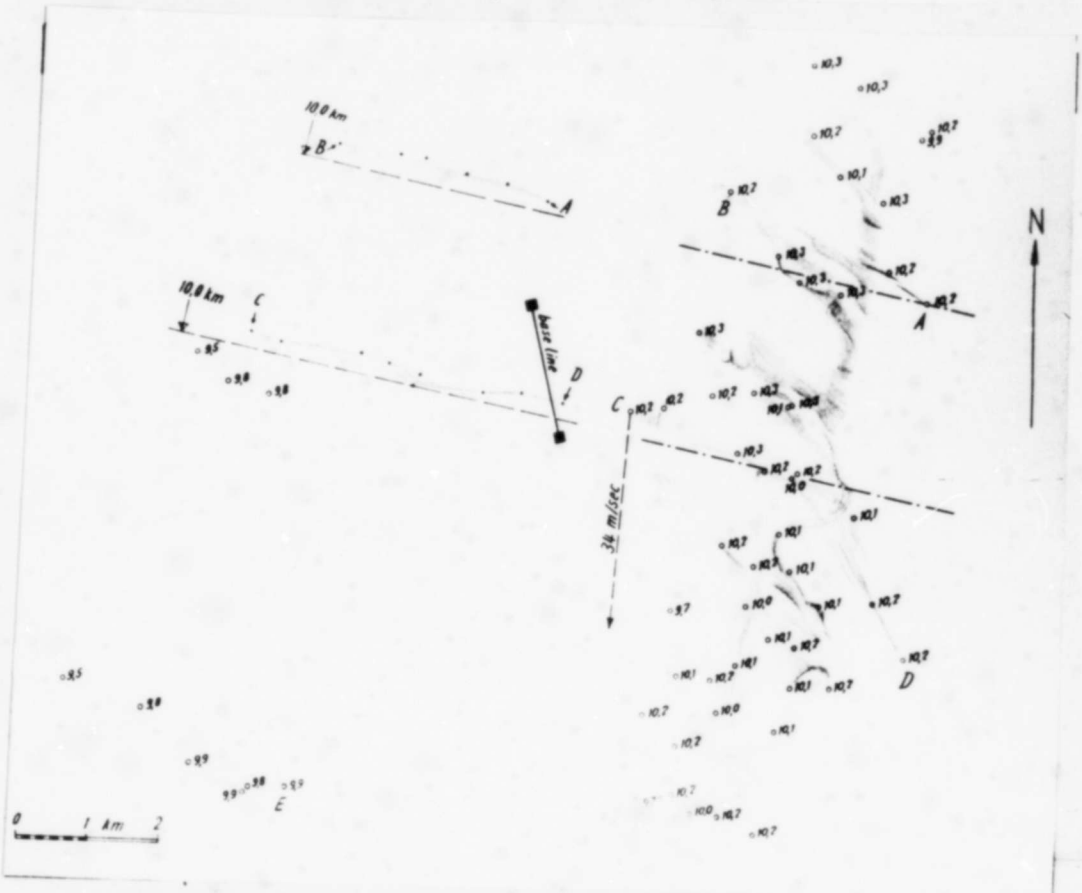


Fig. 5a: 2 March 1957: Topography of the band depicted in Fig. 4; altitudes in [km]. Positions of cross sections dash-stippled, respective cross sections at the left.

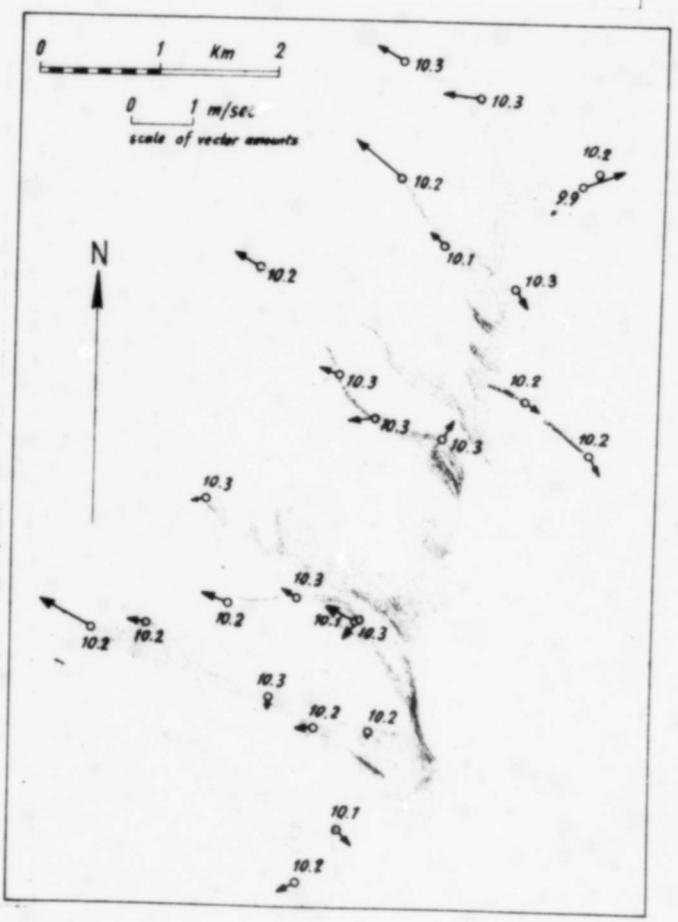


Fig. 5b: Portion of band depicted in Figs. 4, 5a; arrows denote vectors of small scale motion with respect to band-fixed coordinate system.

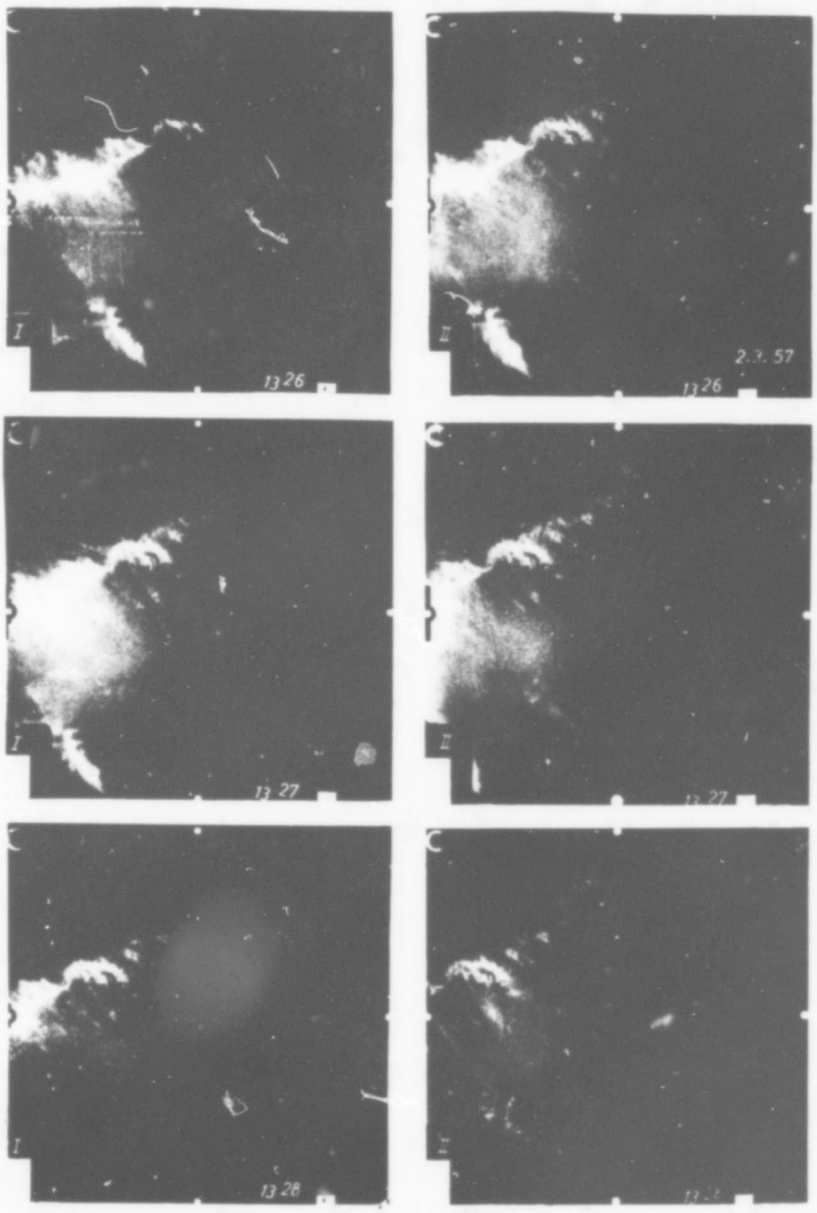


Fig. 6: 2 March 1957: Successive stereo pictures of portion of ci-bands at 12:26, 12:27, 12:28.

Fig. 7a: 2 March 1957, 12:40:
Small panorama toward SW.

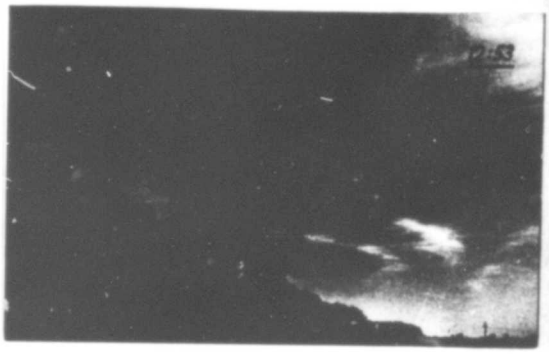
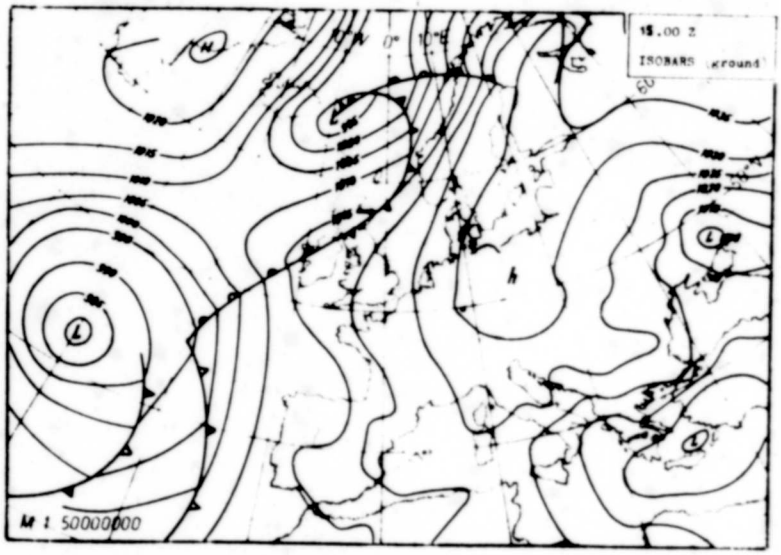


Fig. 7b: Photo at 12:53 toward SSW.

Fig. 8: 2 March 1957, 15:00: Sea level isobars mb .



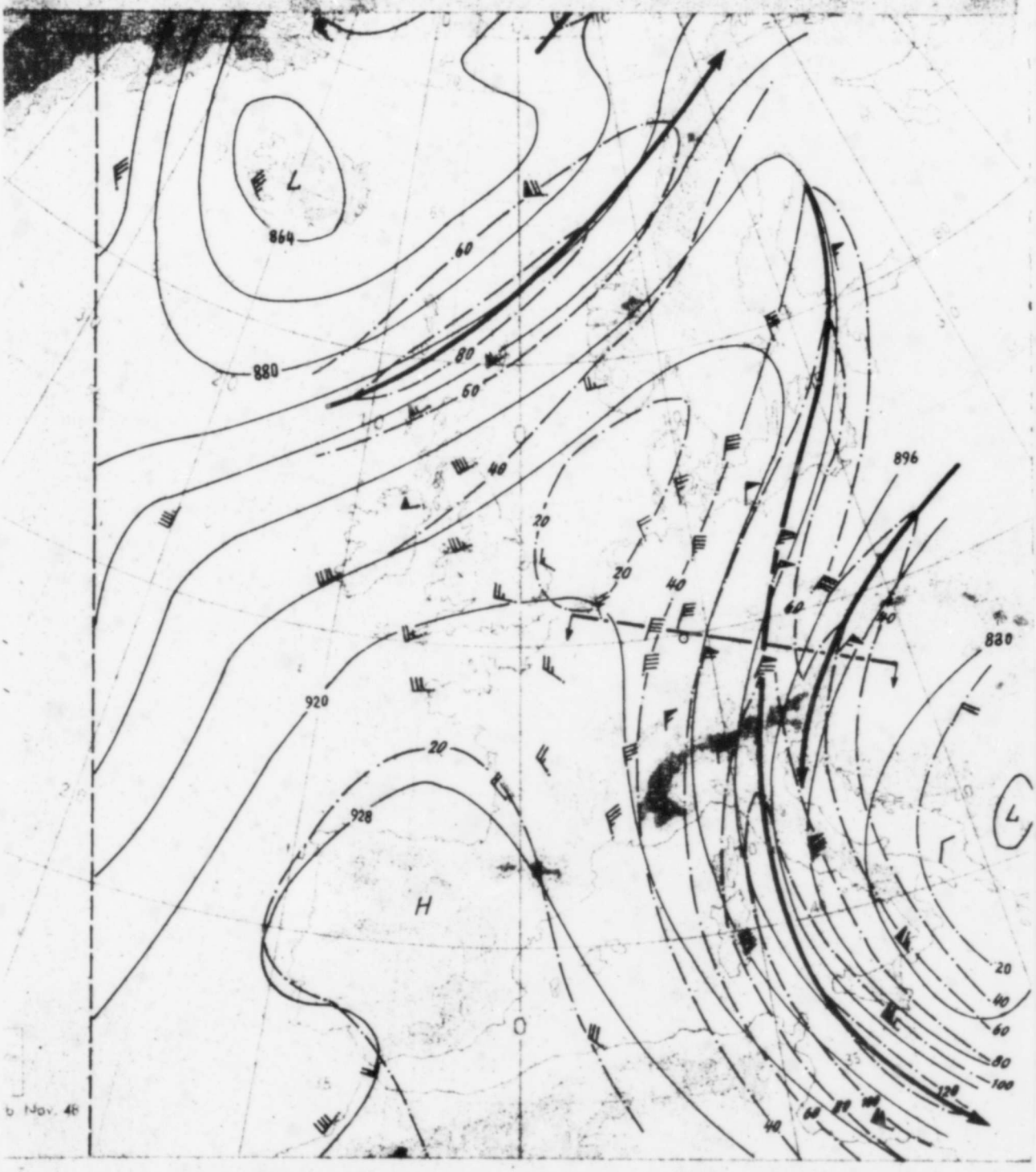


Fig. 9: 2 March 1957, 15:00 : 300 mb contours [10 gpm], isotachs [knots] (dash-dotted), and jet stream axes.

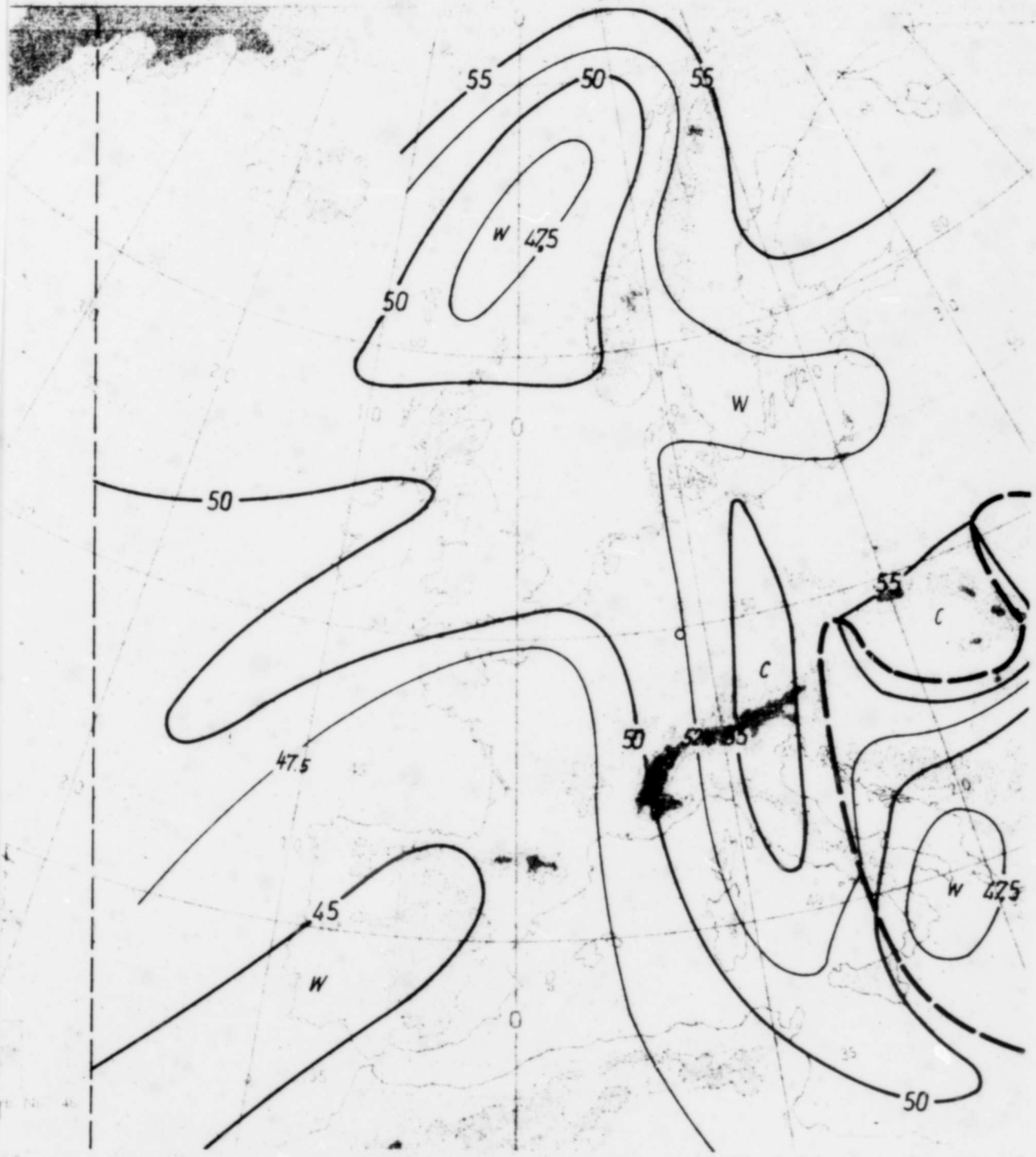


Fig.10 : 2 March 1957, 03:00 : 300 mb isotherms [-°C]. Dashed : Tropopause.

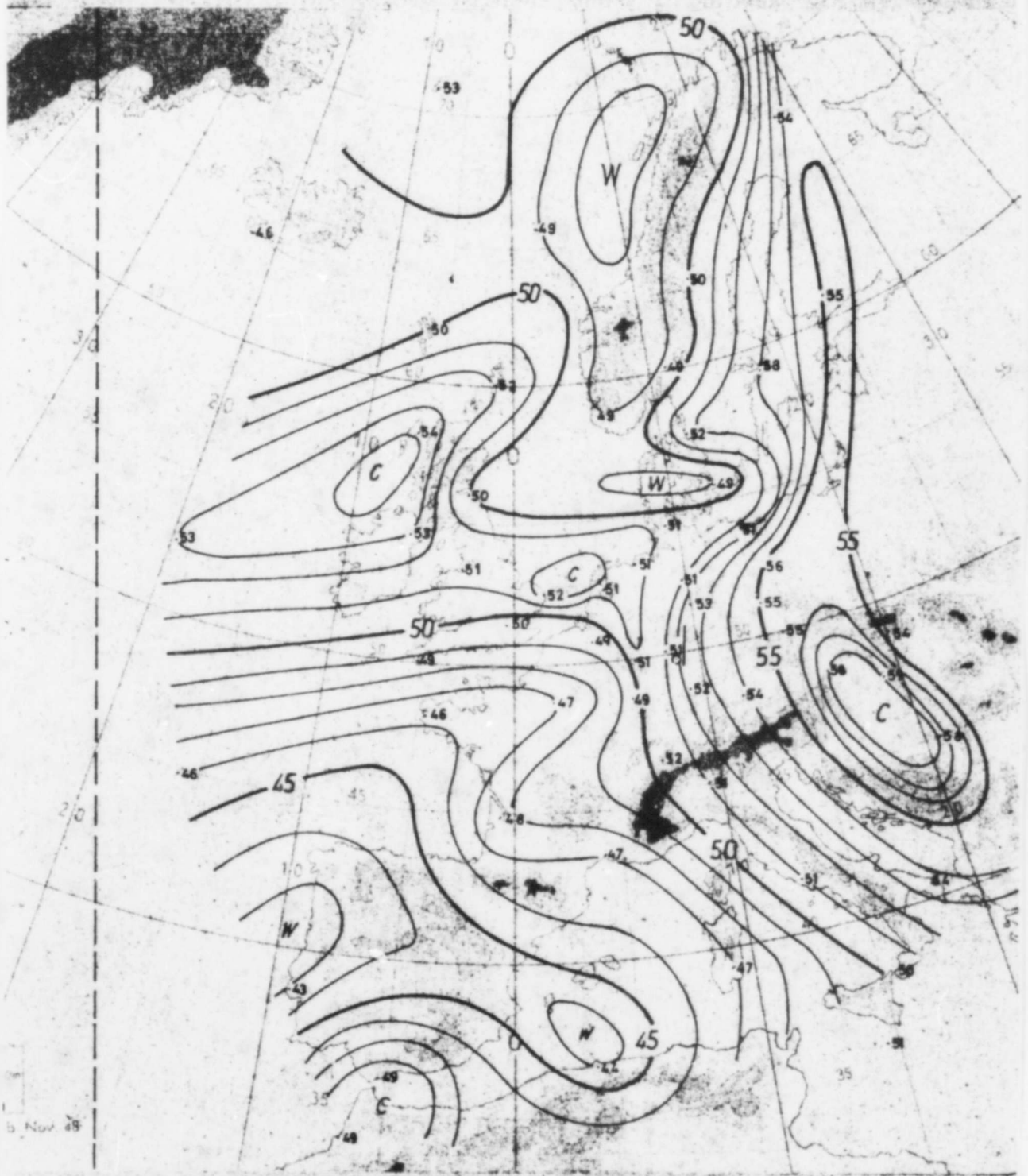


Fig. 11: 2 March 1957, 15:00 ; 300 mb isotherms [-°C]. Short line near the 50°N/10°E intersection marks position of ci-bands at 12:40.

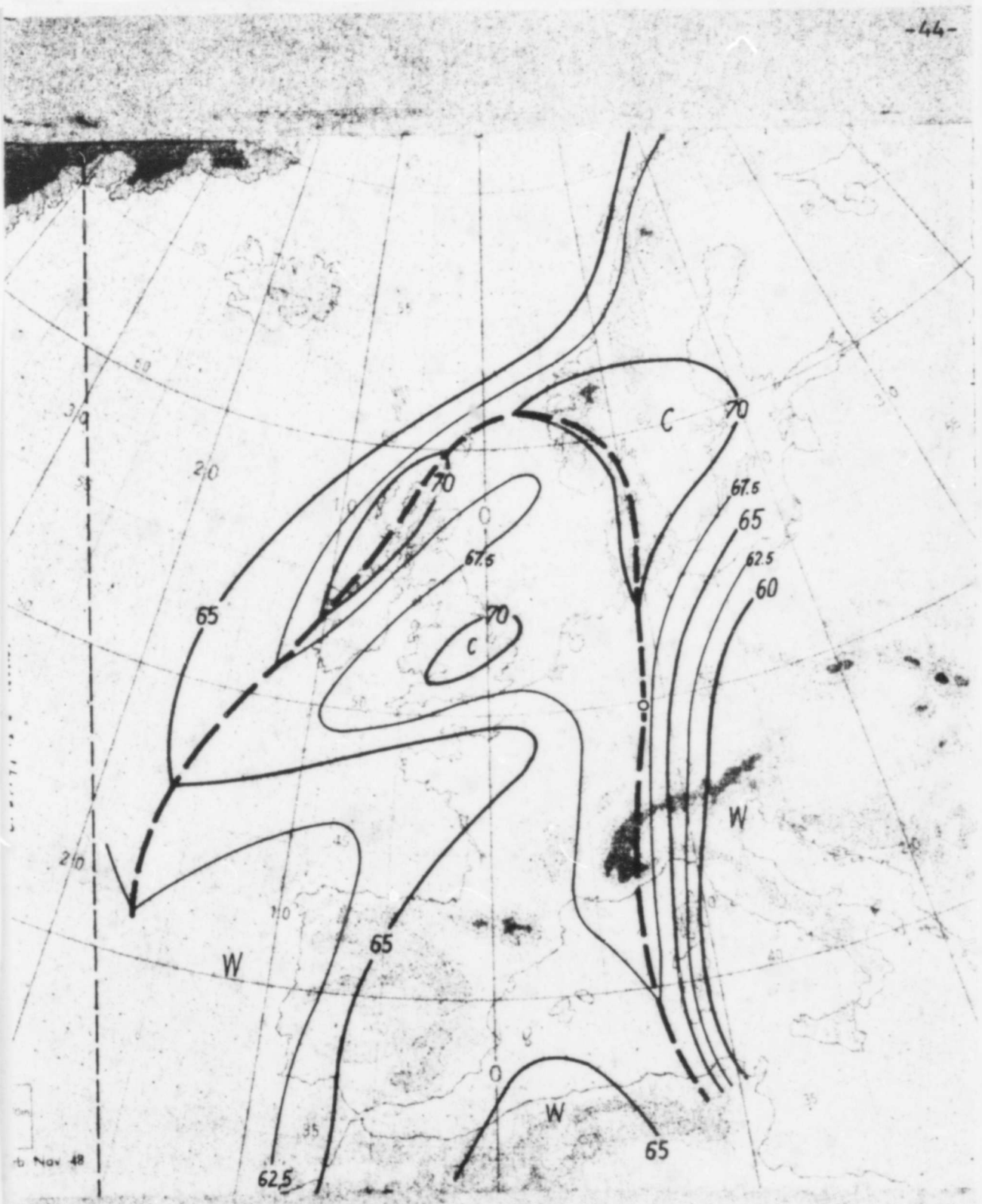


Fig. 12: 2 March 1957, 12h00 : 200 mb isotherms [-°C] . 200 mb level over western Europe still below the tropopause (dashed line).

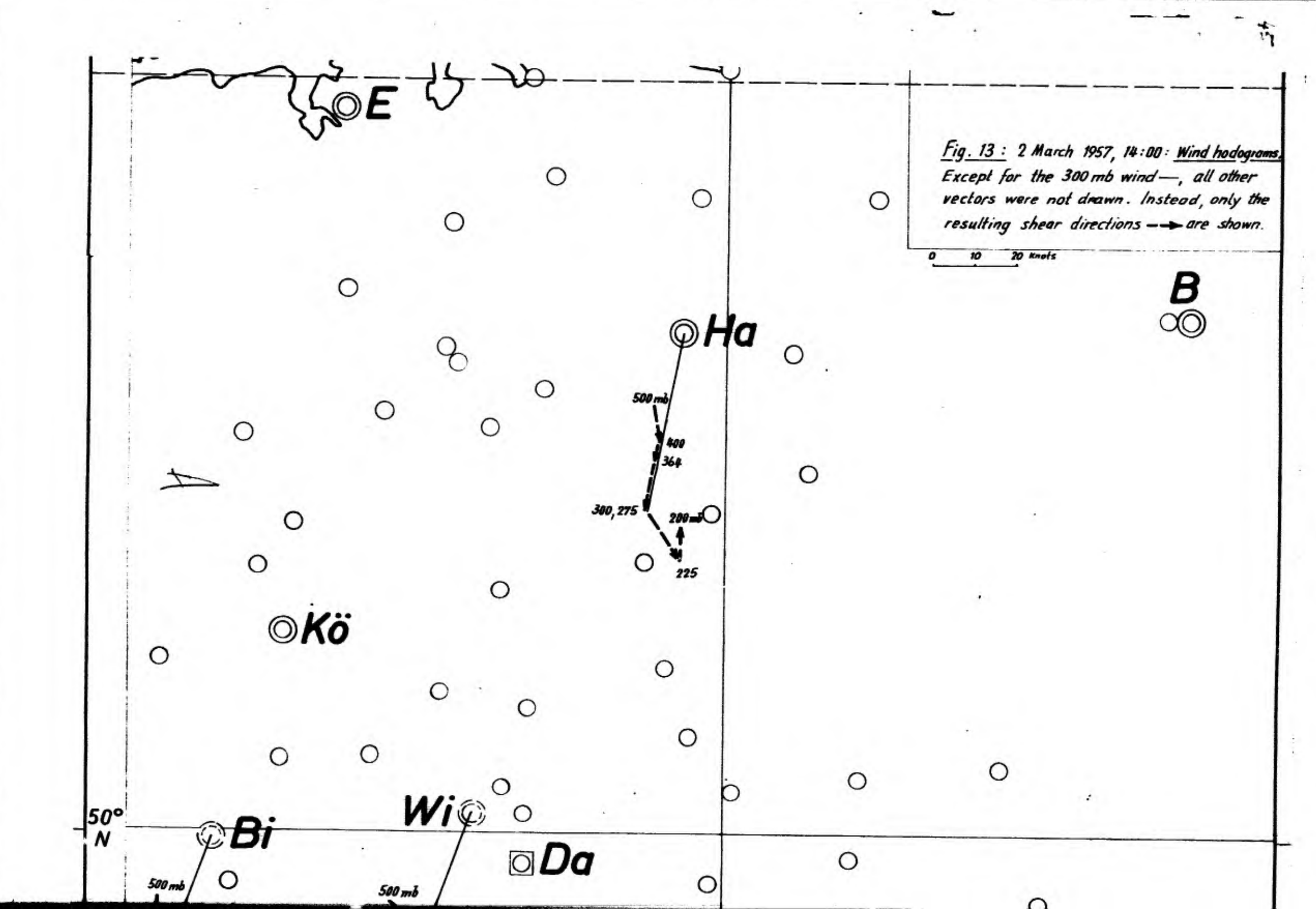
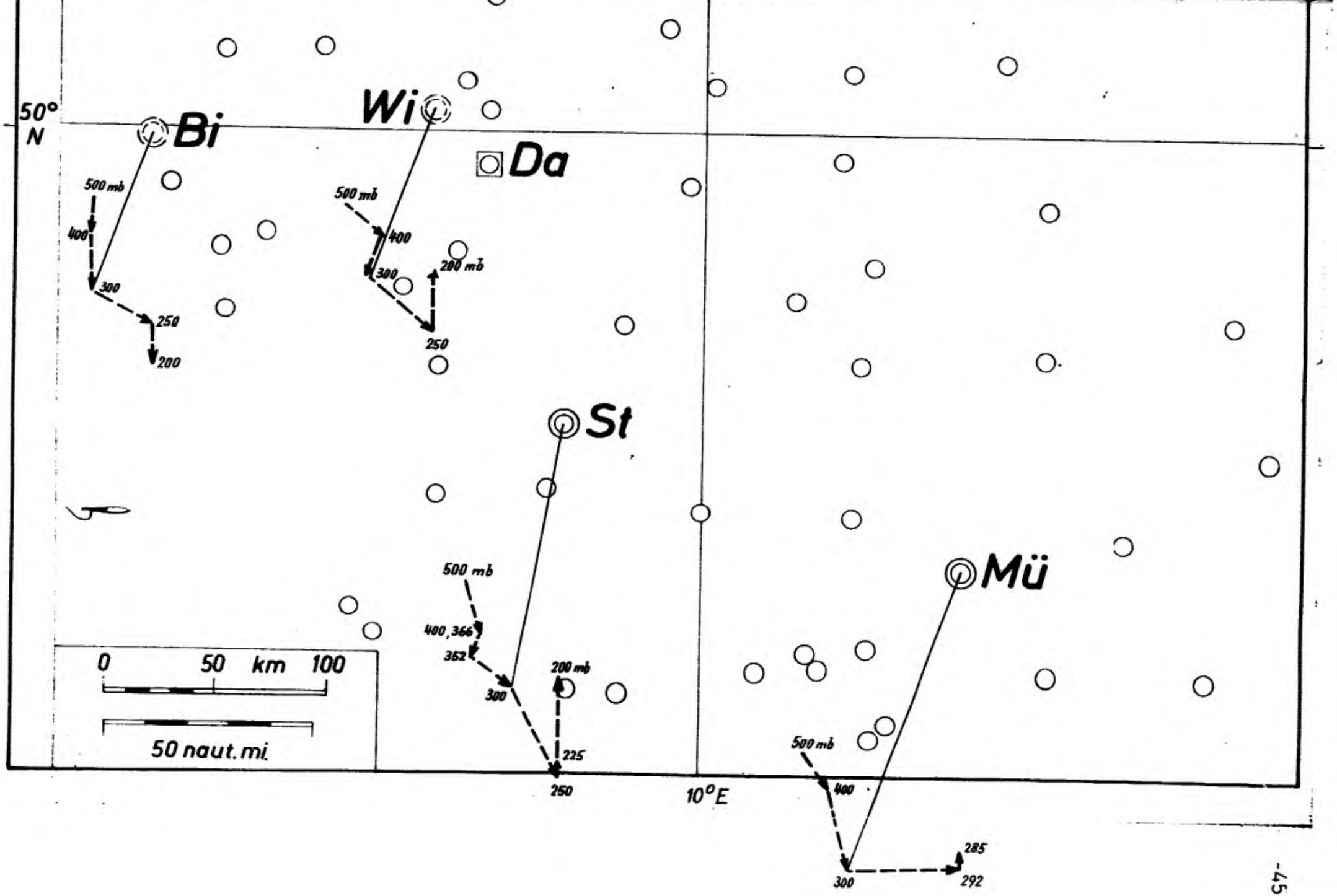


Fig. 13 : 2 March 1957, 14:00 : Wind hodograms. Except for the 300 mb wind —, all other vectors were not drawn. Instead, only the resulting shear directions ⟶ are shown.

0 10 20 Knots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362
200 mb
225
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50 naut. mi.
10° E
285
292

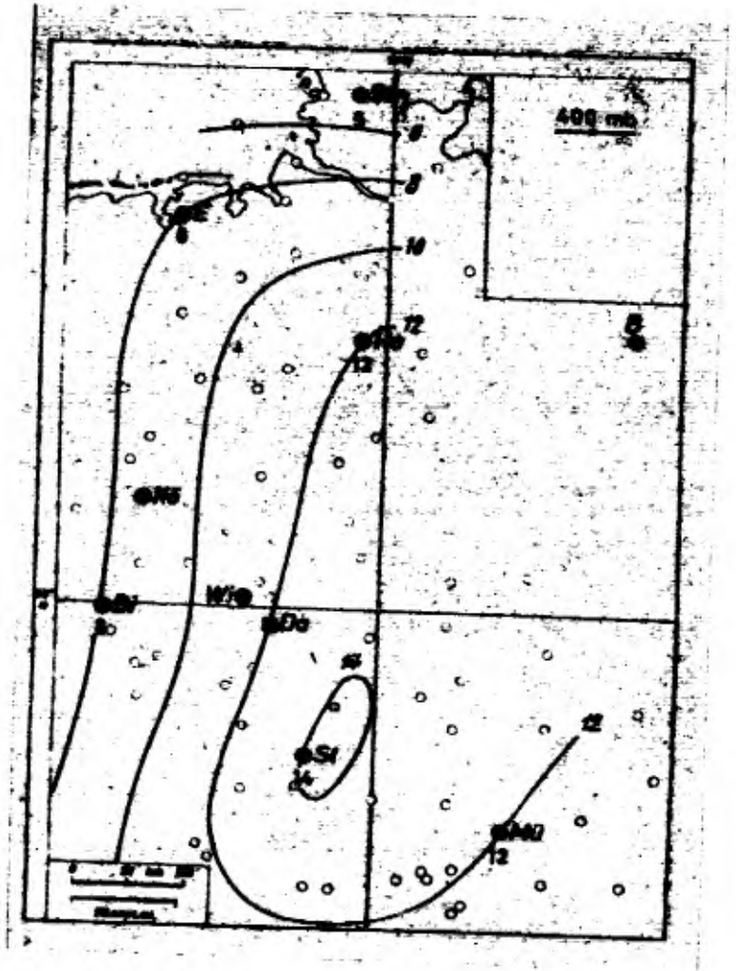


Fig. 14 : 2 March 1957, 14:00 : 400 mb - isohumids ($T-T_d$) [°C].

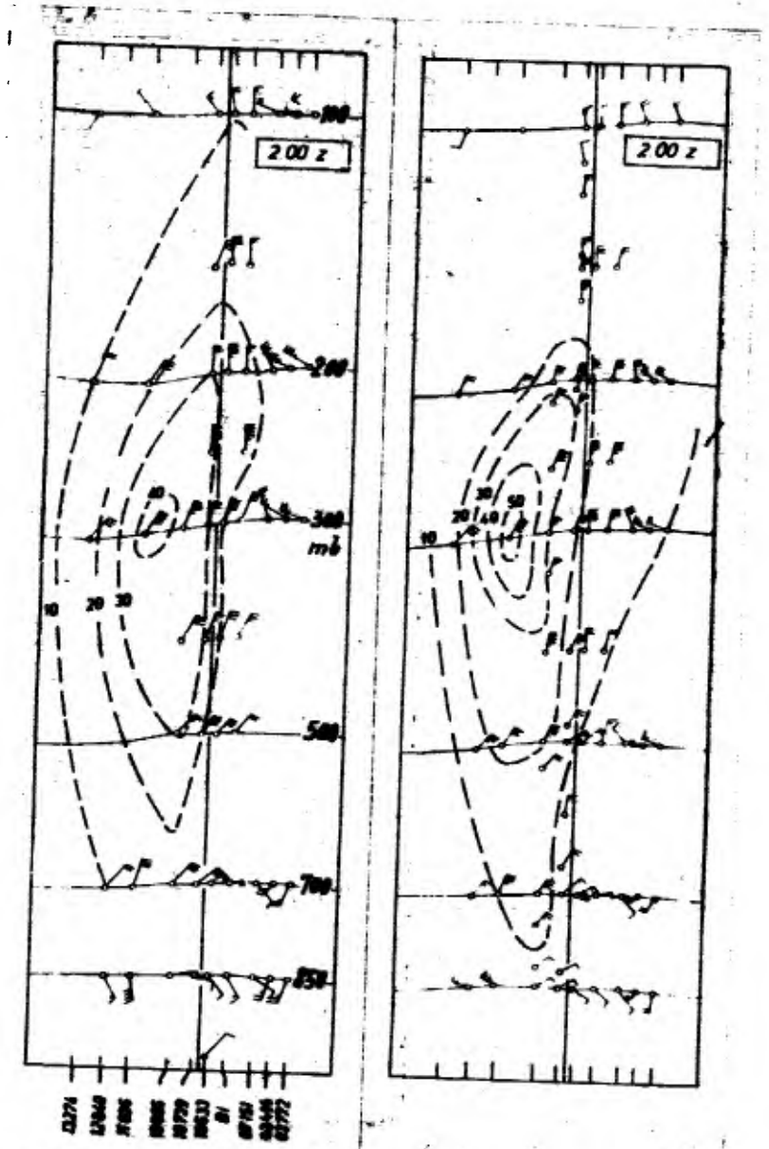


Fig. 15a : 2 March 1957, 02:00 : Wind cross section

Fig. 15b : 3 March 57, 02:00 : Wind cross section

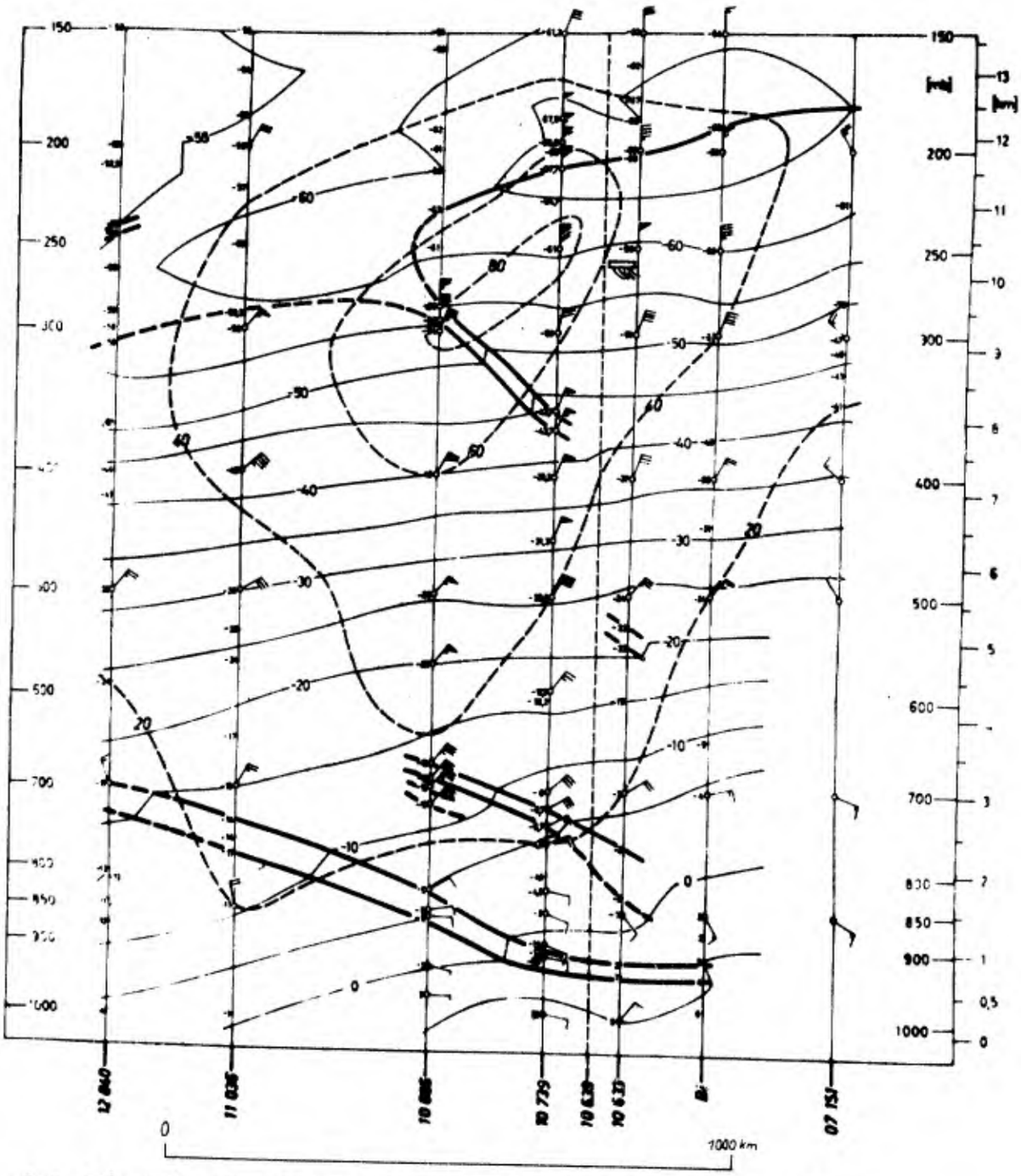


Fig. 16: 2 March 1957, 14:00: Cross section of wind [knots] and temperature [°C], for position, see Fig. 9. Vertical line over Darmstadt [10 639] dashed, nearby rectangle marks ci-band level. Thick line marks base of tropopause, thick dashed lines mark layers of increased stability. "Wrap-around front" in accordance with scheme of CONOVER [6].

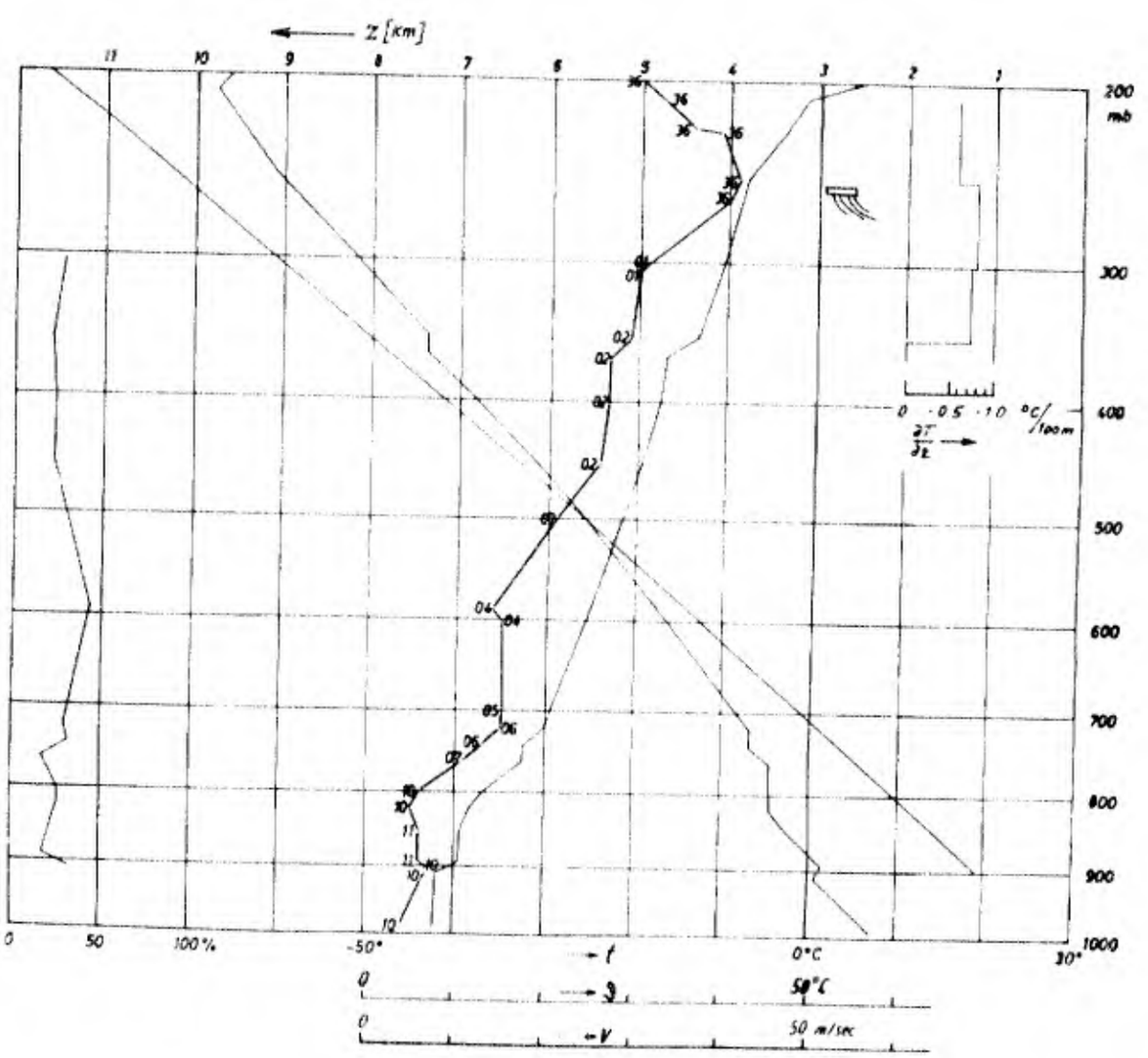


Fig. 17: 2 March 1957, 14:00: Wind, temperature, $p(z)$ and humidity sounding of Stuttgart, contanckereous line ending at upper right denotes the potential temperature. At outer right: $\partial T/\partial z$. Small rectangle marks altitude of ci-bands over Darmstadt at 12:40.

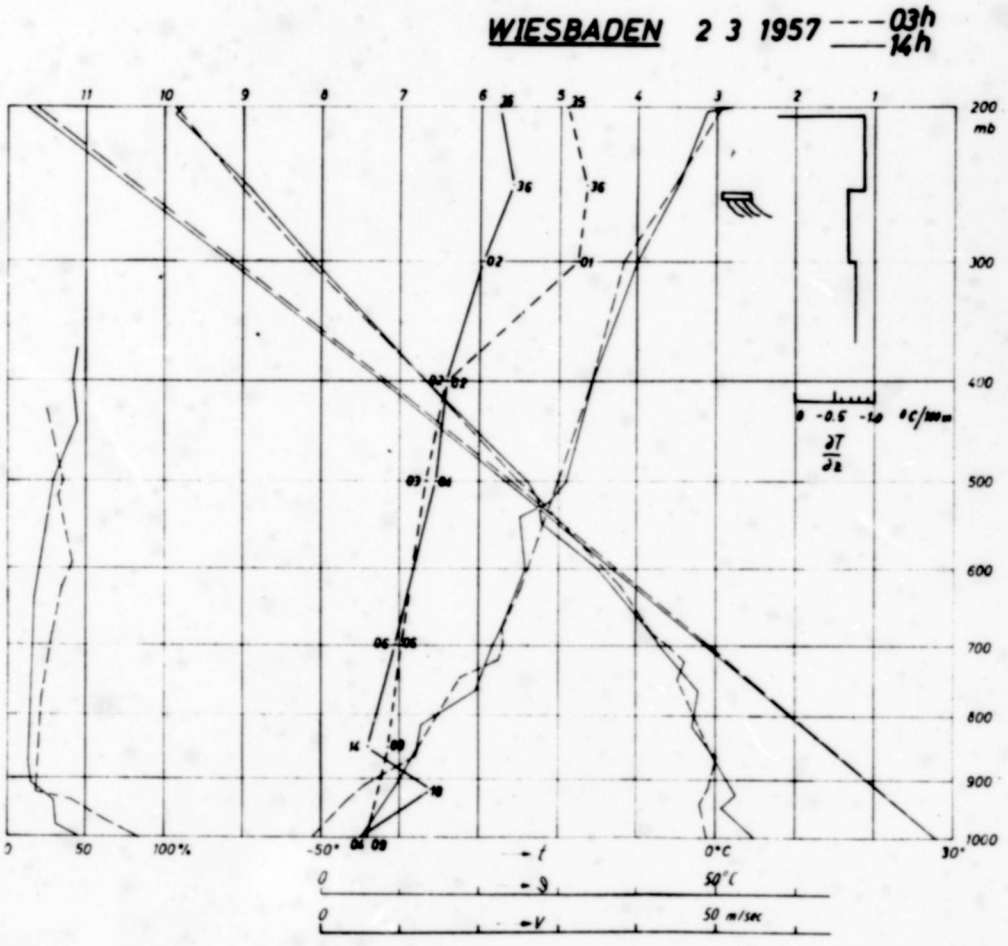


Fig. 18: 2 March 1957: Wiesbaden soundings at 03:00 and 14:00. At outer right: $\partial T/\partial z$. Small rectangle marks altitude of ci-bands over Darmstadt at 12:40.

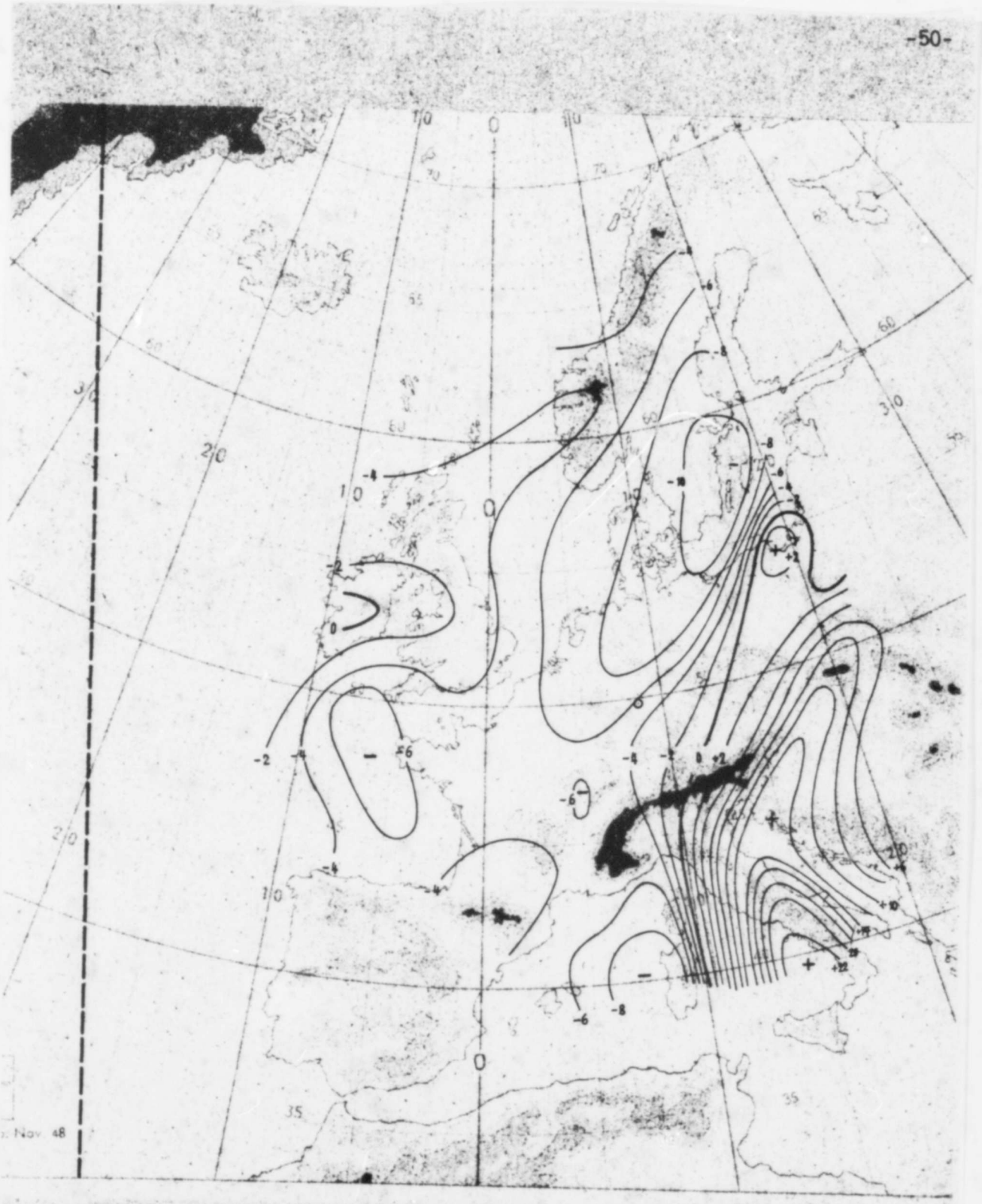
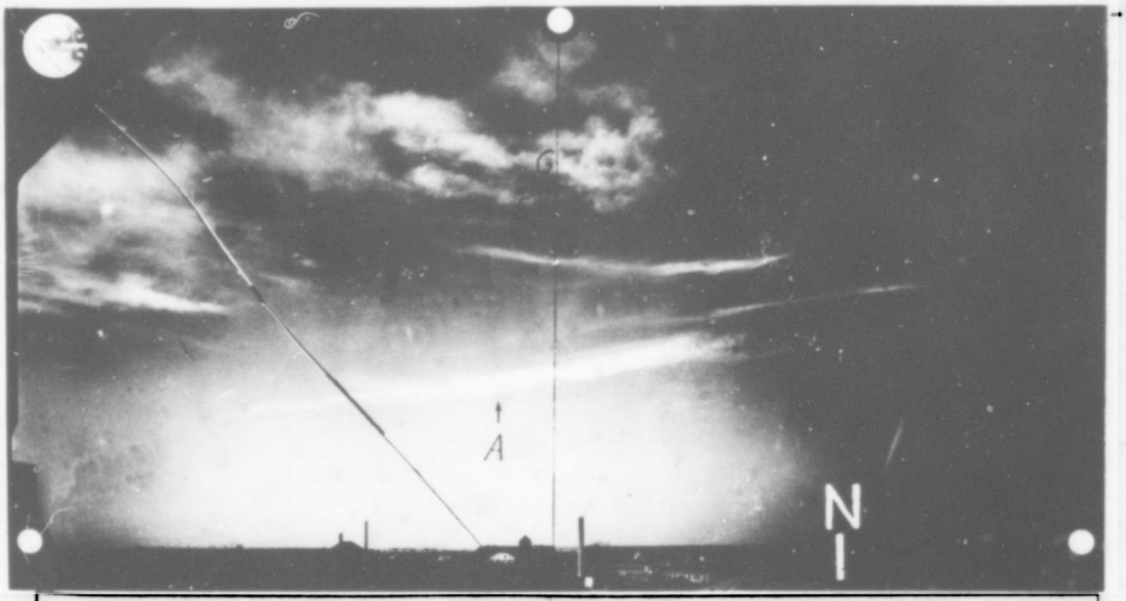


Fig. 19: 2 March 1957, 15:00Z 300 mb relative vorticity $\left[10^{-5}\ \text{sec}^{-1}\right]$.



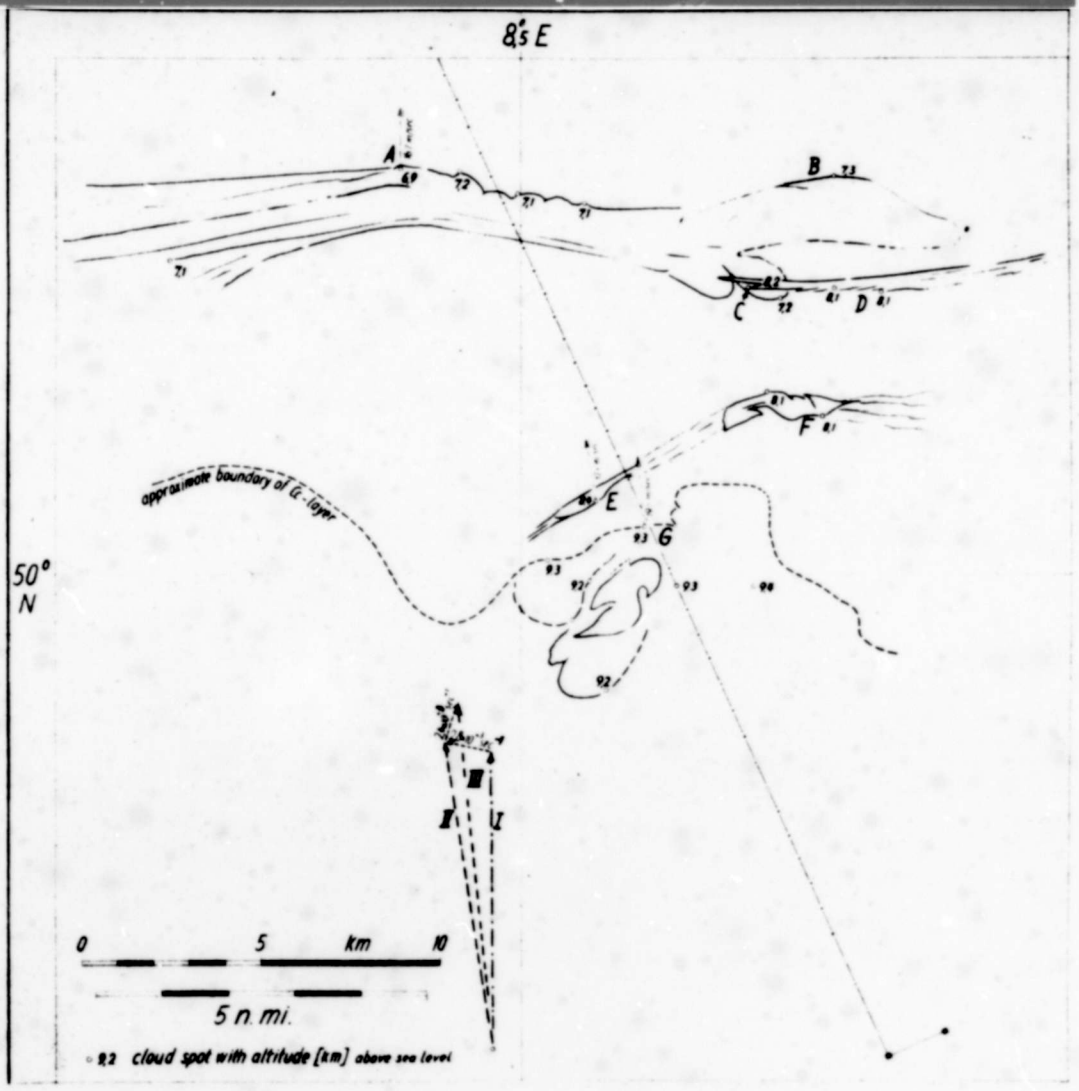


Fig. 1: 6 Nov 1962, 14:14: Photograph and plan; vertical fiducial line in the photograph marks the taking direction (dash-stippled in plan, starting at left camera of baseline, below right).

14:05

14:08

Fig. 2a: 6 Nov 1962: Photographs at 14:05 and 14:08, toward NNW. Photographic axis tilted 45°.

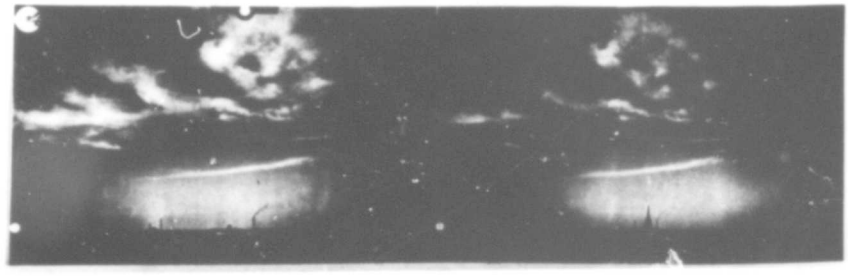


Fig. 2b: 6 Nov 1962, 14:19: Stereo pair, also taken toward 336°.

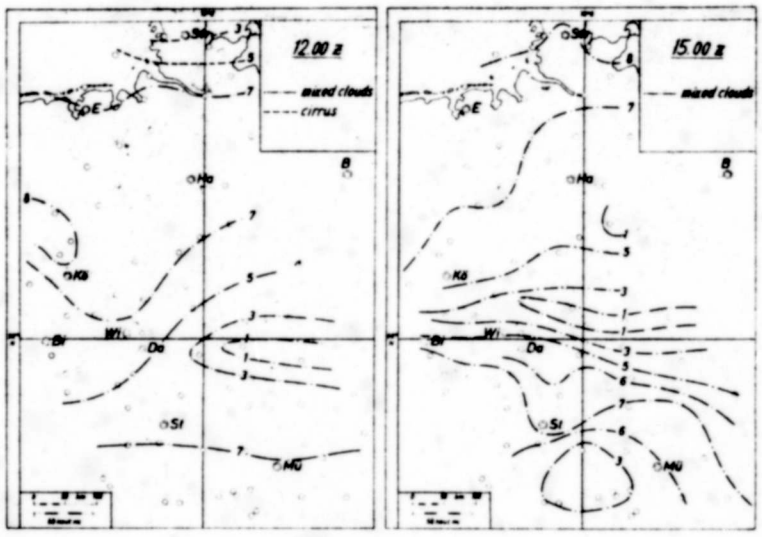
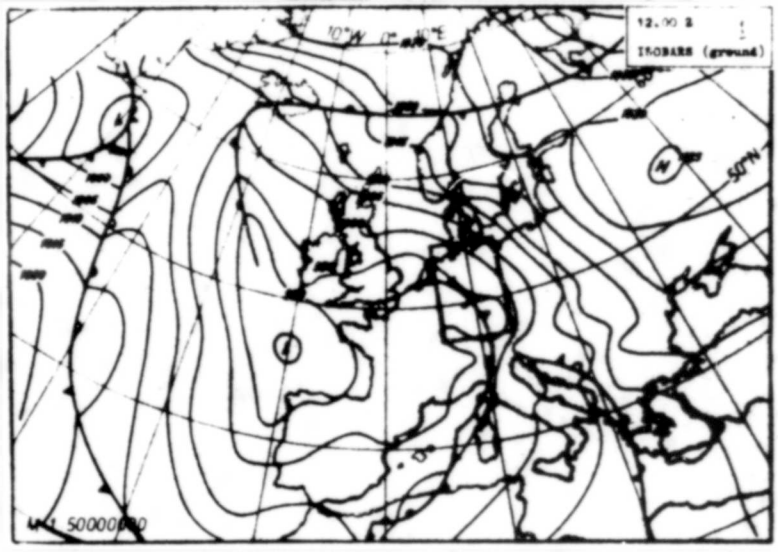


Fig. 3: 6 Nov 1962: Isonephs at 12:00 and 15:00; cloud cover is composed exclusively out of ci (60%) and ac (40%).

Fig. 4: 6 Nov 1962, 12:00: Sea level isobars [mb].



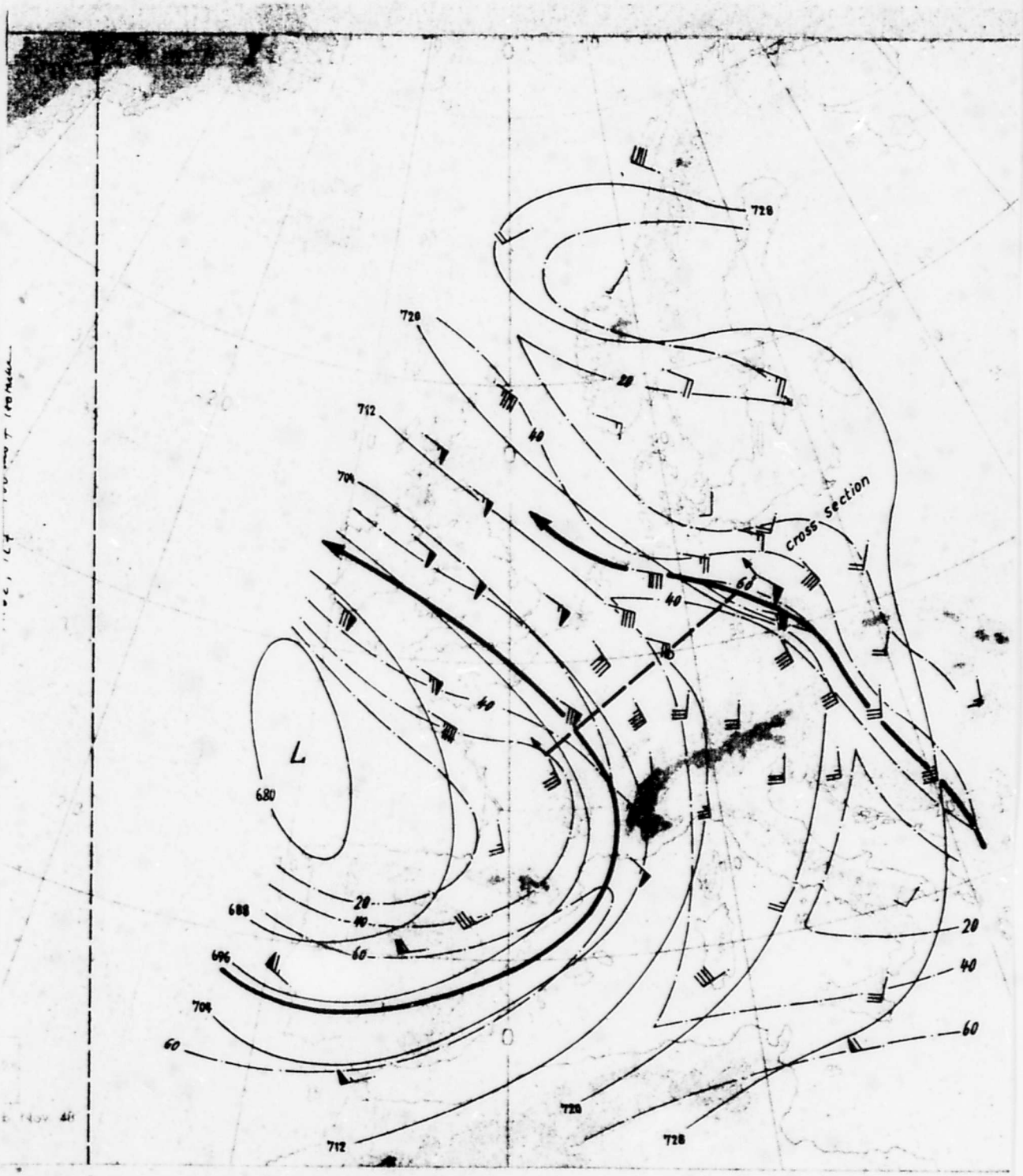


Fig. 5 : 6 Nov 1962, 12:00 : 400 mb contours [10 gpm] , isotachs [knots] dash-stippled, and jet stream axes.

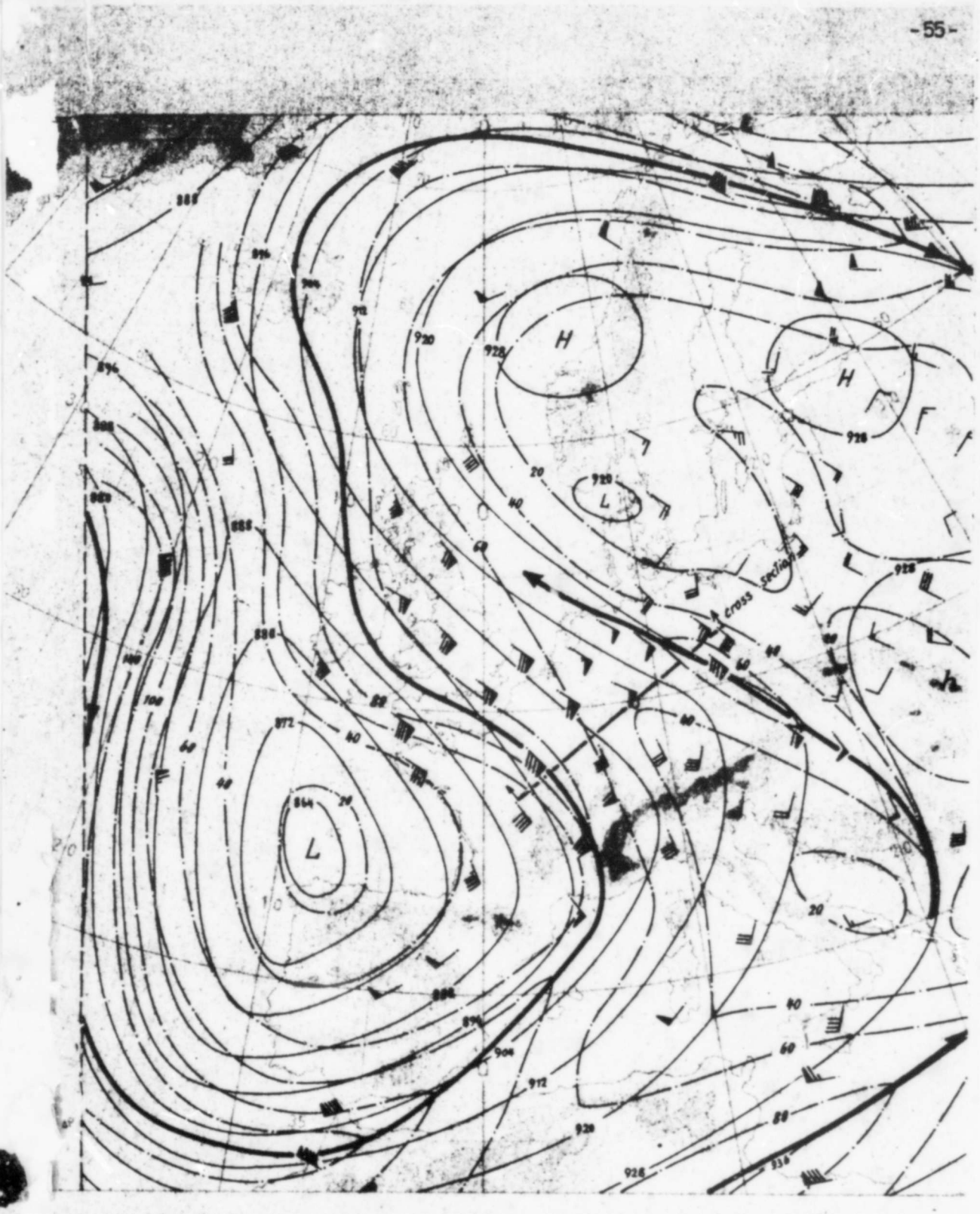


Fig. 6 : 6 Nov 1962, 12:00 : 300 mb contours [10 gpm] , isotachs [knots] dash stippled, and jet stream axes.

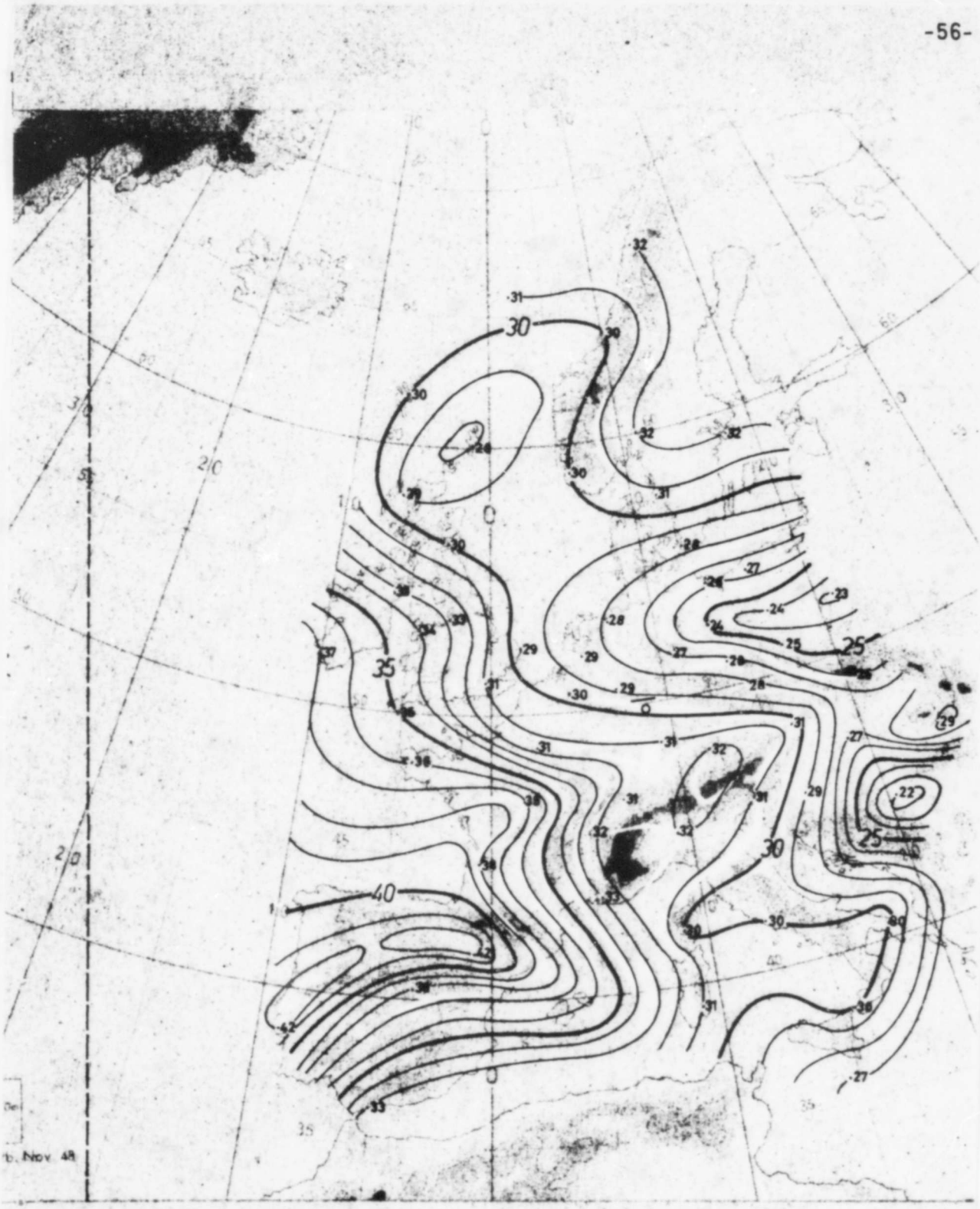


Fig. 7: 6 Nov 1962, 12:00; 400 mb isotherms [-°C]. Short line near the 50°N/ 10°E intersection depicts position of short ci-streaks at 14:15.

Fig. 8 : 6 Nov 1962, 12:00 : 300 mb isotherms [-°C] .
Short line near the 50°N/10°E intersection depicts position of short oi-streaks at 14:15.

Dashed line: tropopause.

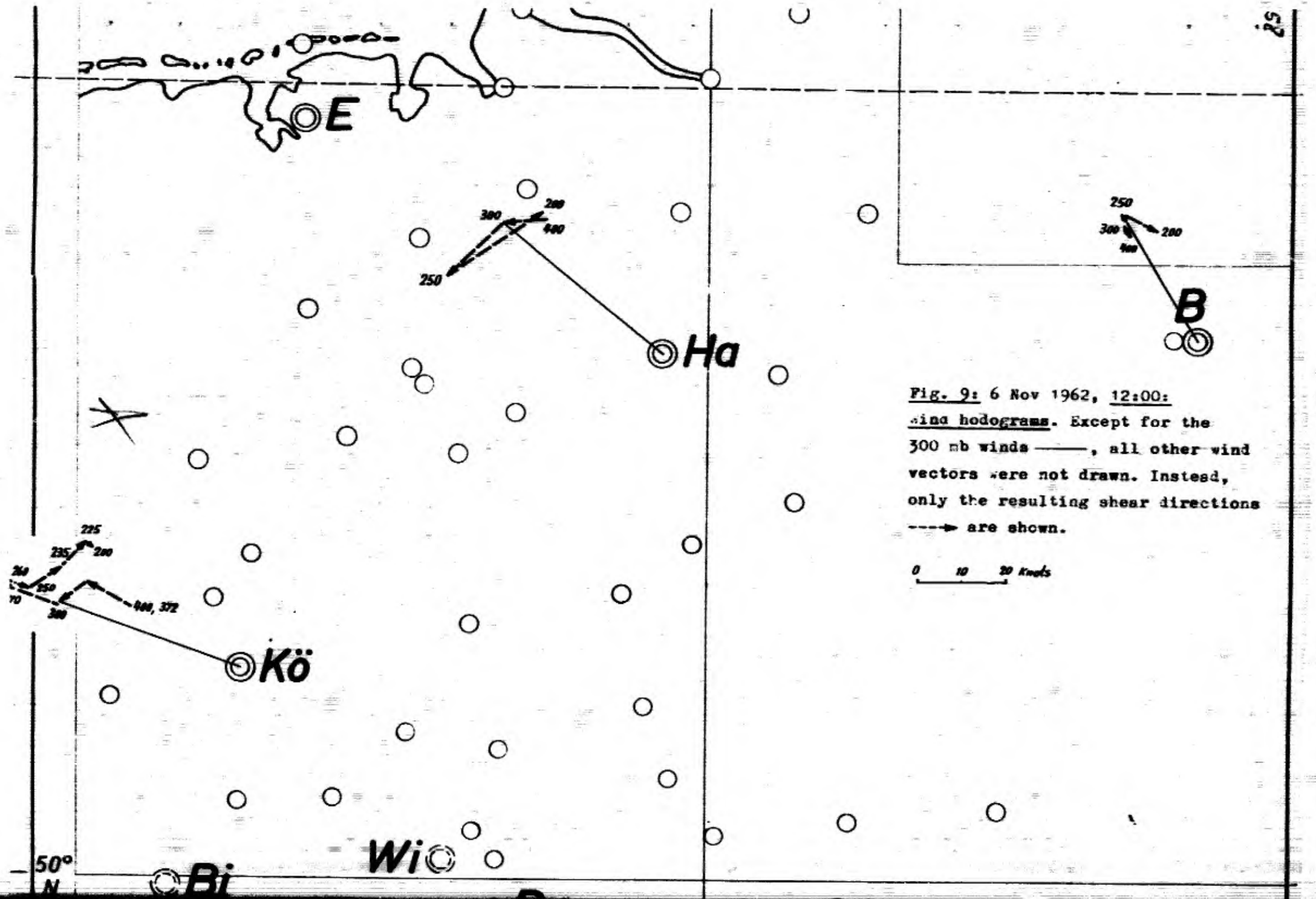
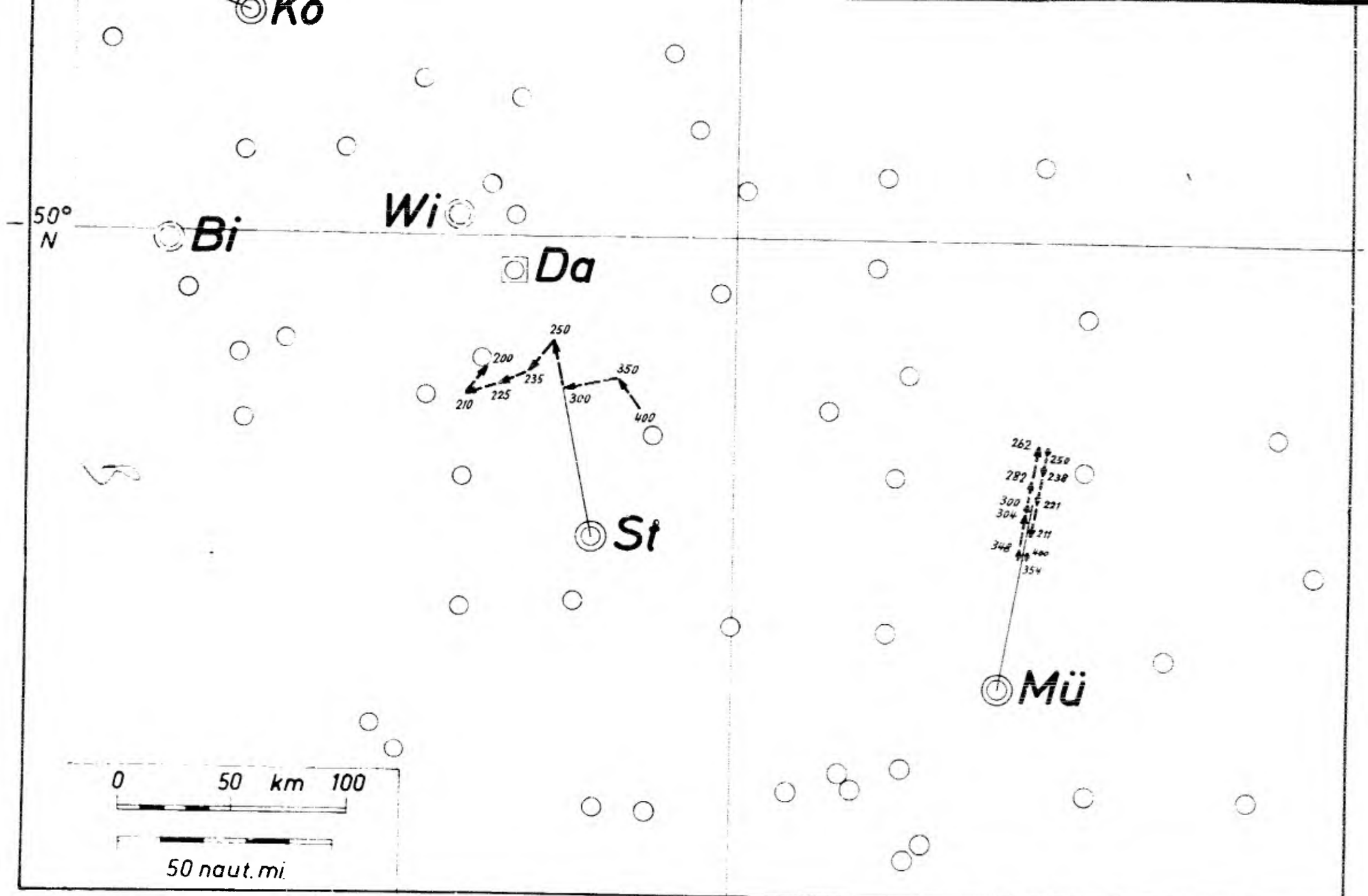


Fig. 9: 6 Nov 1962, 12:00: Wind hodograms. Except for the 300 mb winds ———, all other wind vectors were not drawn. Instead, only the resulting shear directions ----→ are shown.

0 10 20 Knots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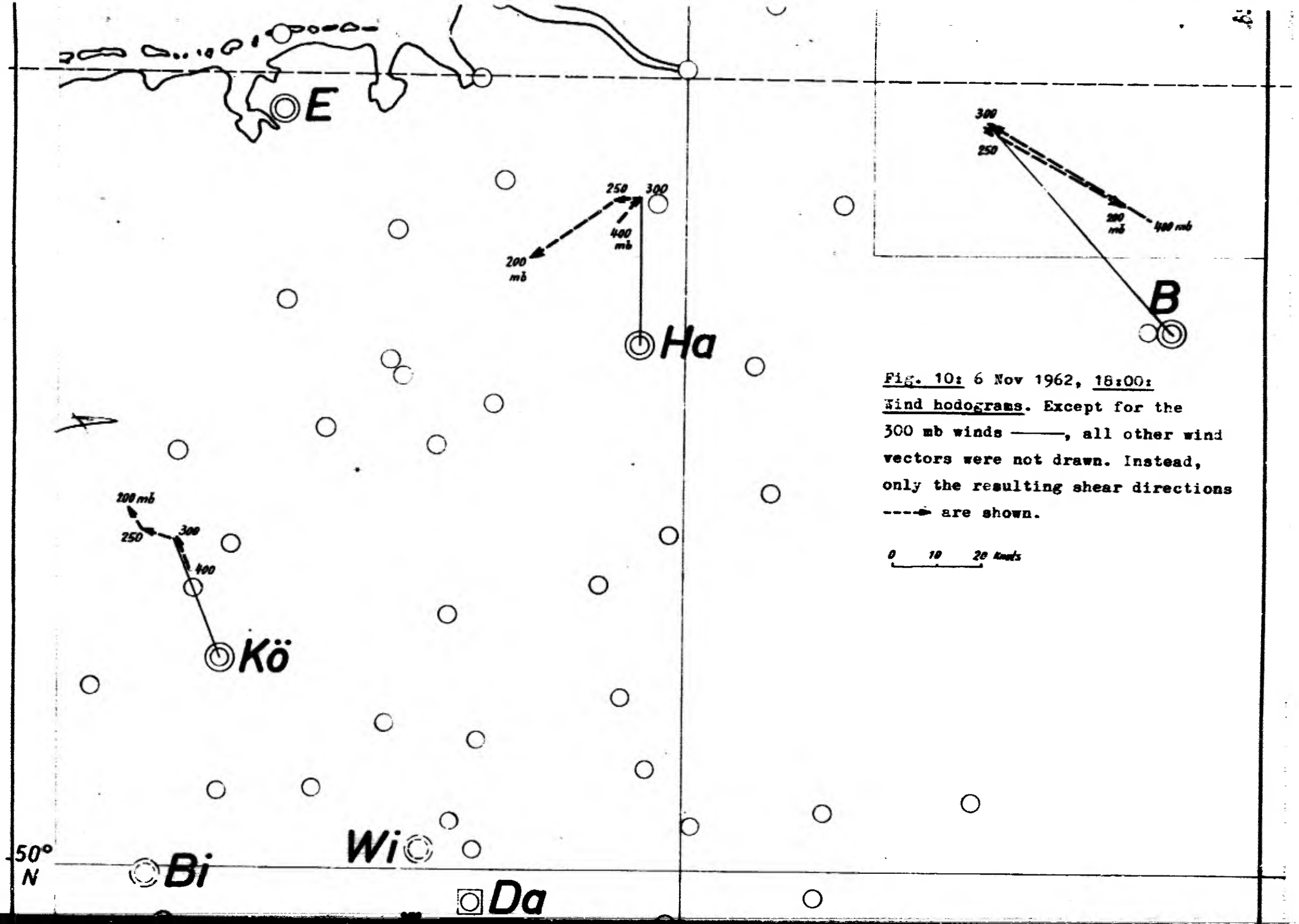
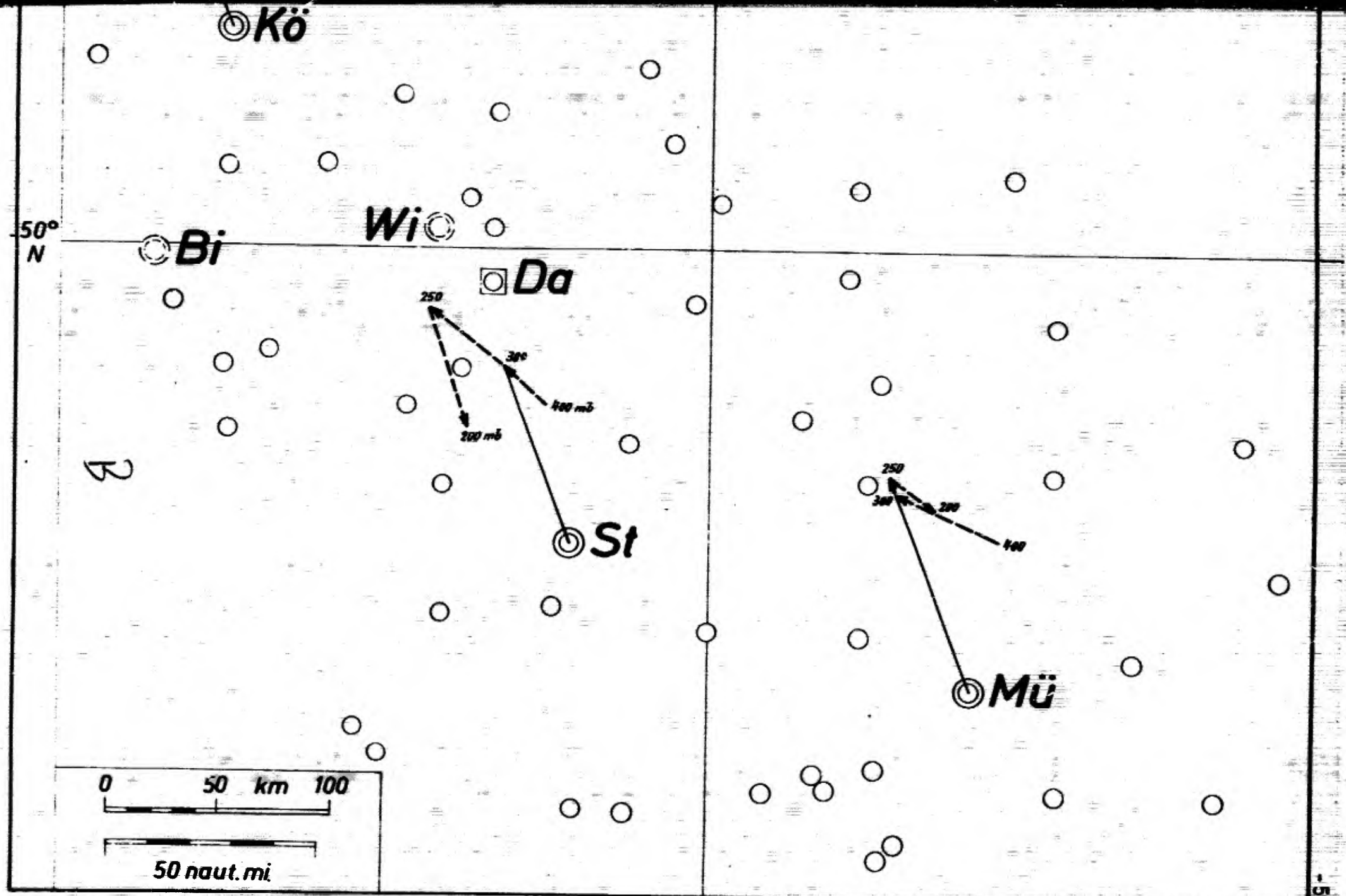


Fig. 10: 6 Nov 1962, 18:00: Wind hodograms. Except for the 300 mb winds ———, all other wind vectors were not drawn. Instead, only the resulting shear directions ----➔ are shown.

0 10 20 Knots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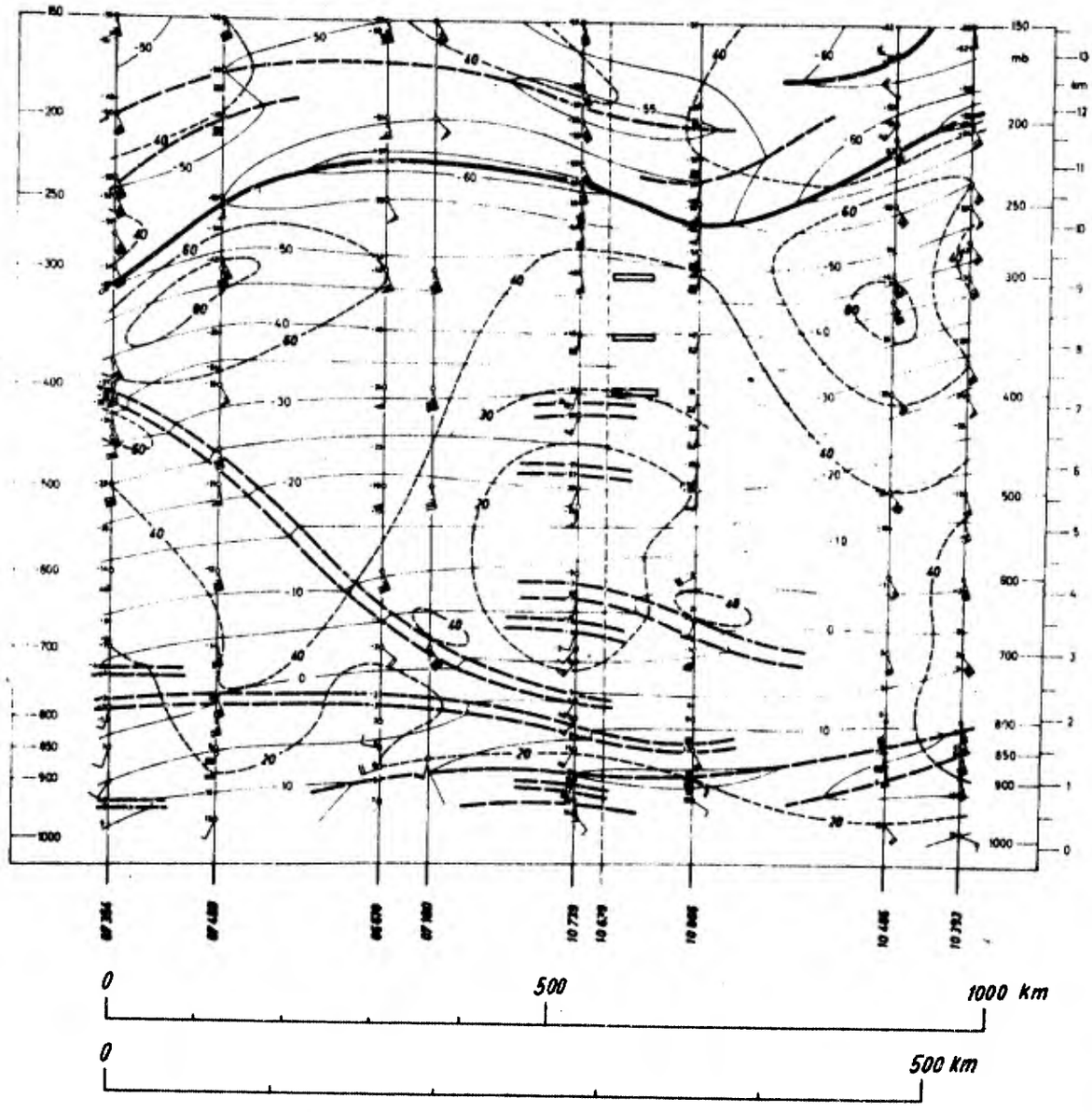


Fig. 11: 6 Nov 1962, 12:00 ; Cross section of wind [knots] and temperature [°C], for position, see Fig. 6 . Vertical line over Darmstadt [10639] dashed, nearby rectangles mark positions of three different cirrus systems.
Thick line marks base of tropopause and stable layer above, thick dashed lines mark layers of increased stability.

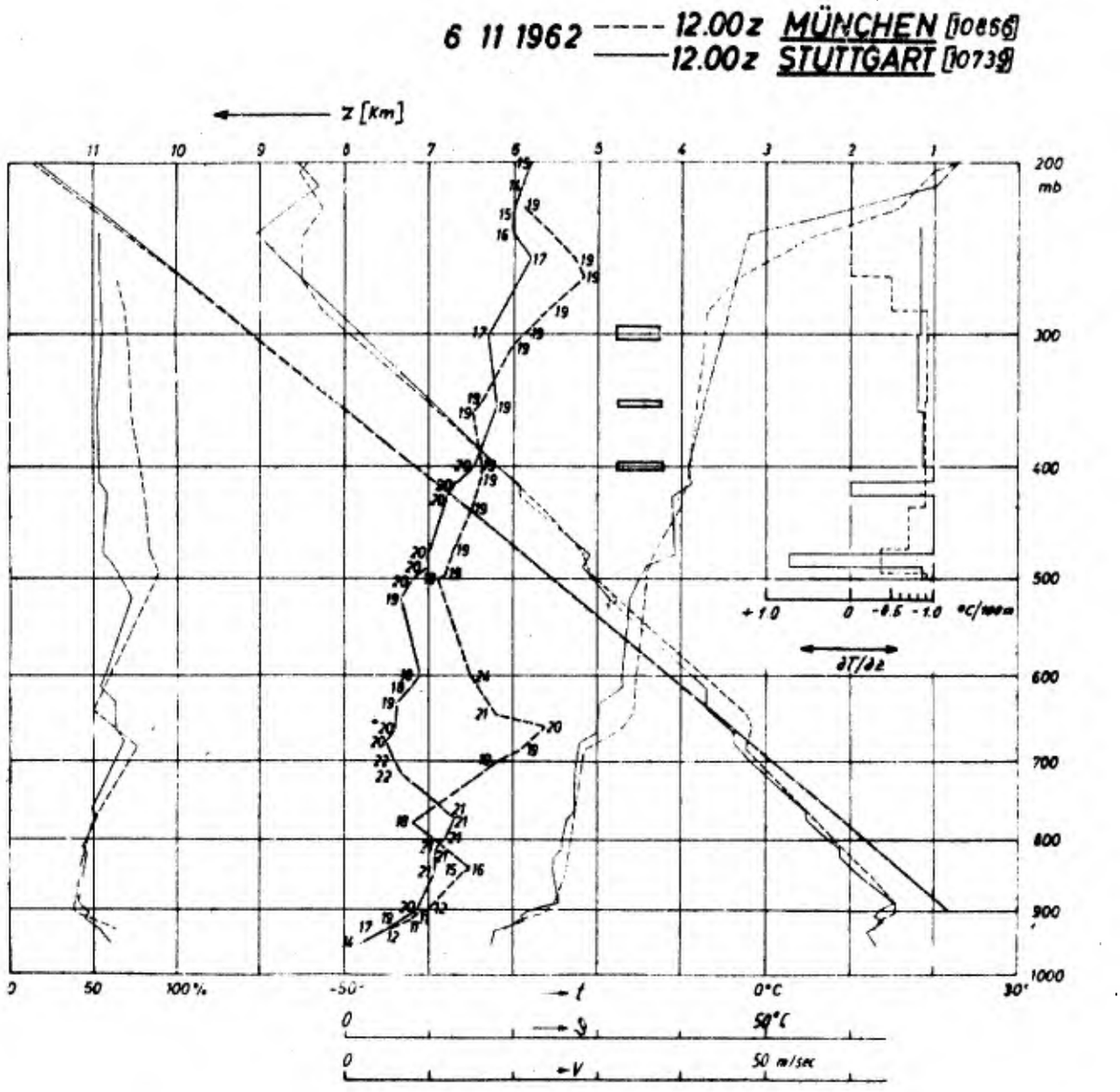


Fig.12: 6 Nov 1962, 12:00 : Wind, temperature, $p(z)$ and humidity soundings of Munich and Stuttgart. Outer right : $\frac{\partial T}{\partial z}$. Rectangles mark cirrus altitudes over Darmstadt at 14:15.

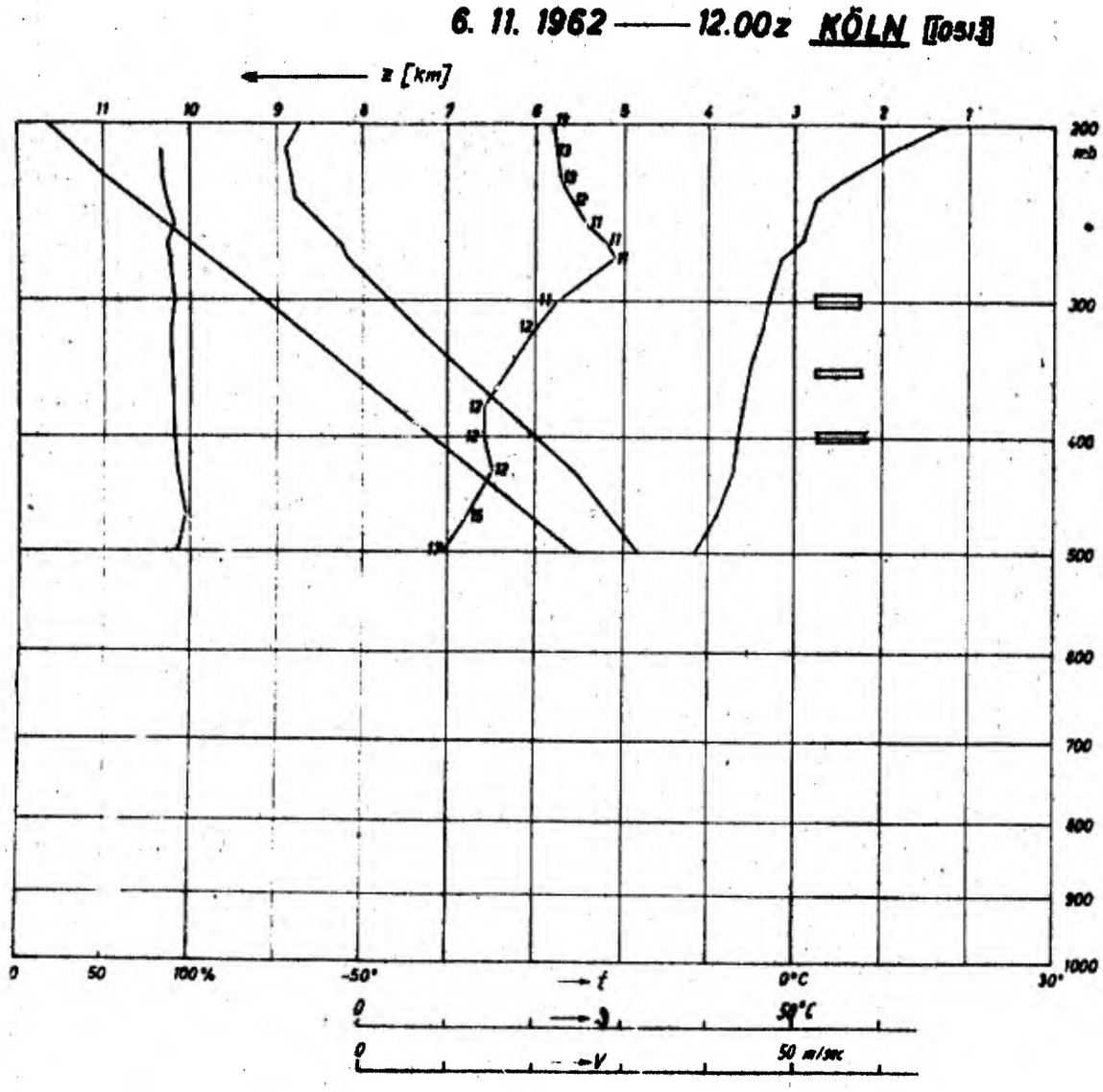


Fig. 13: 6 Nov 1962, 12:00 : Wind, temperature, humidity and p(z), within 500 ≤ p ≤ 200 mb, of Köln. Small rectangles mark cirrus altitudes over Darmstadt at 14:15.

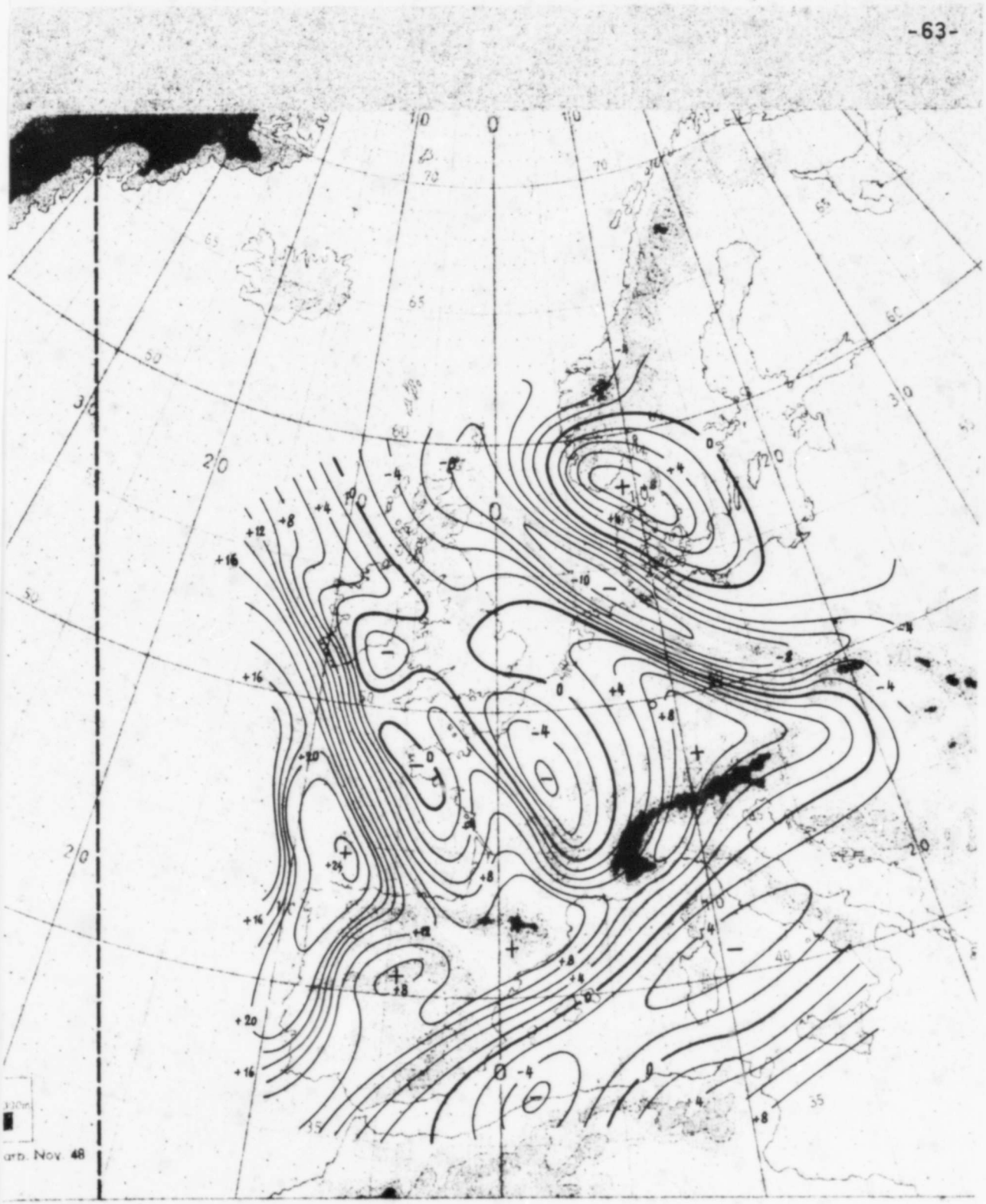


Fig. 14: 6 Nov 1962, 12:00 : 300 mb relative vorticity $[10^{-5}\,sec^{-1}]$.

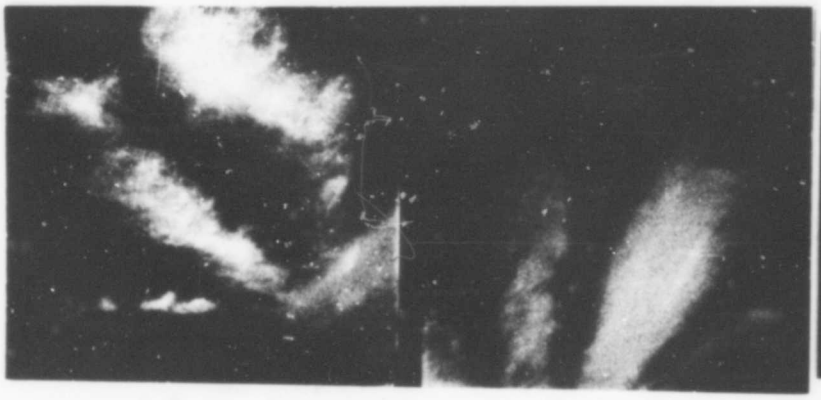


Fig. 1: 7 Nov 1962, 8:22: Photos approximately toward NW (left) and SE (right).

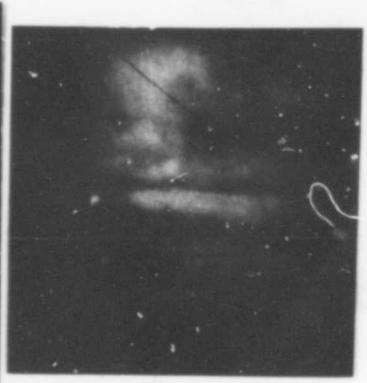


Fig. 2: 7 Nov 1962, 8:31 : Photo toward SW

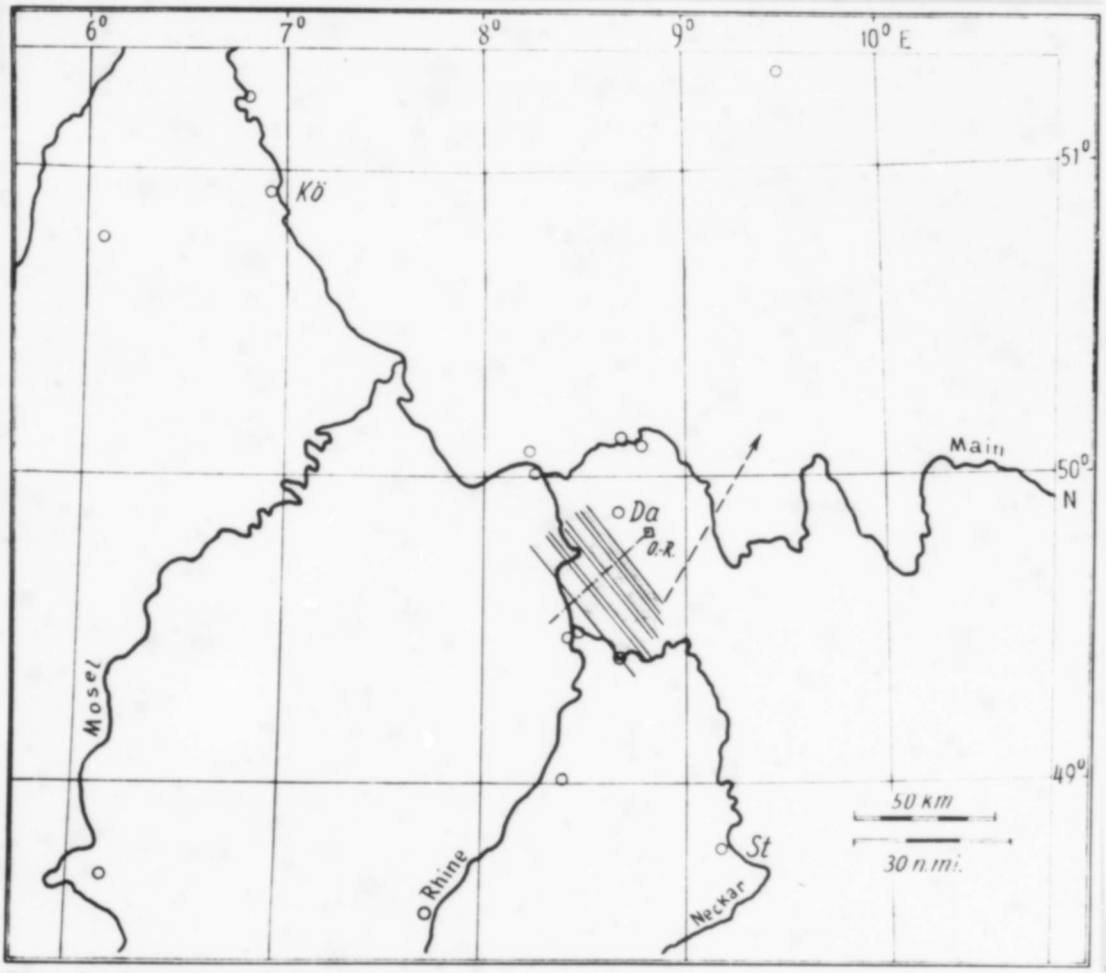


Fig. 3: Position of clouds, depicted in Fig. 2; photographic taking axis is dash-stippled.

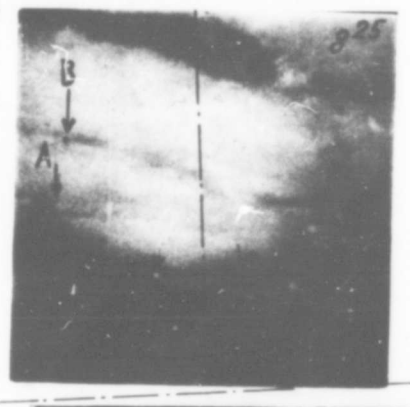


Fig. 4: 7 Nov 1962, 8:25 and 8:28 :
Photo toward W; picture horizon and fiducial line dash-stippled. Migration of bands within three minutes.

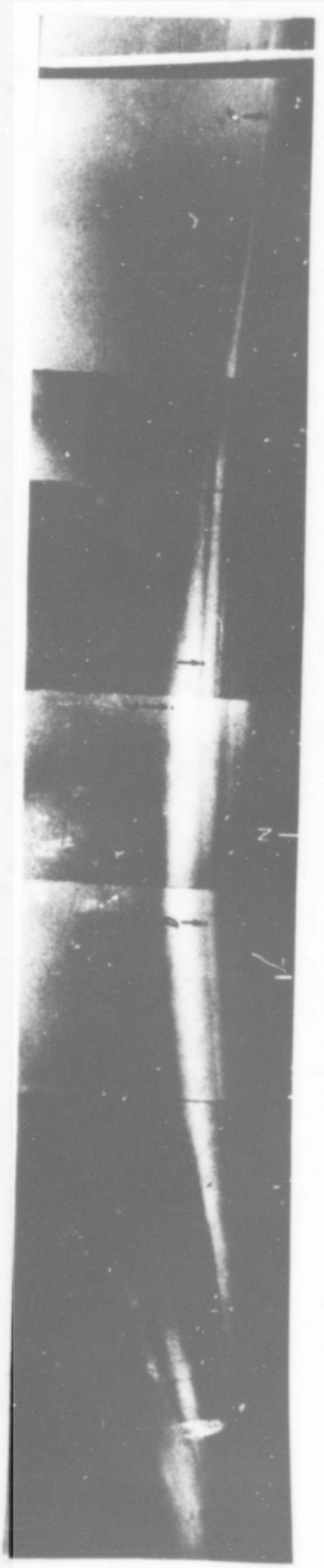
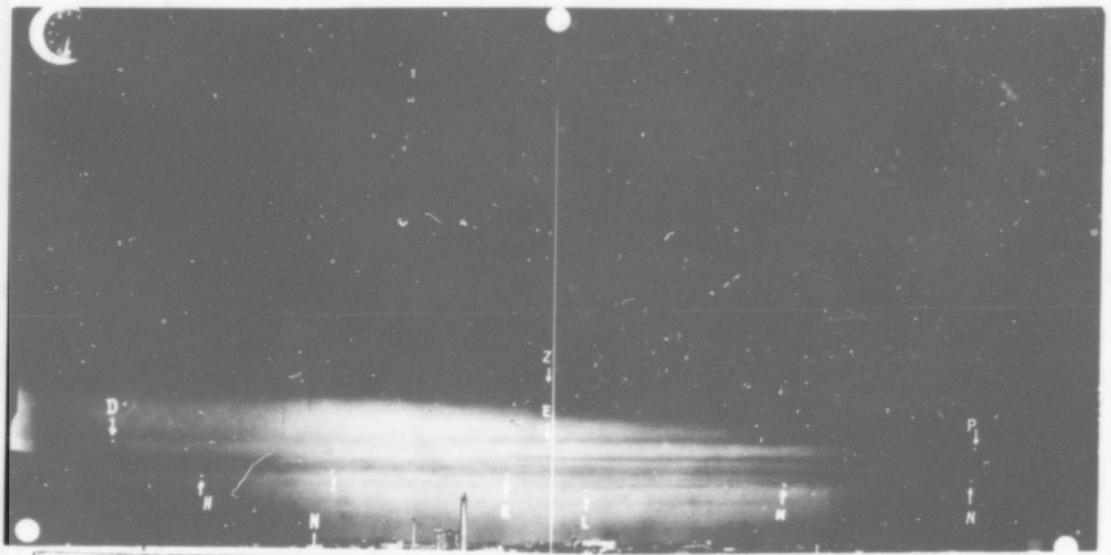


Fig. 5: 7 Nov 1962, 11:05 : Panorama view of cloud bands; mapped in Fig. 6.



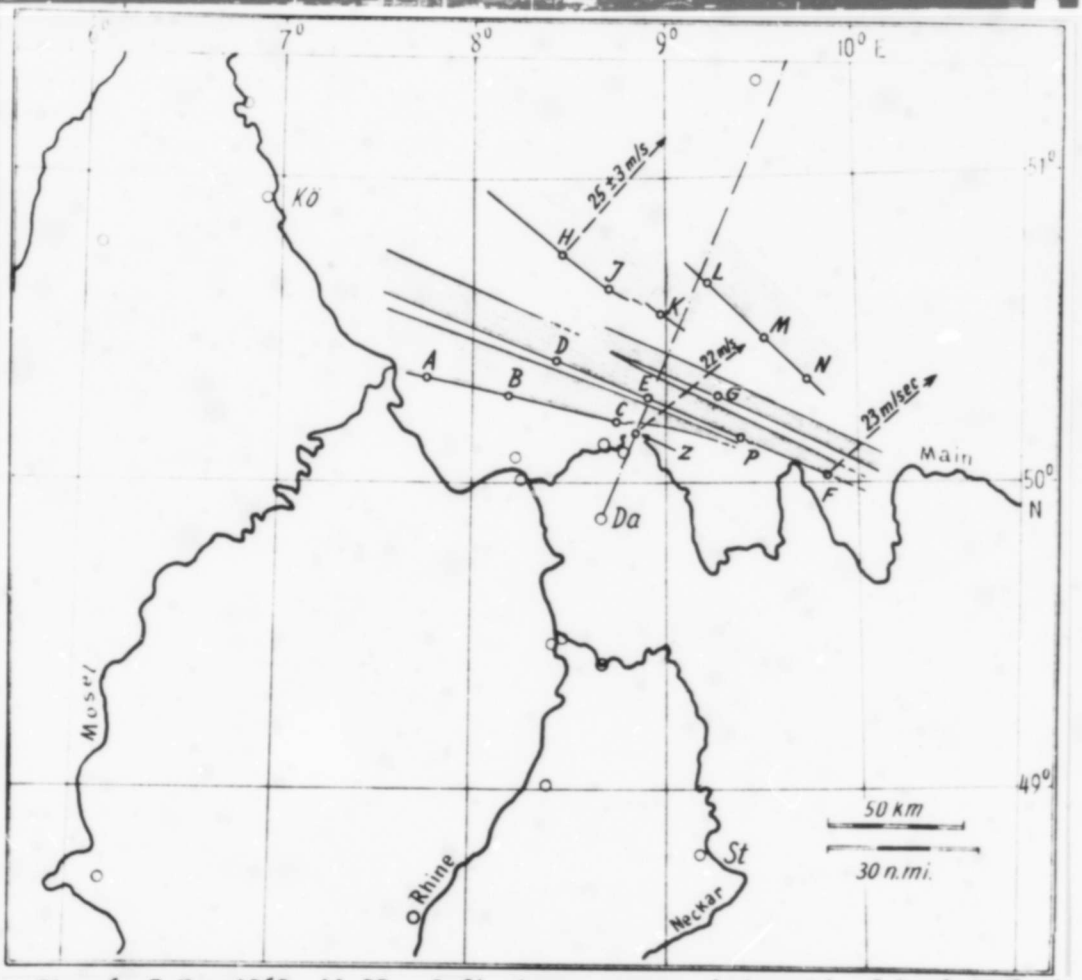


Fig. 6: 7 Nov 1962, 11:02 : Left stereo camera photograph of bands and plan showing their position and motion vectors; taking direction represented by fiducial line in the photograph, dash-stippled in plan.

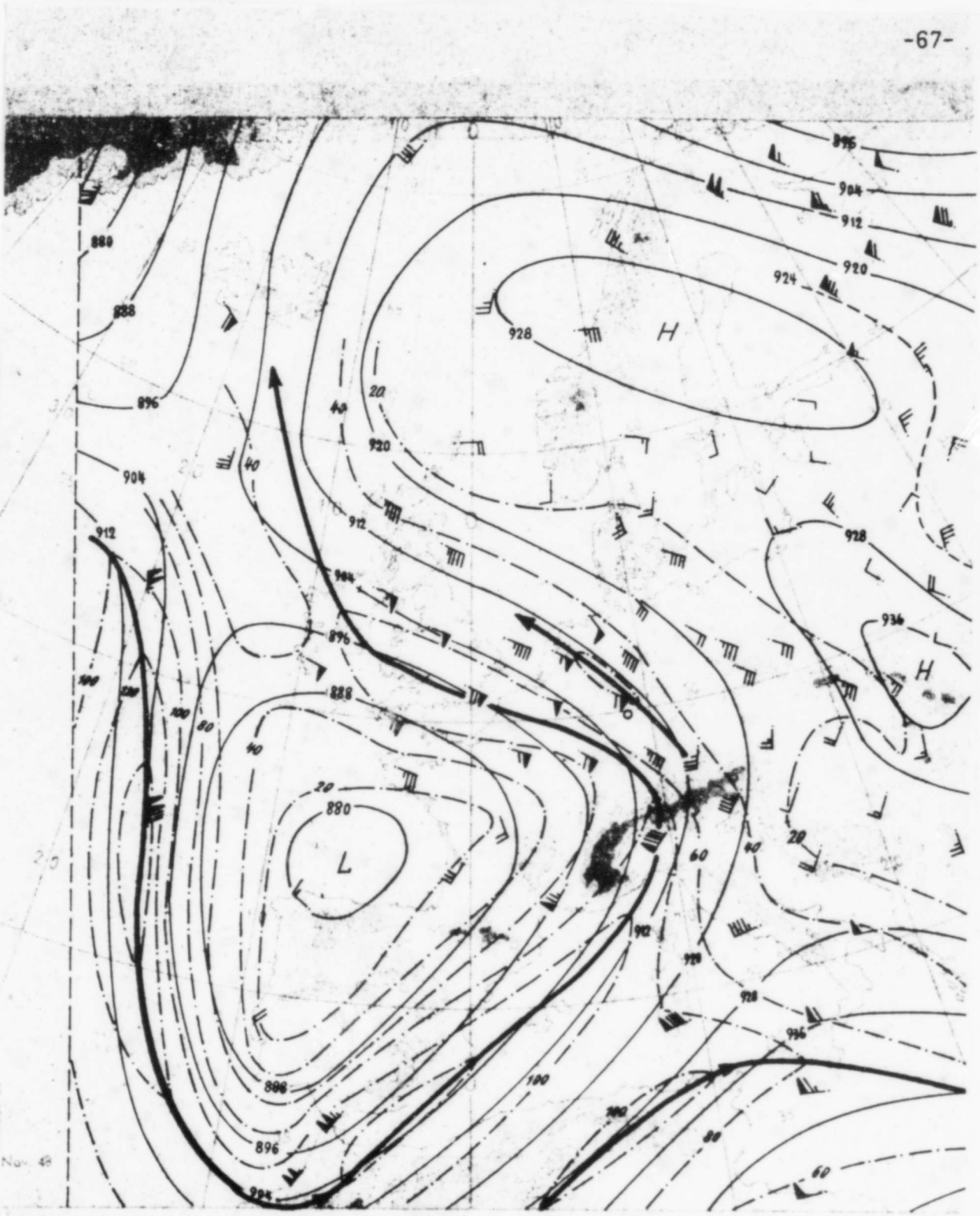


Fig. 7: 7 Nov 1962, 0:00 : 300 mb contours [10 gpm] , isotachs [knots] dash-dotted, and jet stream axes.

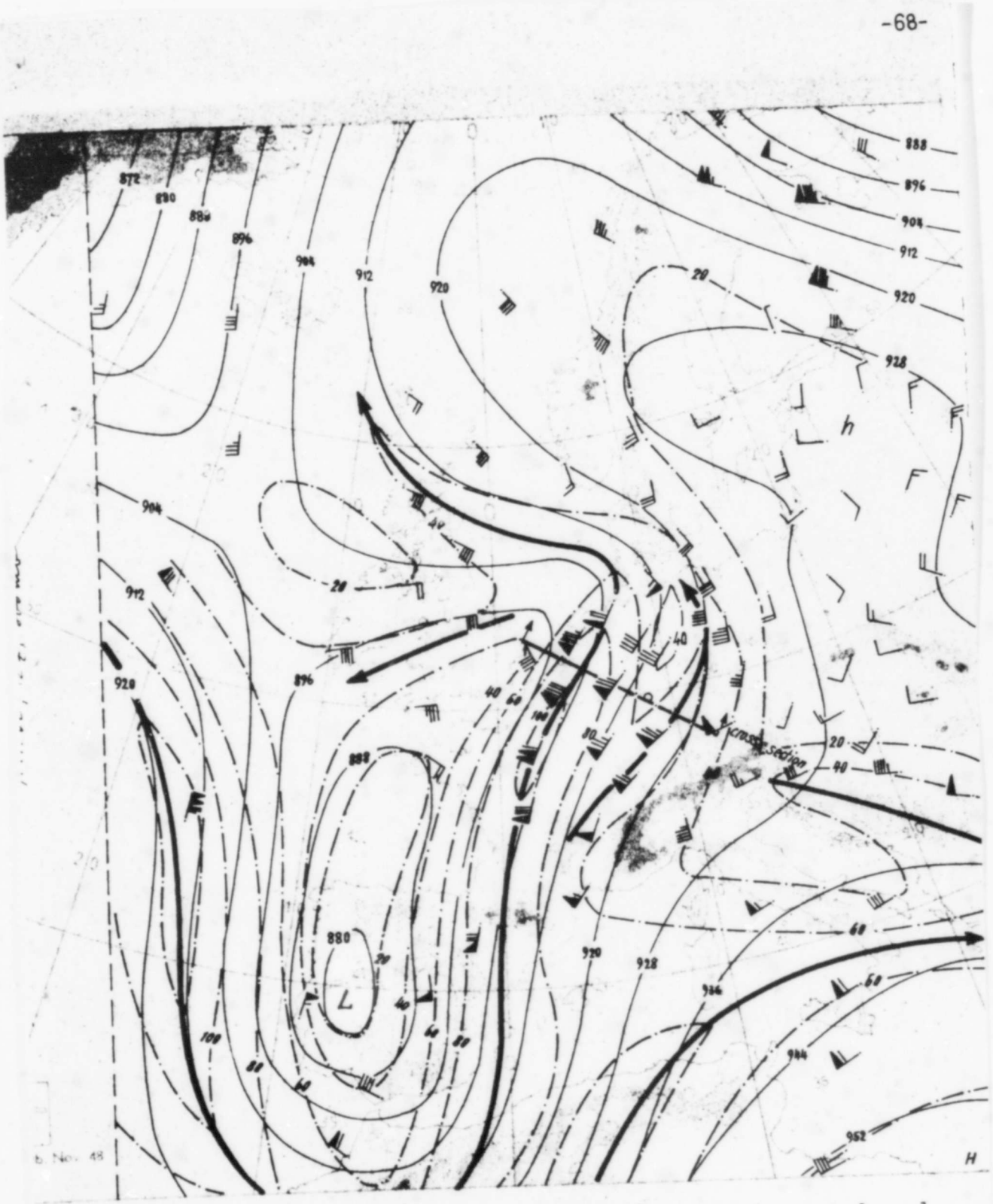


Fig. 8: 7 Nov 1962, 12:00 : 300 mb contours [10 gpm], isotachs [knots] dash-dotted, and jet stream axes.
Position of cross section (Fig. 15) dash-stippled.

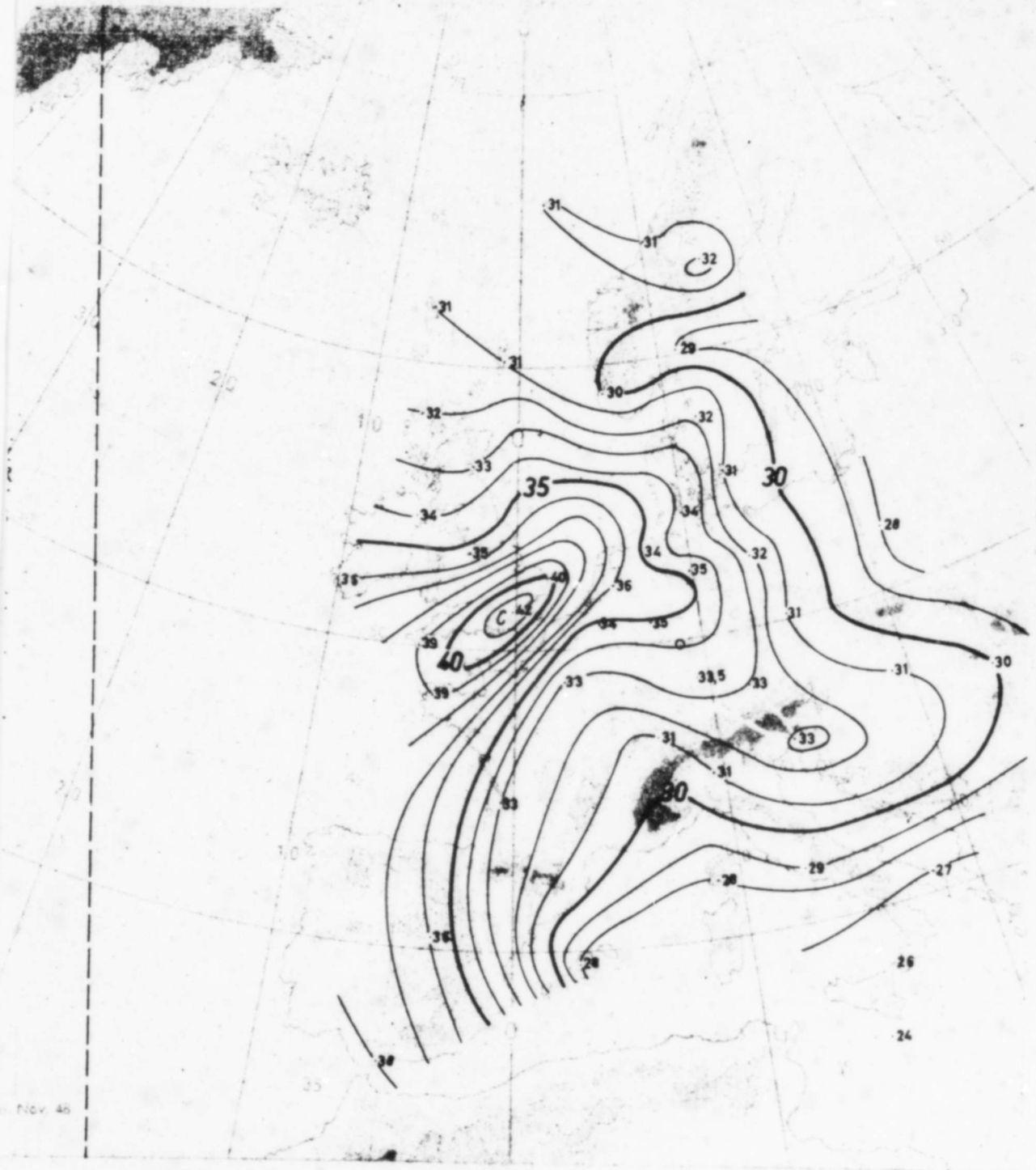


Fig. 9: 7 Nov 1962. 12:00 : 400 mb isotherms [-°C].

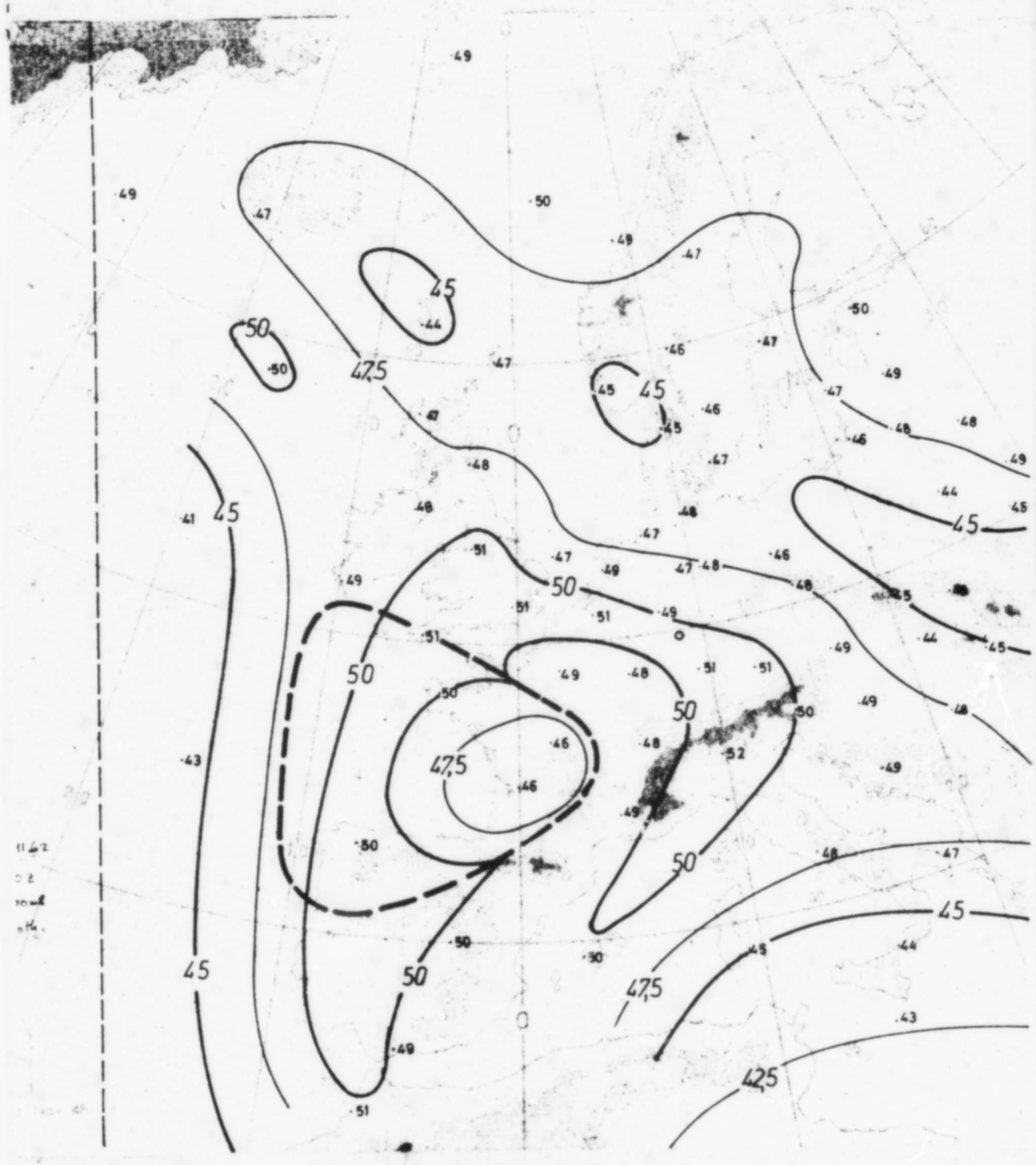


Fig.10: 7 Nov 1962, 0:00 : 300 mb isotherms [-°C].

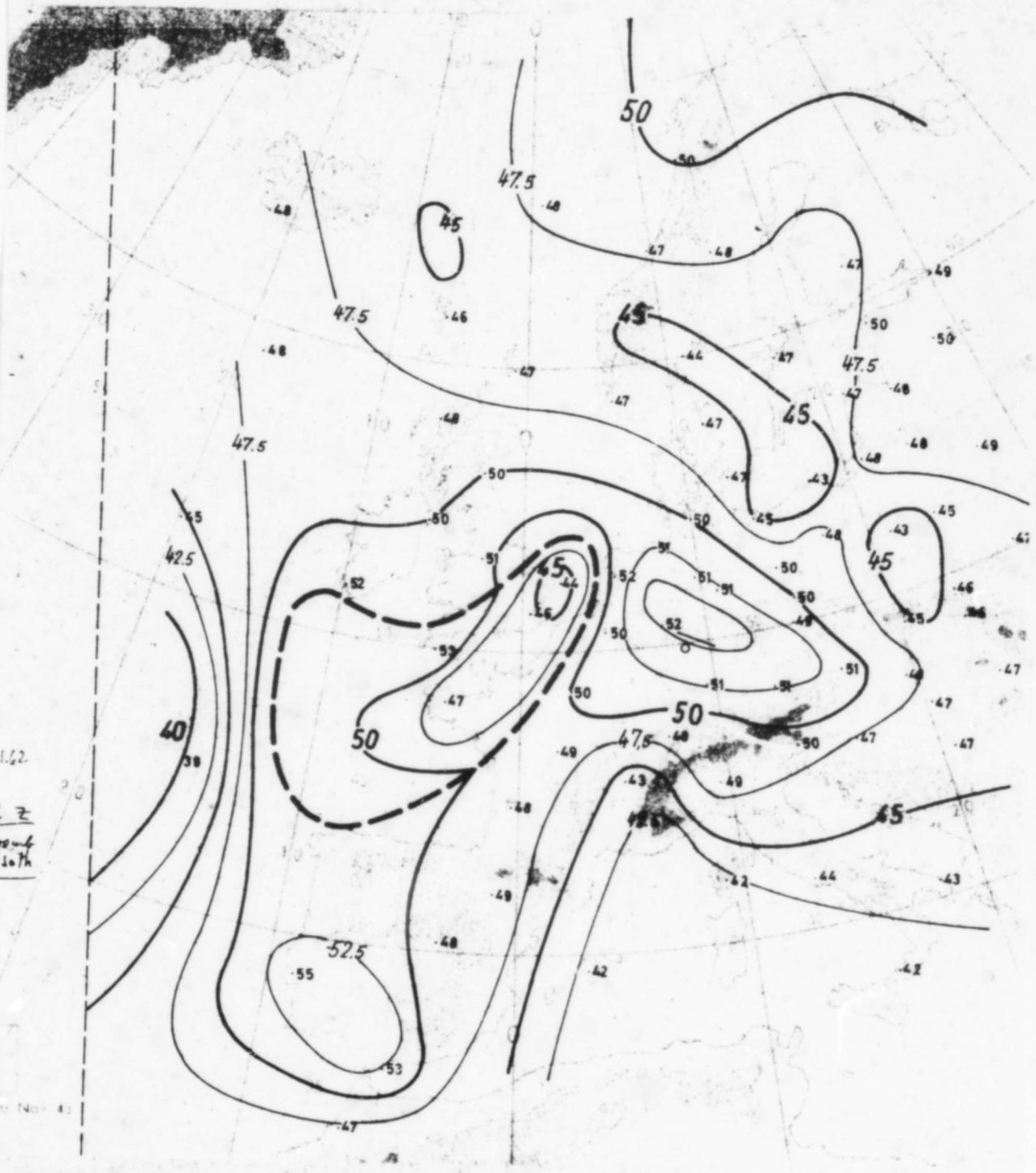


Fig. 11: 7 Nov 1962, 12:00 : 300 mb isotherms.*) Straight line near the 50°N/10°E intersection marks position of ci-bands at 11:02.

*) [-°C]

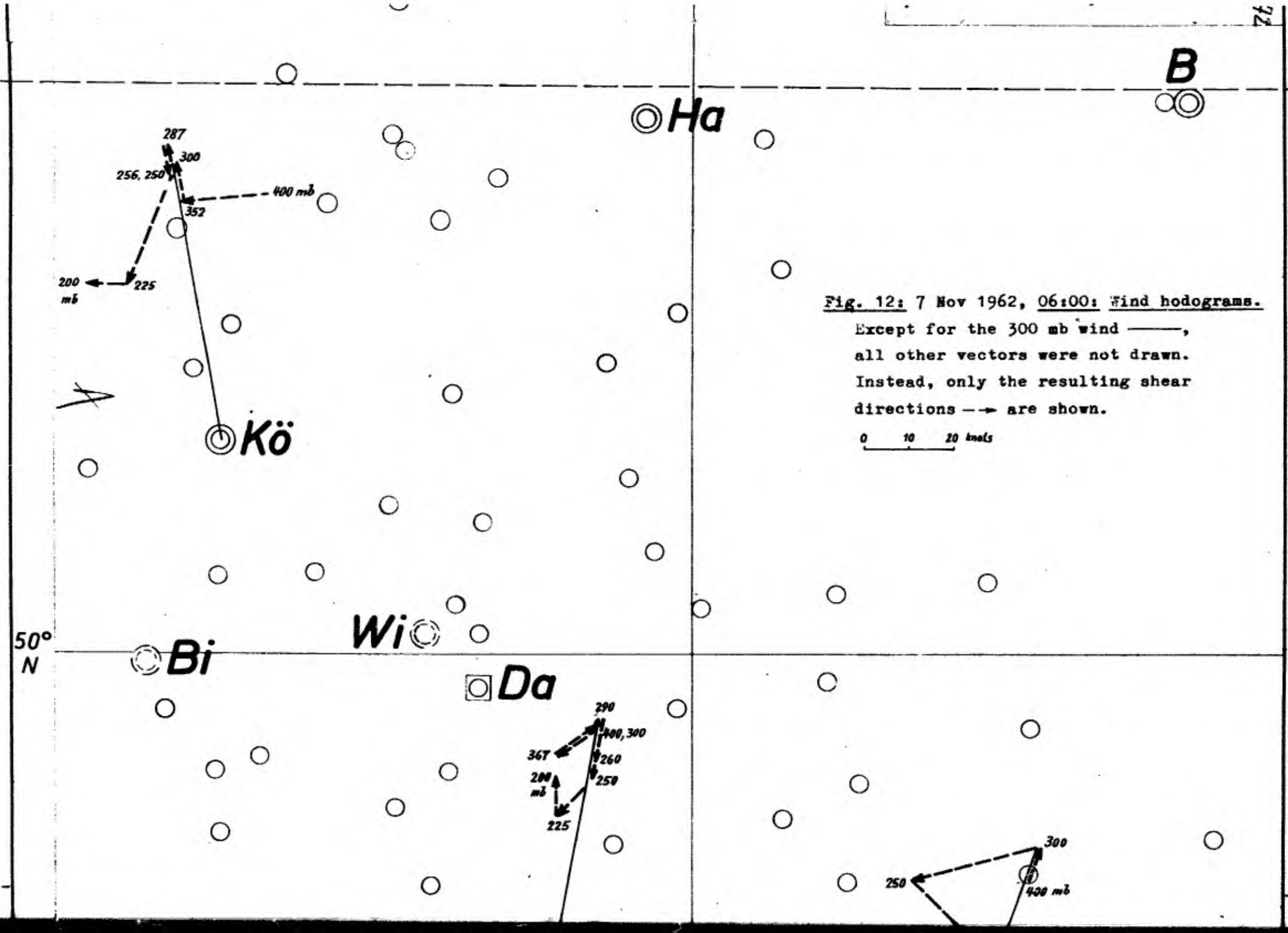
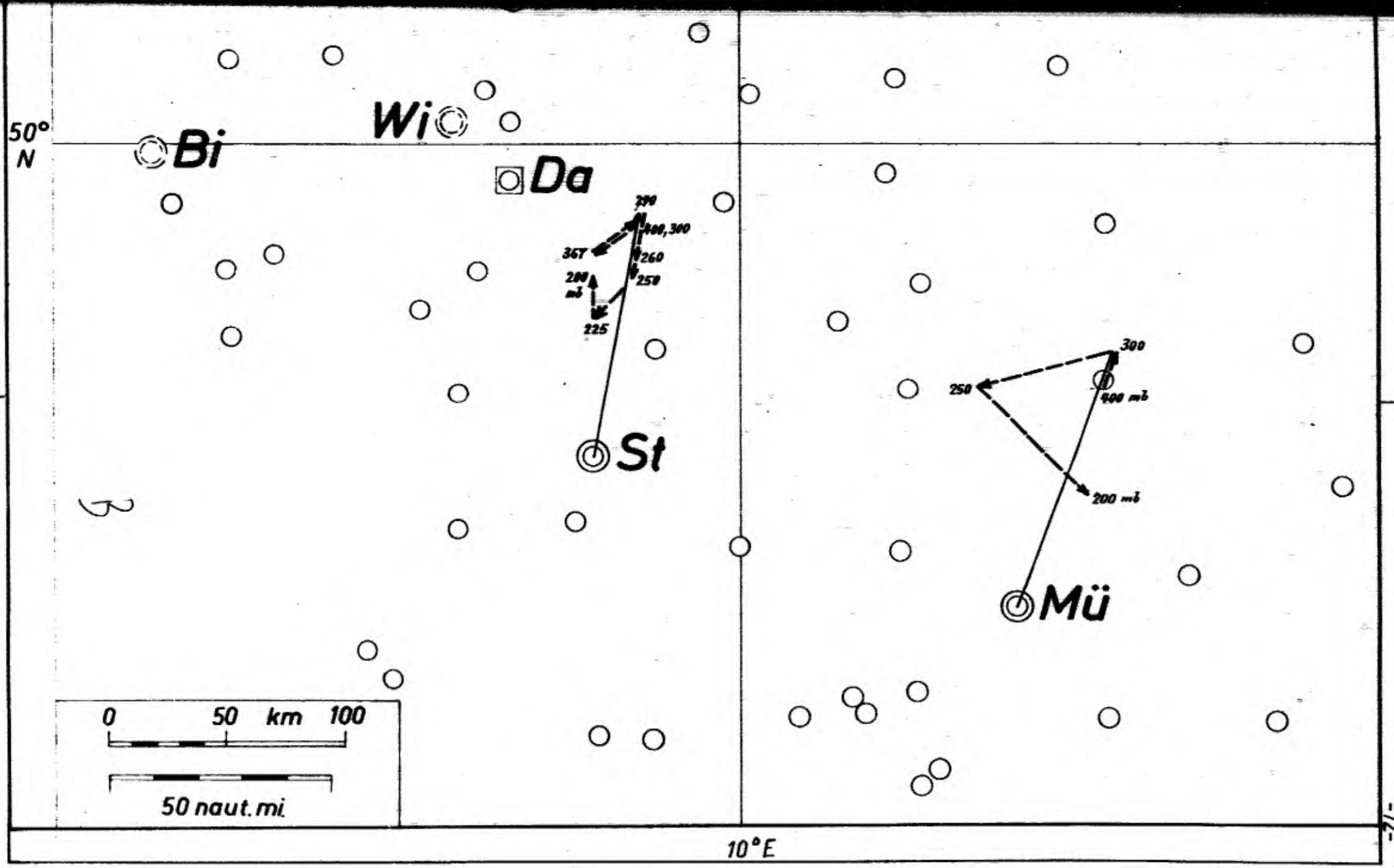


Fig. 12: 7 Nov 1962, 06:00: Wind hodograms.
Except for the 300 mb wind ———,
all other vectors were not drawn.
Instead, only the resulting shear
directions —→ are shown.

0 10 20 knots


50° N
Bi
Wi
Da
St
Mü
390
300, 300
260
250
367
280 mb
225
300
250
400 mb
200 mb
0 50 km 100
50 naut. mi
10° E

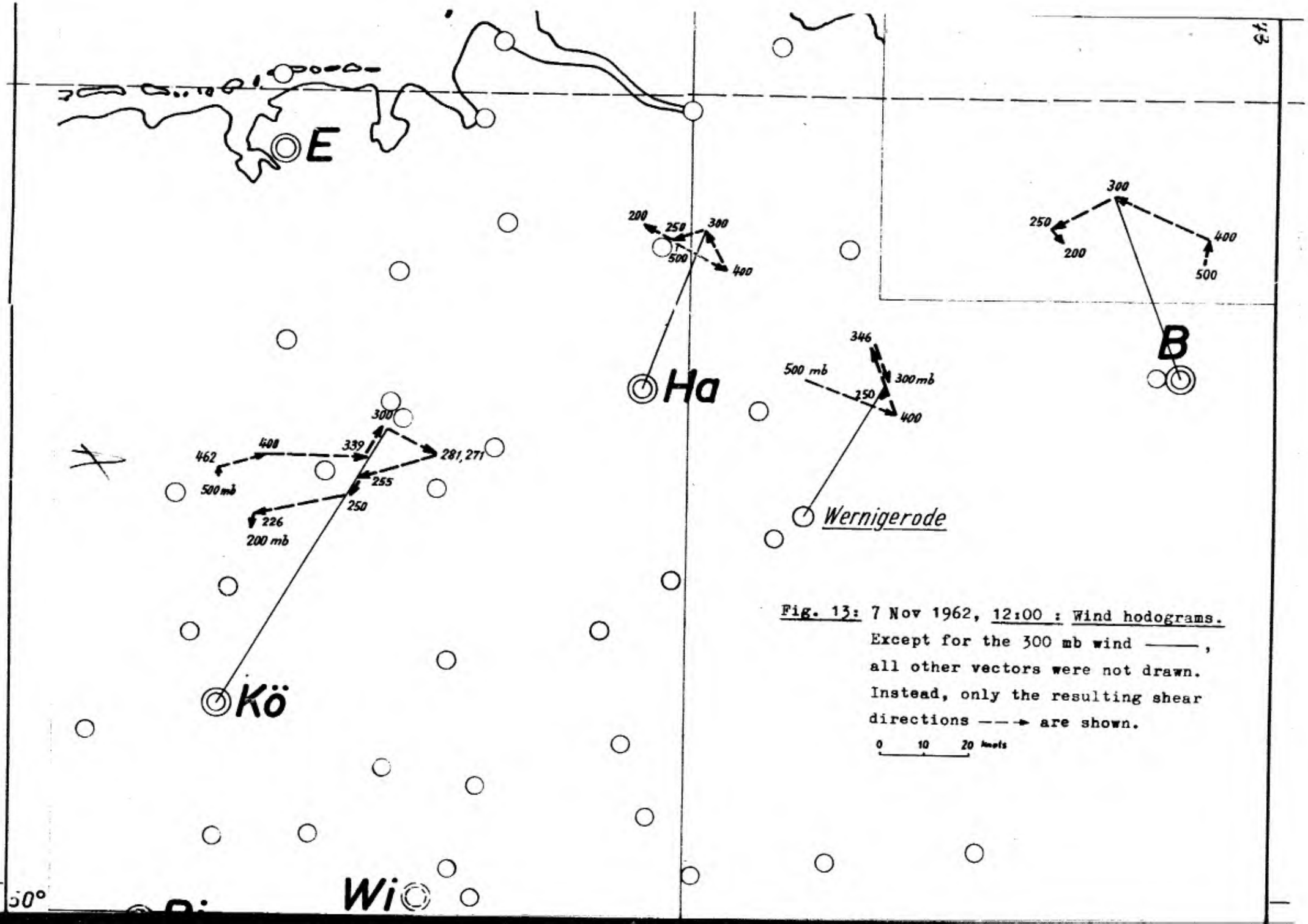
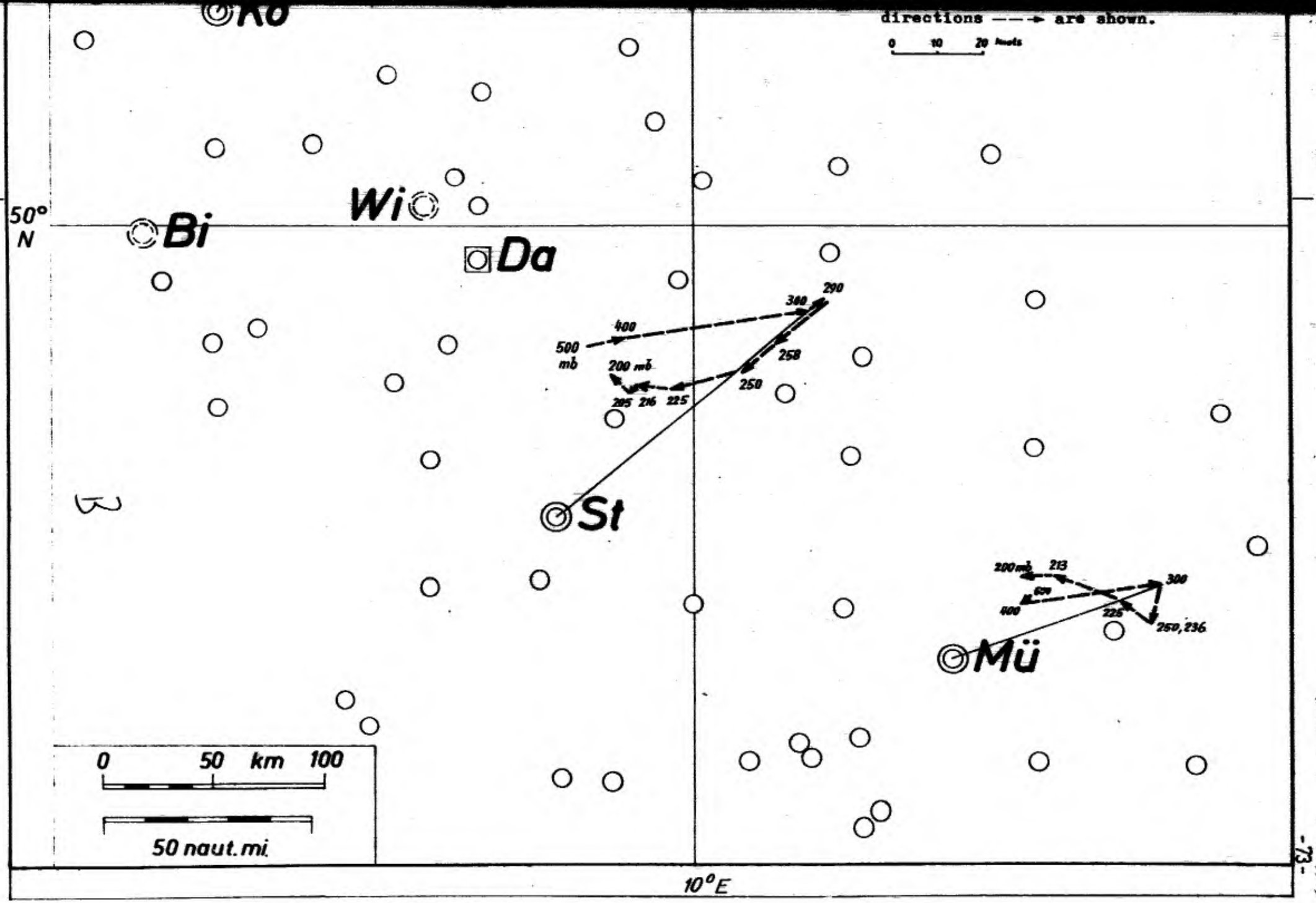


Fig. 13: 7 Nov 1962, 12:00 : Wind hodograms. Except for the 300 mb wind ———, all other vectors were not drawn. Instead, only the resulting shear directions – – → are shown.

0 10 20 knots


directions ——→ are shown.
0 10 20 knots
Ko
Wi
Bi
Da
50° N
290
300
400
500 mb
258
200 mb
250
205 216 225
St
200 mb 213
300
400
225
250, 236
Mü
0 50 km 100
50 naut. mi
10° E

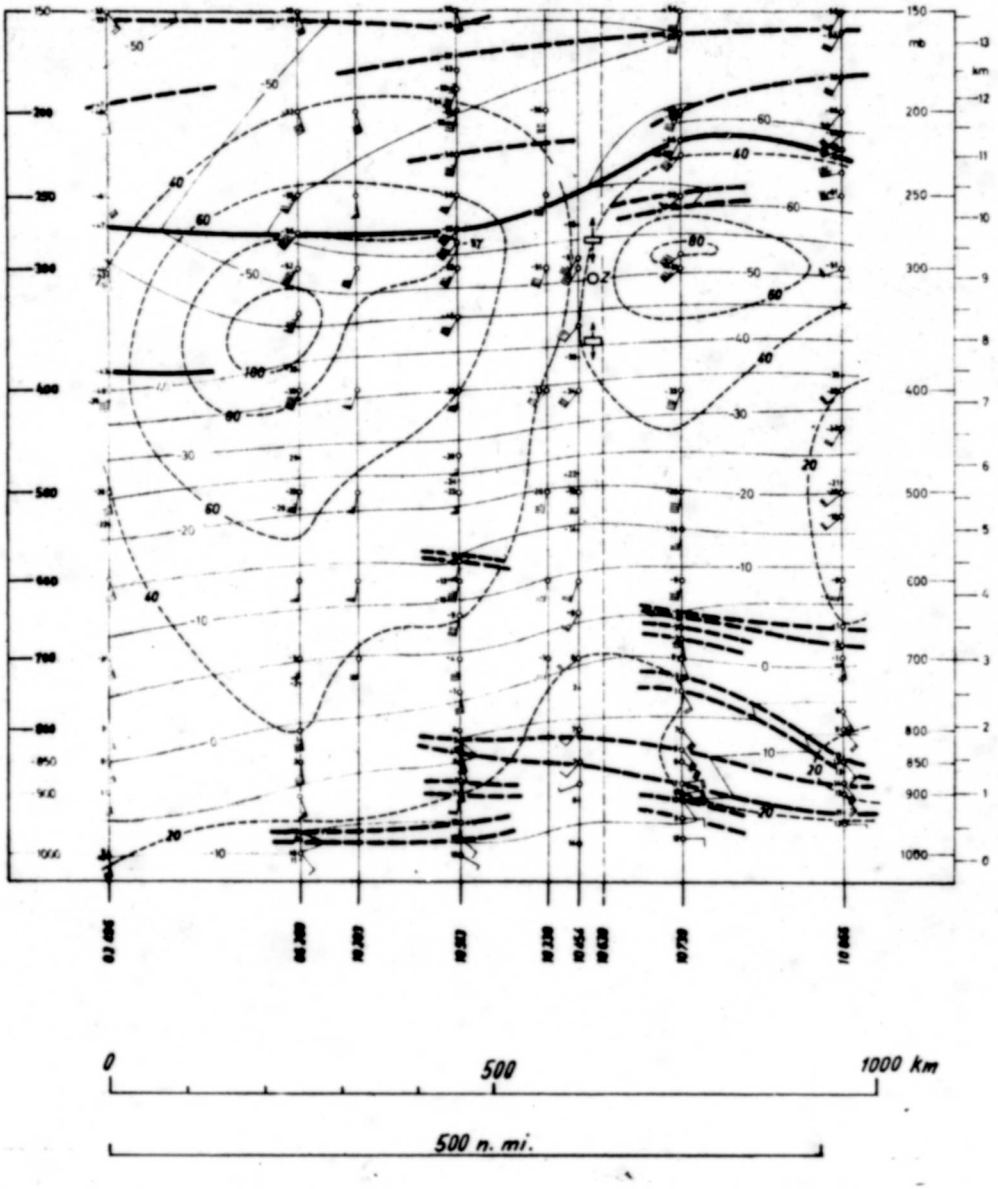


Fig. 14: 7 Nov 1962, 12:00: Wind [knots] and temperature [C°] cross section, from Hemsby (03496) to Munich (10866). Vertical line over Darmstadt (10639) dashed; small rectangles close to it mark ci-bands; arrows up and downward denote mean standard error of altitude measurement.
Tick line marks base of tropopause; thick dashed lines mark layers of increased stability.

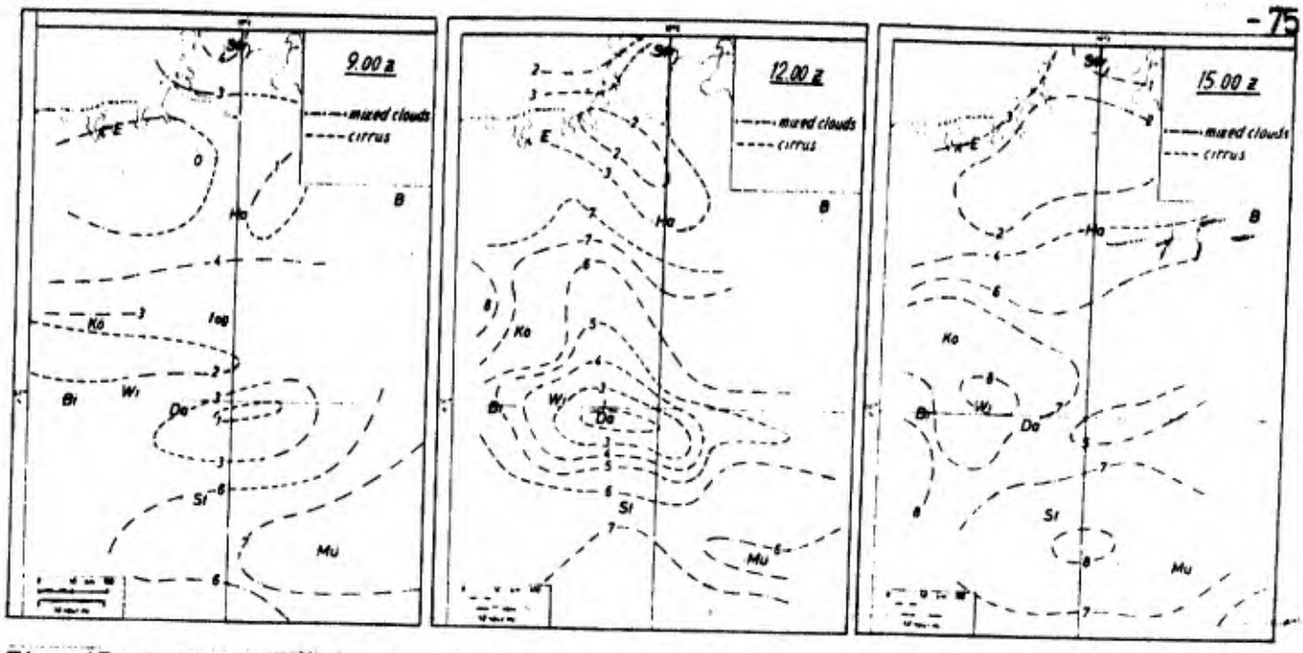


Fig. 15: 7 Nov 1962: Isonephs at 3-hour intervals;

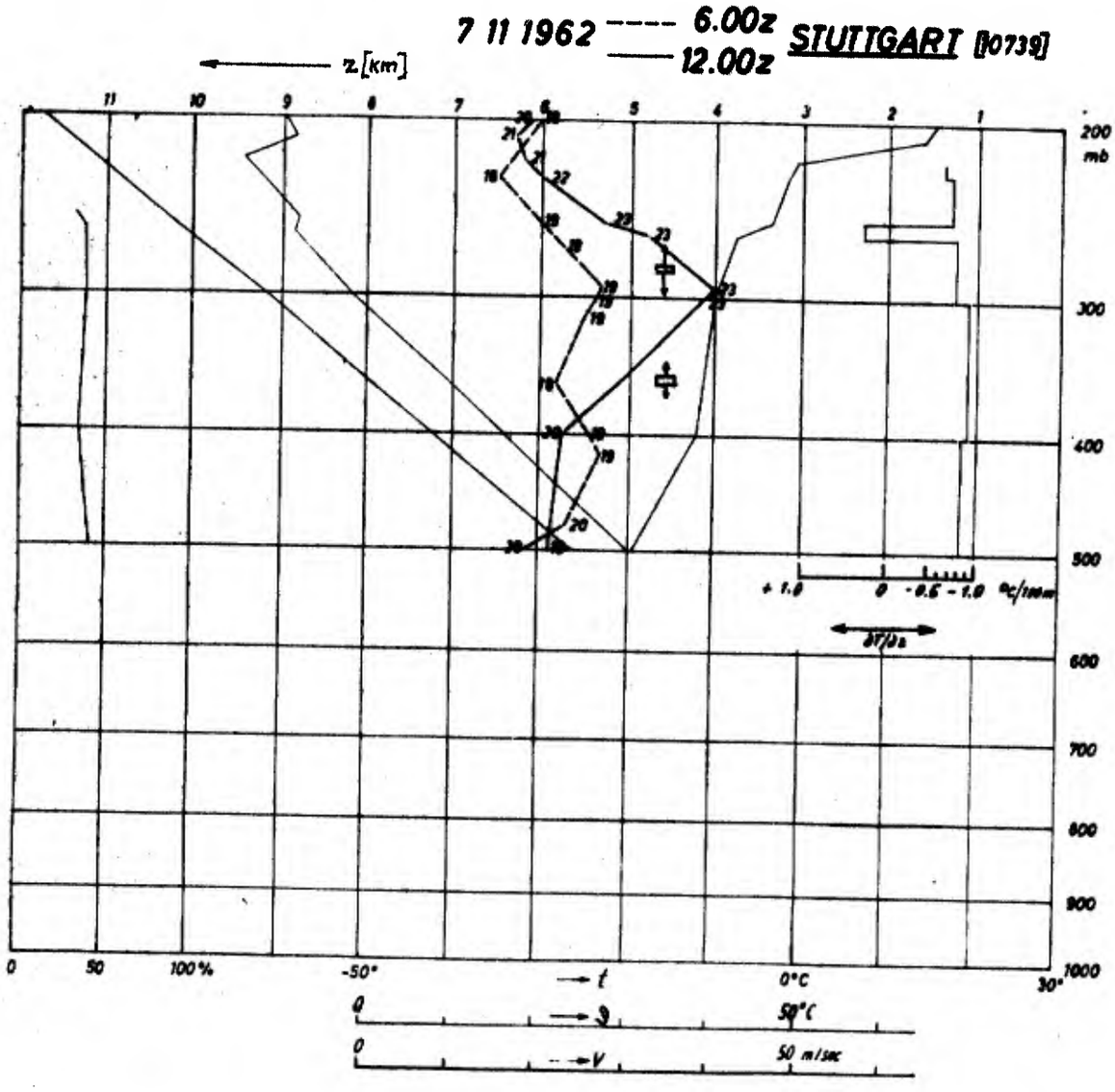


Fig.16: 7 Nov 1962 : Stuttgart wind at 06:00,
and wind, temperature humidity and $p(z)$ at 12:00. Outer right: $\partial T/\partial z$.

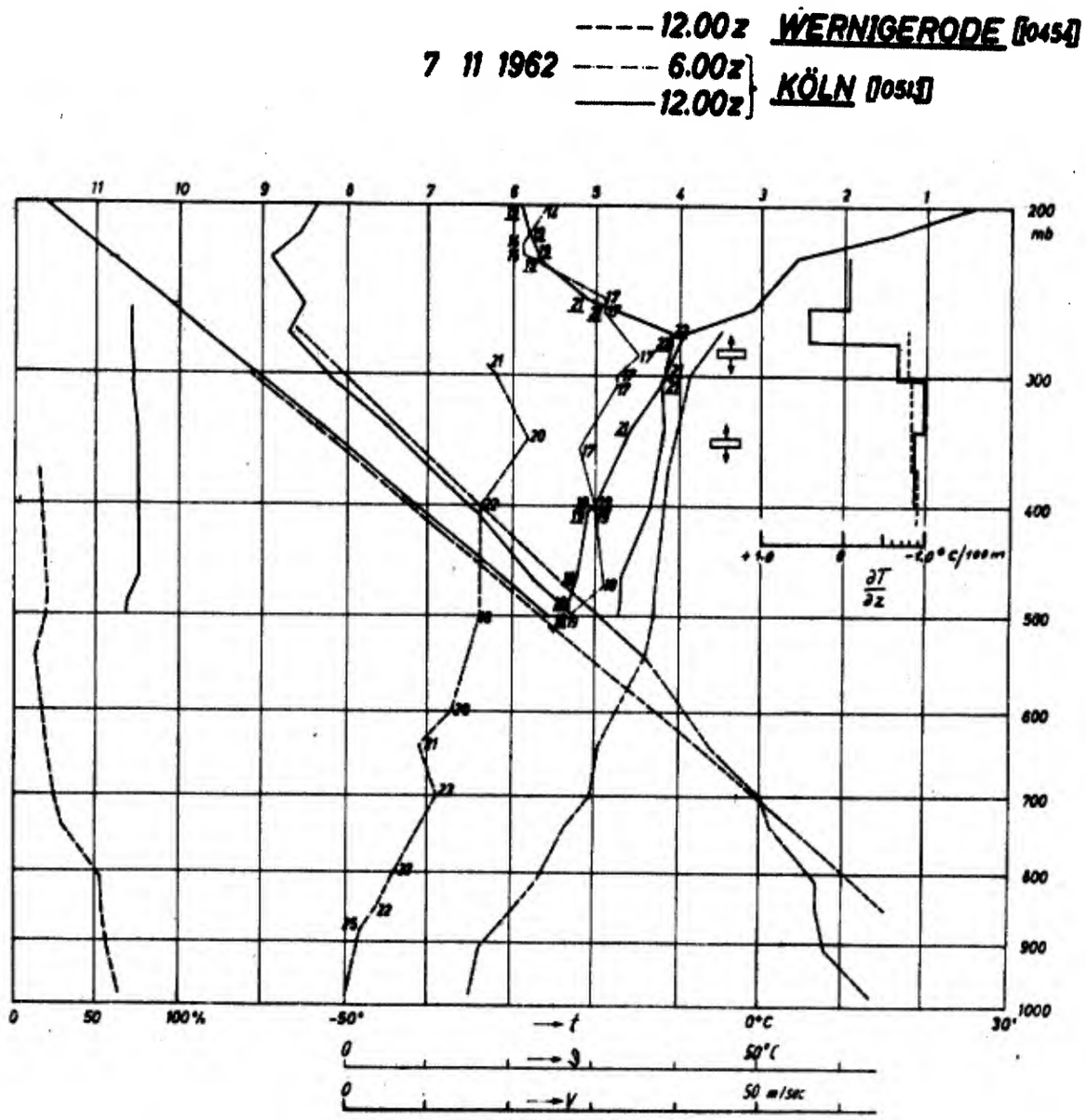


Fig.17: 7 Nov 1962, 6:00 and 12:00 : Aerologic ascents.
Wind directions [10°] of Köln underlined.

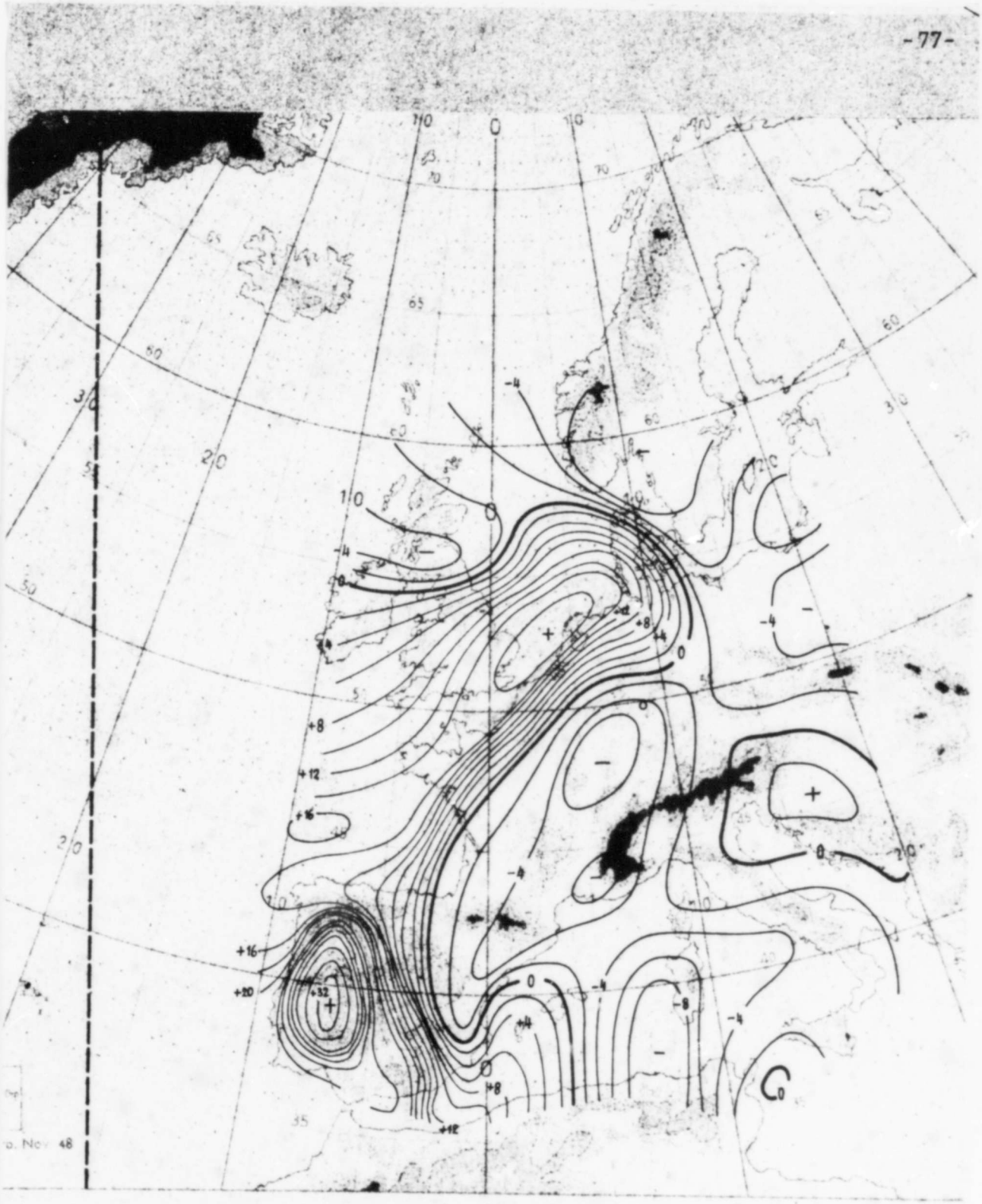


Fig.18: 7 Nov. 1962, 12:00 : 300 mb relative vorticity $\left[10^{-5}\ sec^{-1}\right]$.

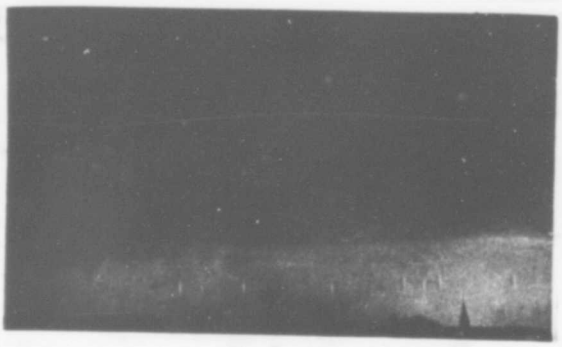


Fig. 1a: 1 March 1963, 9:44: Photo toward 264°.

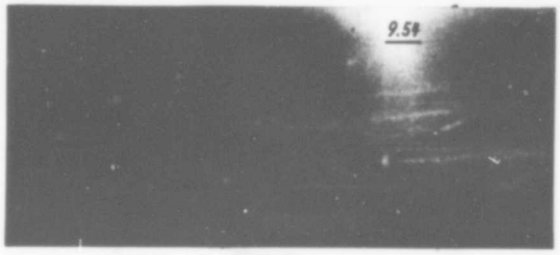


Fig. 1b: Photo toward SW at 9:54.

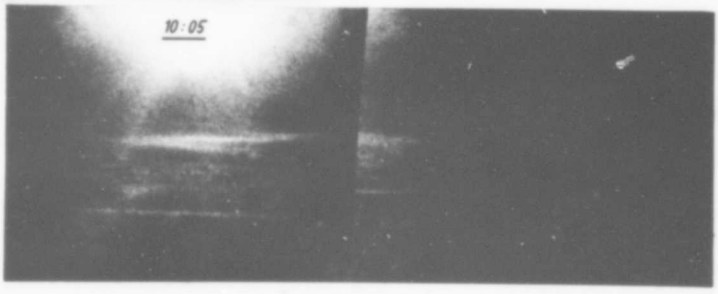


Fig. 1c: Small panorama toward 165°.

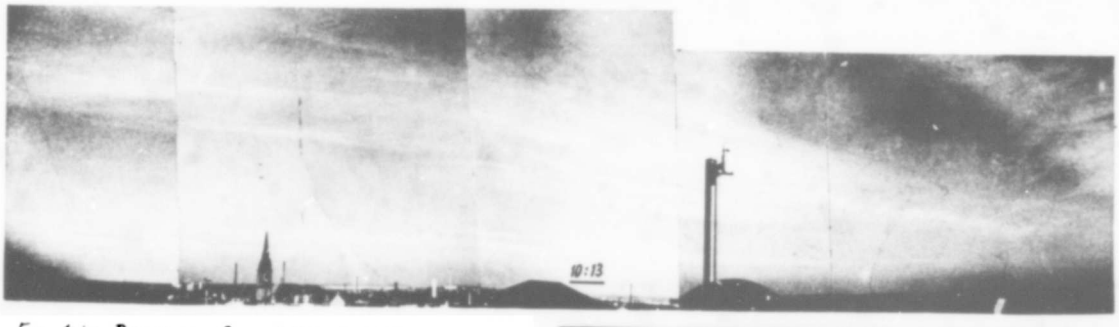


Fig. 1d: Panorama from WNW to ENE.

Fig. 1e: Photo toward 48°. Dash-stippled: Position and orientation of faint bands.

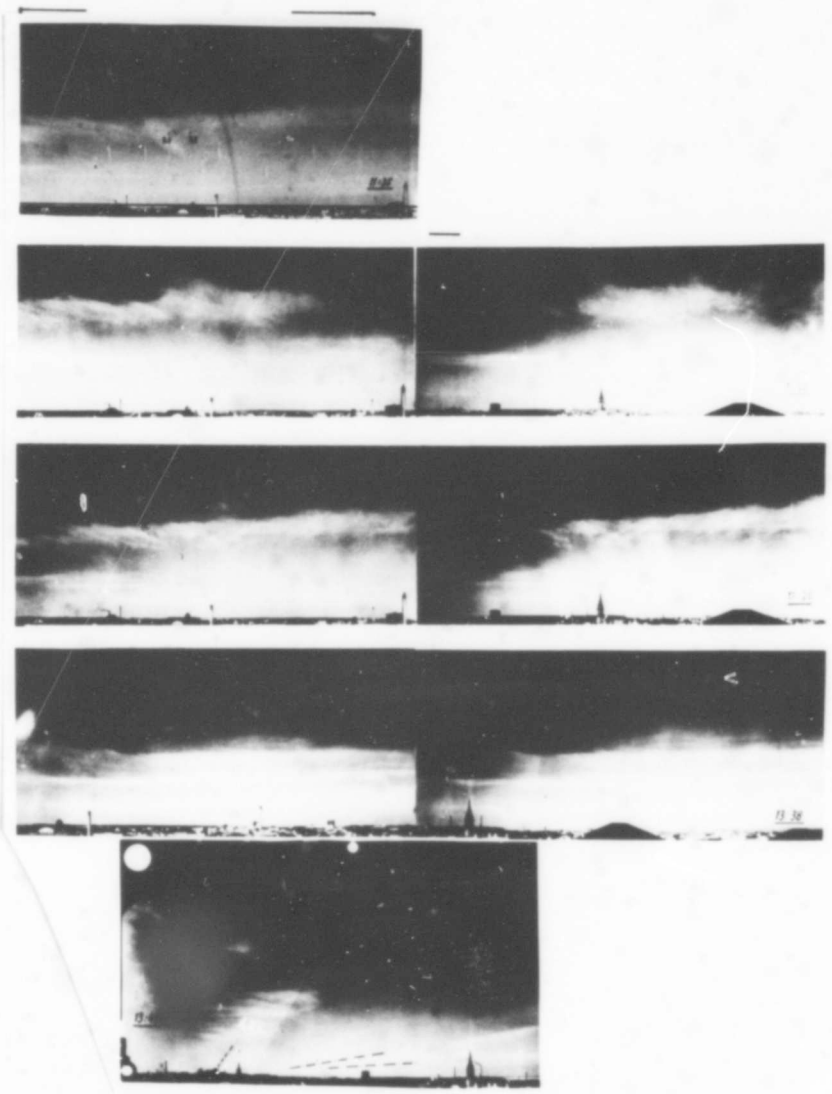


Fig. 2: 1 March 1963:

Upper left: Altitudes of band points were inscribed in photograph taken toward 336°, with left (western) camera.

Center : Stereo pairs, out of subsequent stereo series, also toward 336°.

Below : Last photograph of band, taken toward NW.

Respective times inscribed in photographs.

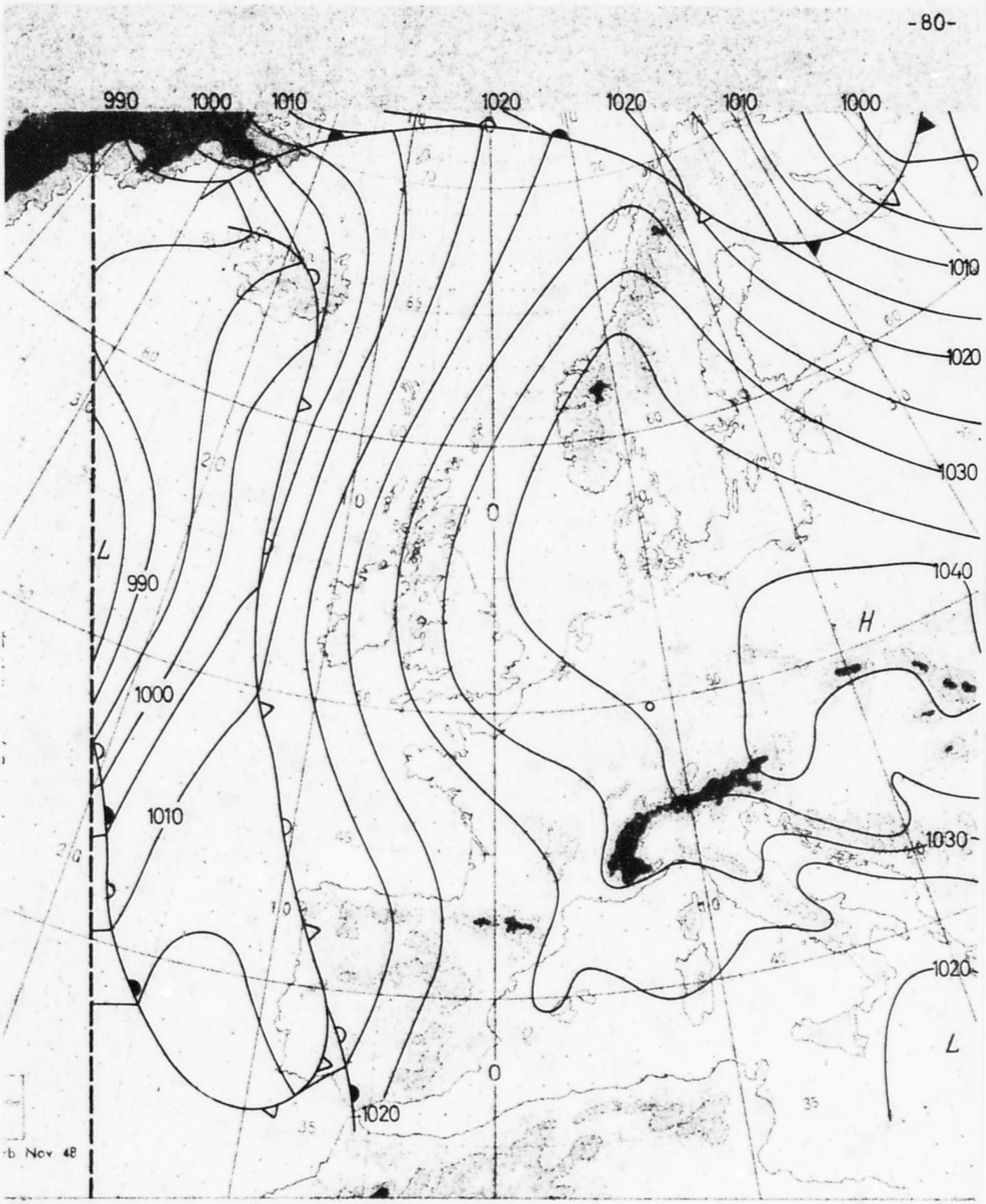


Fig. 3 : 1 March 1963, 06:00 : Sea level isobars [mb] and surface and high level fronts.

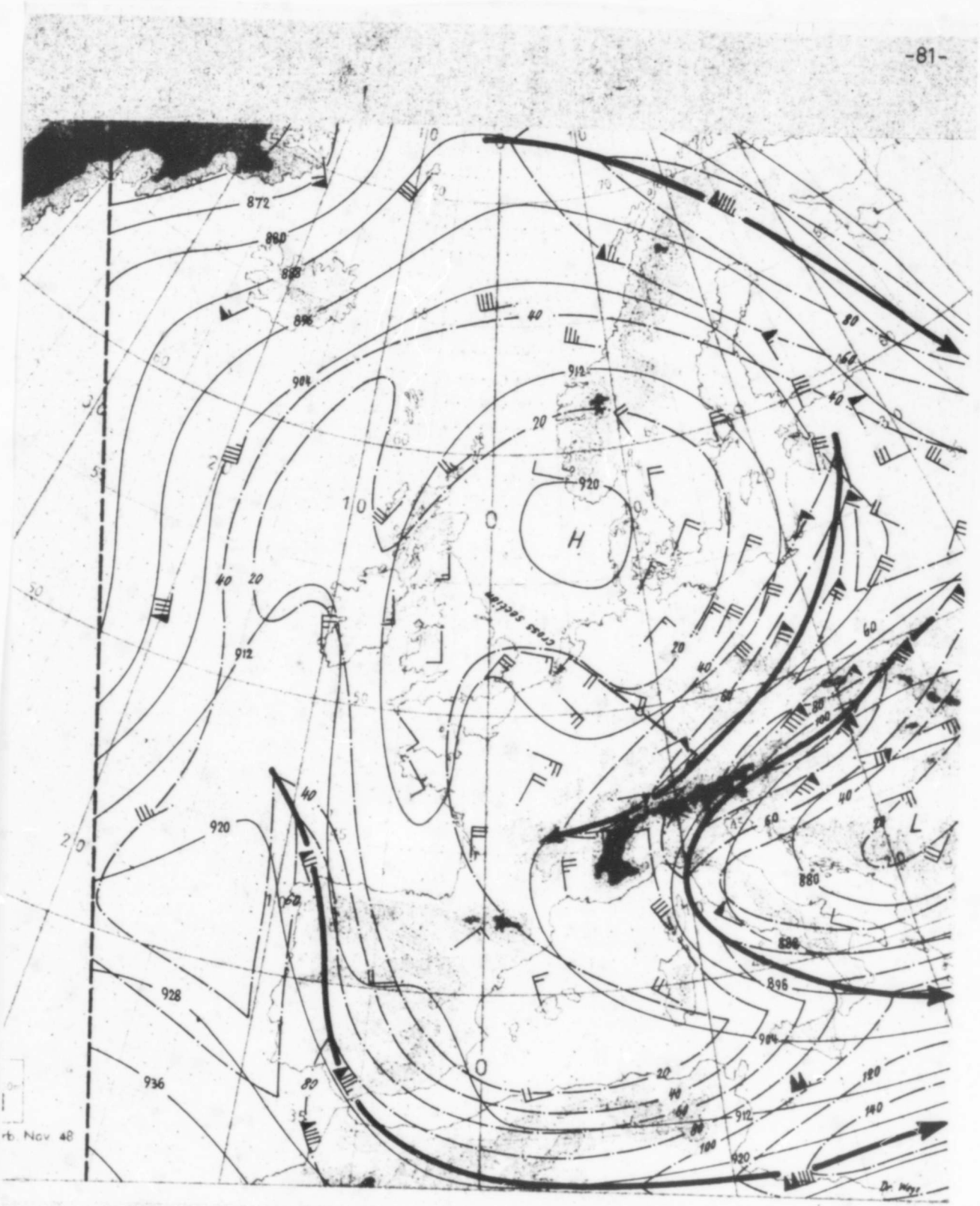


Fig. 4 : 1 March 1963, 12:00 : 300 mb contours [10 gpm] , isotachs [knots] (dash-dotted), and jet stream axes.

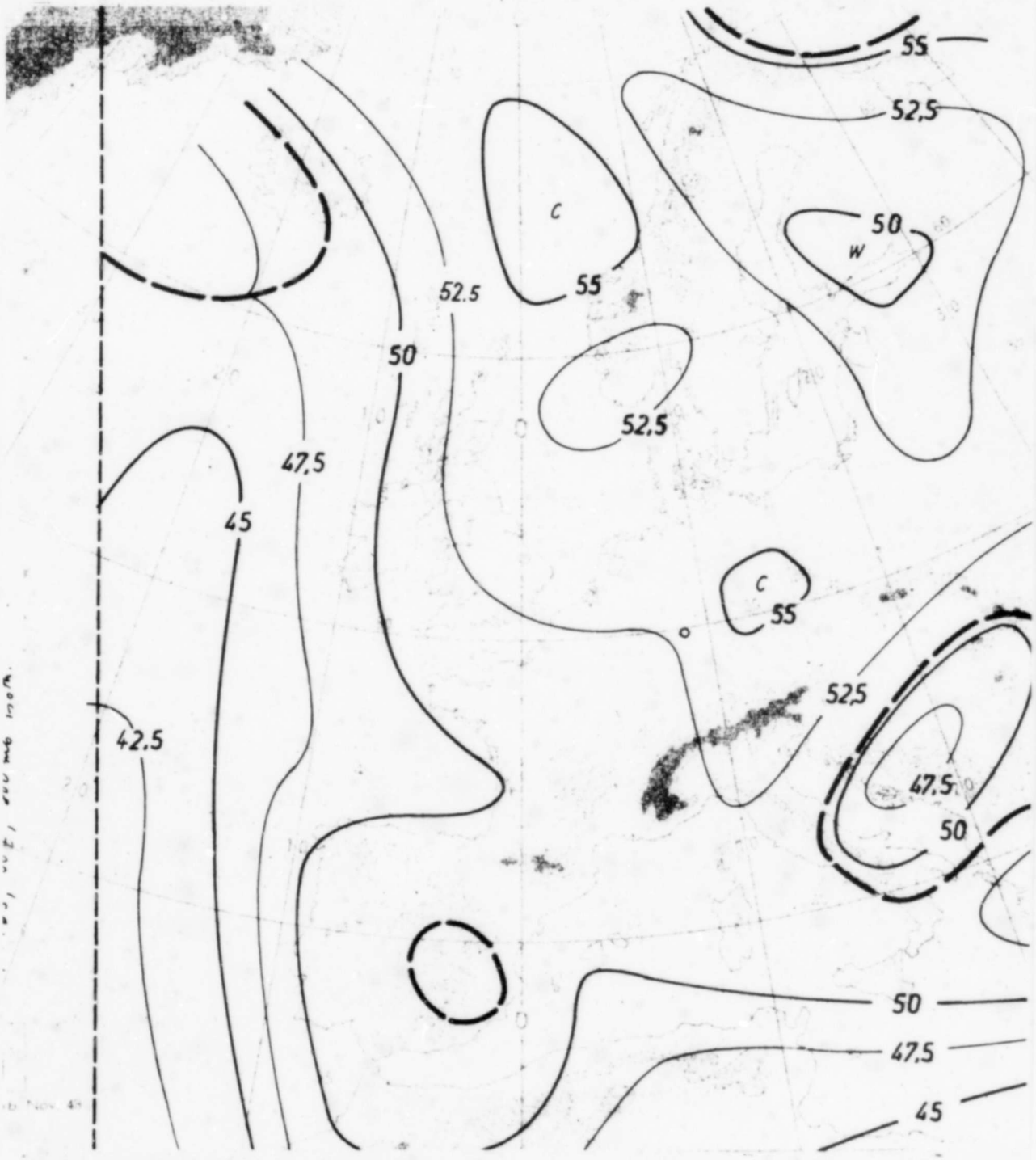


Fig. 5 : 1 March 1963, 0:00 : 300 mb isotherms $\left[-^{o}C\right]$; trace of intersection with tropopause : dashed thick line.

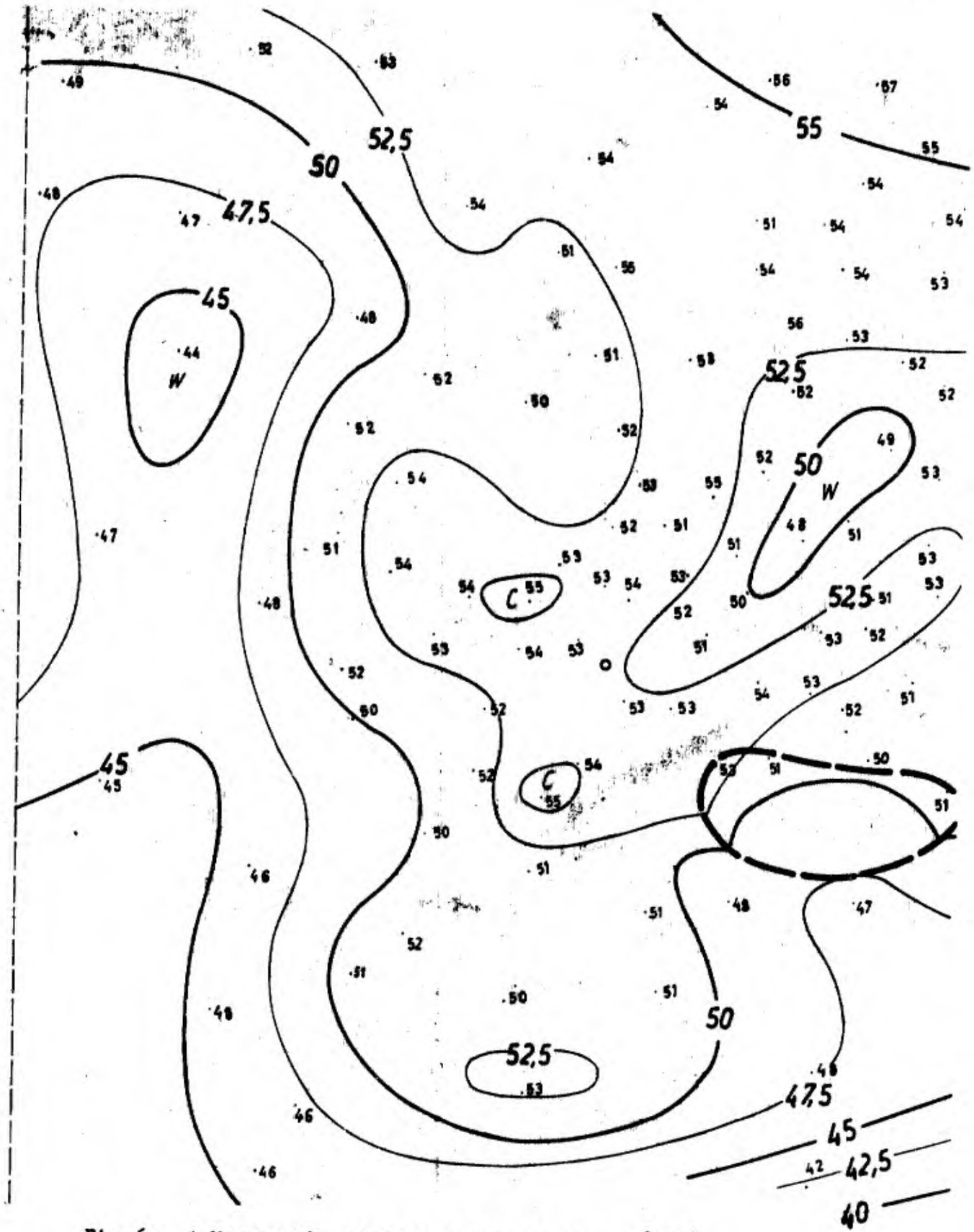


Fig. 6 : 1 March 1963, 12:00 : 300 mb isotherms [-°C] ; tropopause dashed.

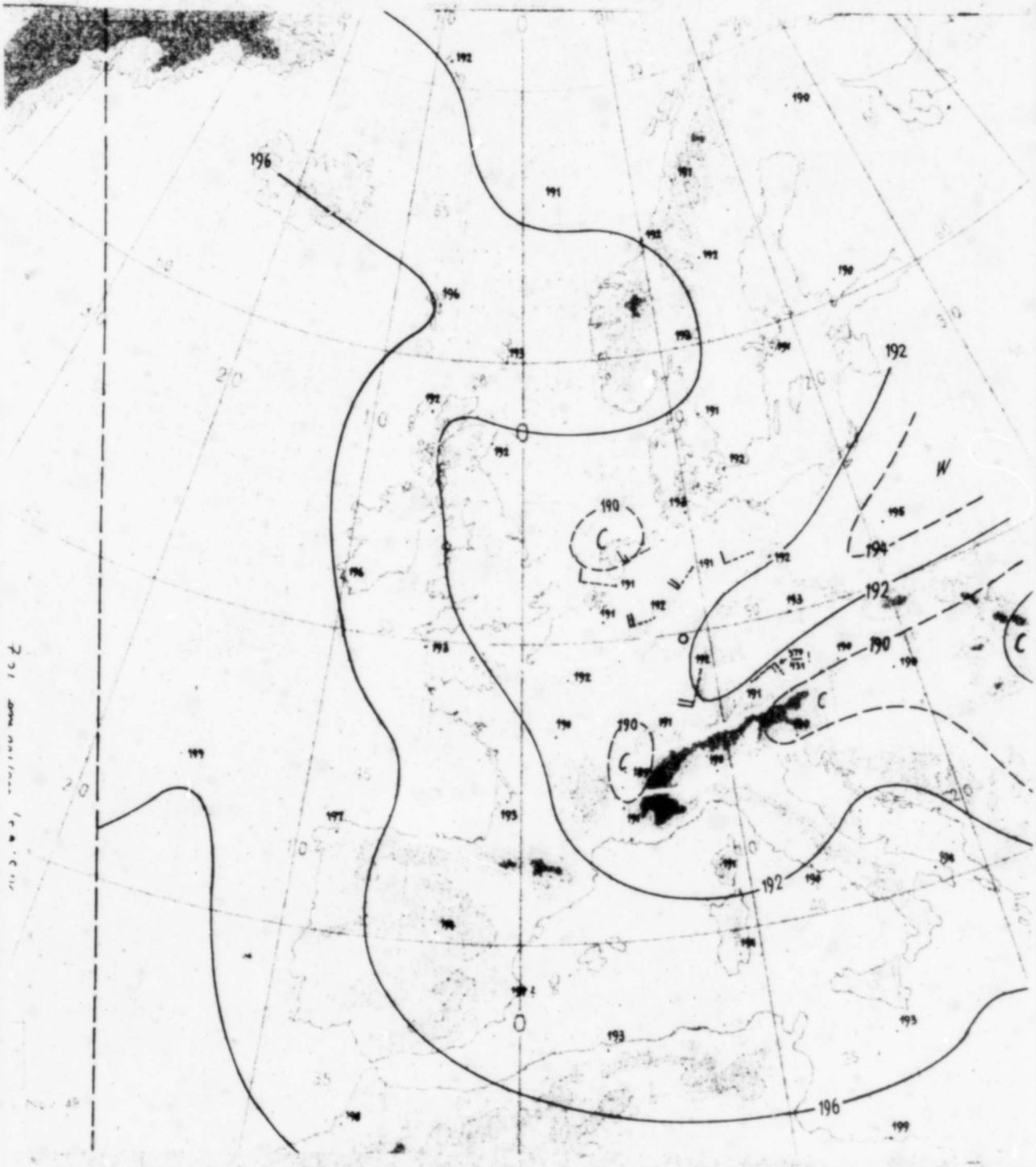


Fig. 7 : 1 March 1963, 12:00 : 300/400 mb relative topography [10 gpm] .

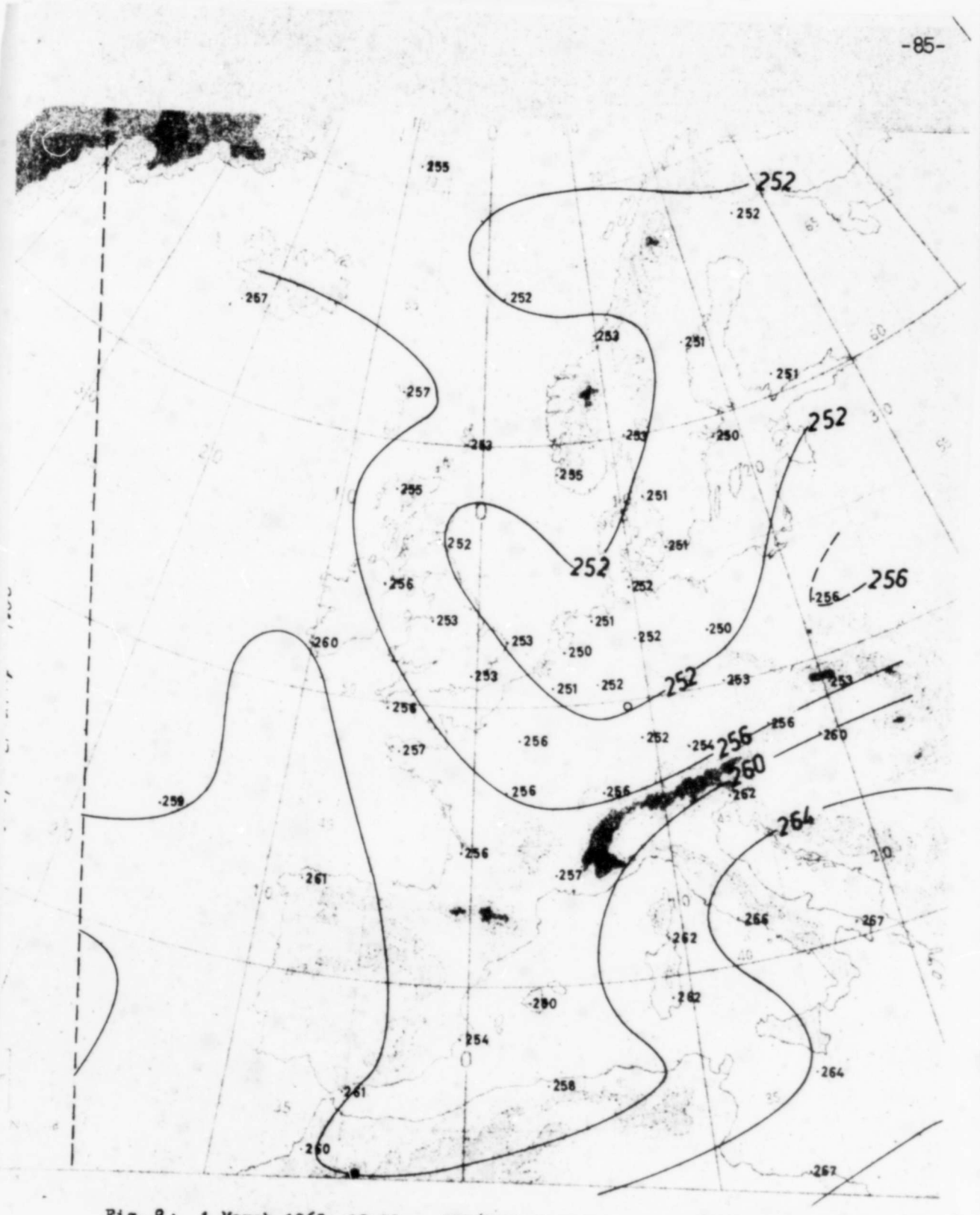


Fig. 8 : 1 March 1963, 12:00 : 200/300 mb relative topography [10 gpm] .

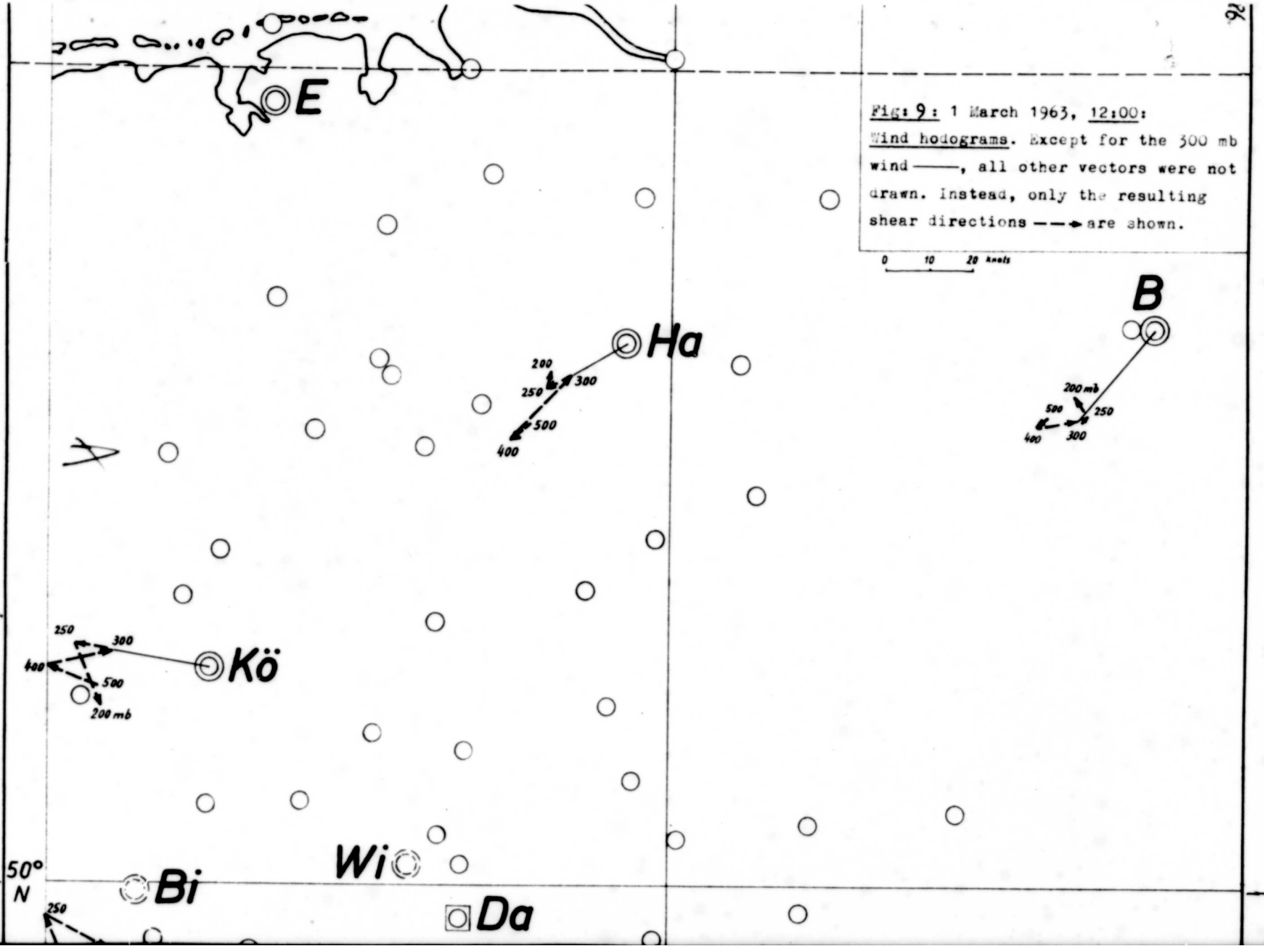
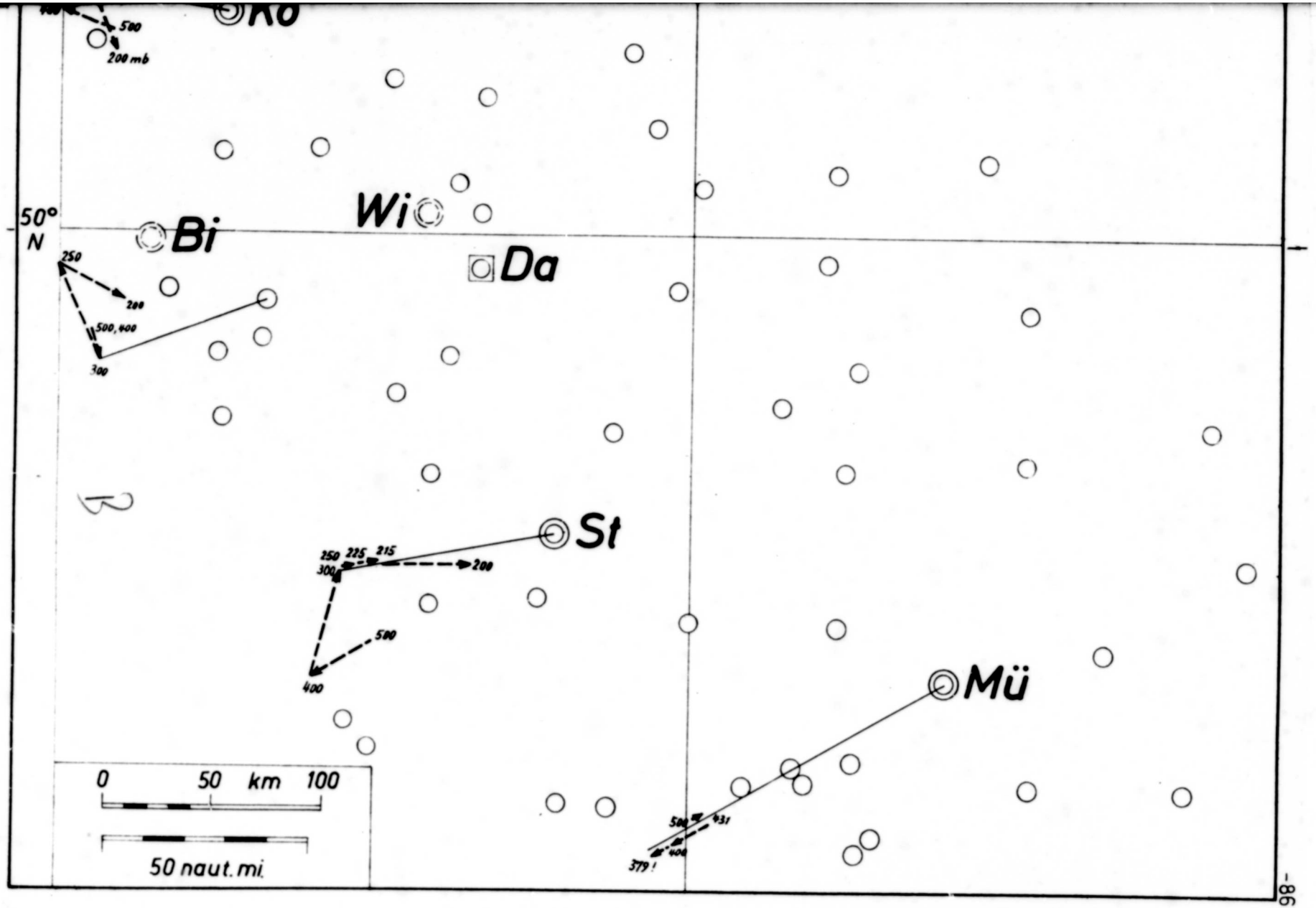


Fig: 9: 1 March 1963, 12:00:
Wind hodograms. Except for the 300 mb wind ——, all other vectors were not drawn. Instead, only the resulting shear directions ——→ are shown.

0 10 20 knots


Ko
500
200 mb
50° N
Wi
Bi
Da
250
200
500, 400
300
St
250 225 215
300
200
500
400
Mü
0 50 km 100
50 naut. mi.

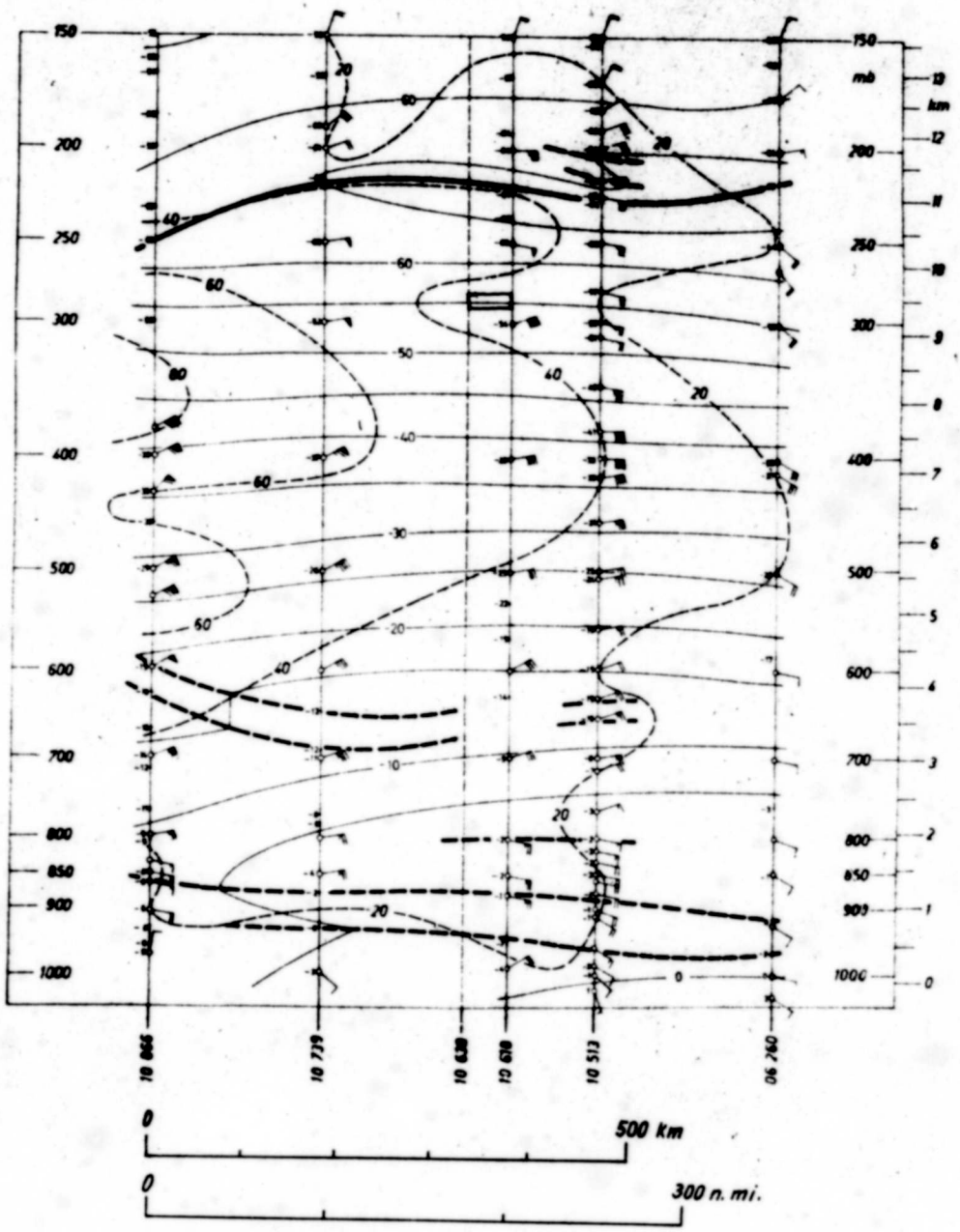


Fig. 10: 1 March 1963, 12:00 : Cross section of wind [knots] and temperature [°C]; for position, see Fig. 4 . Vertical line over Darmstadt (10639) dashed; small rectangle close to it marks ci bands. Thick line marks base of tropopause; thick dashed lines marks layers of increased stability.

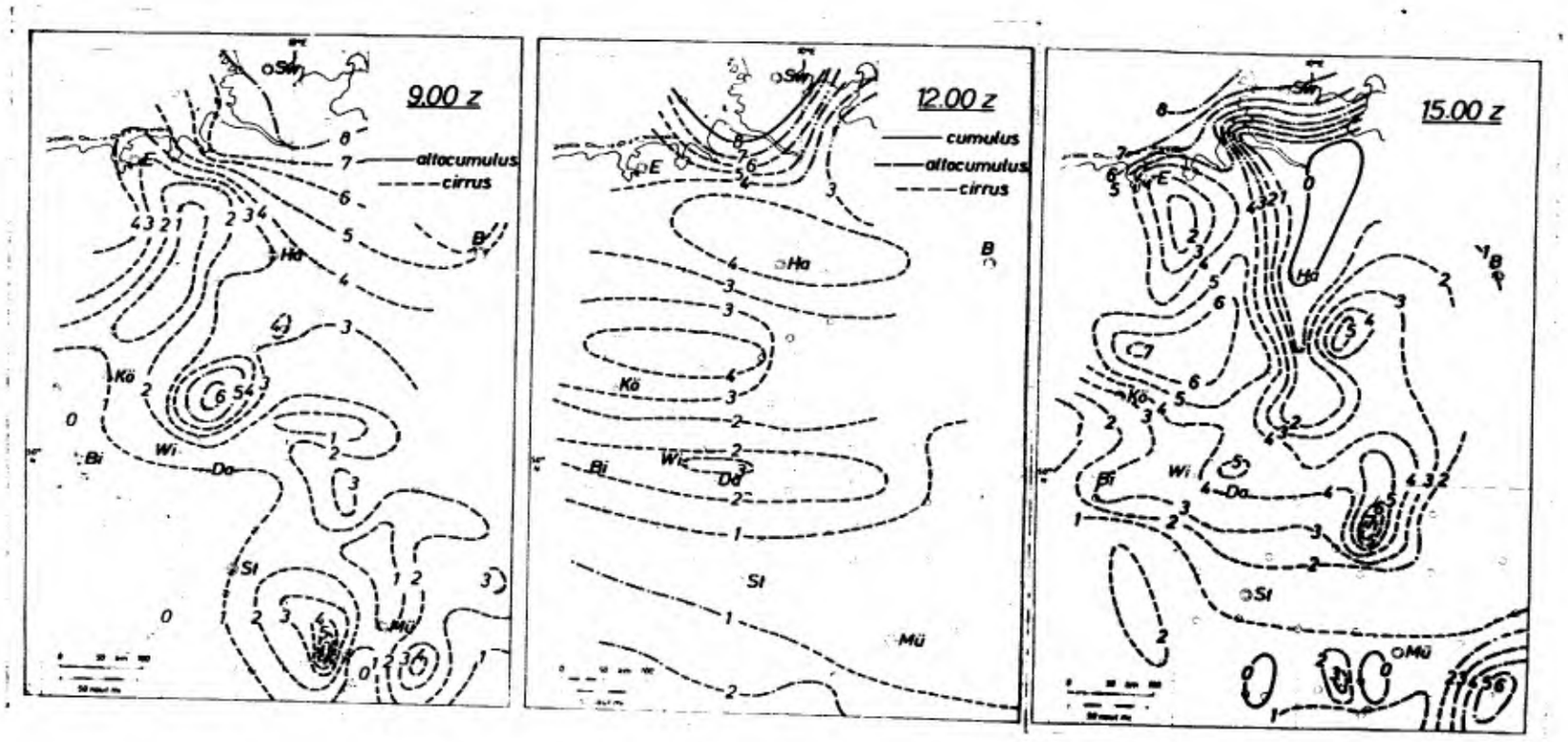


Fig. 11: 1 March 1963 : Isonephs at 3-hour intervals; "8" corresponds to 100% cloud cover.

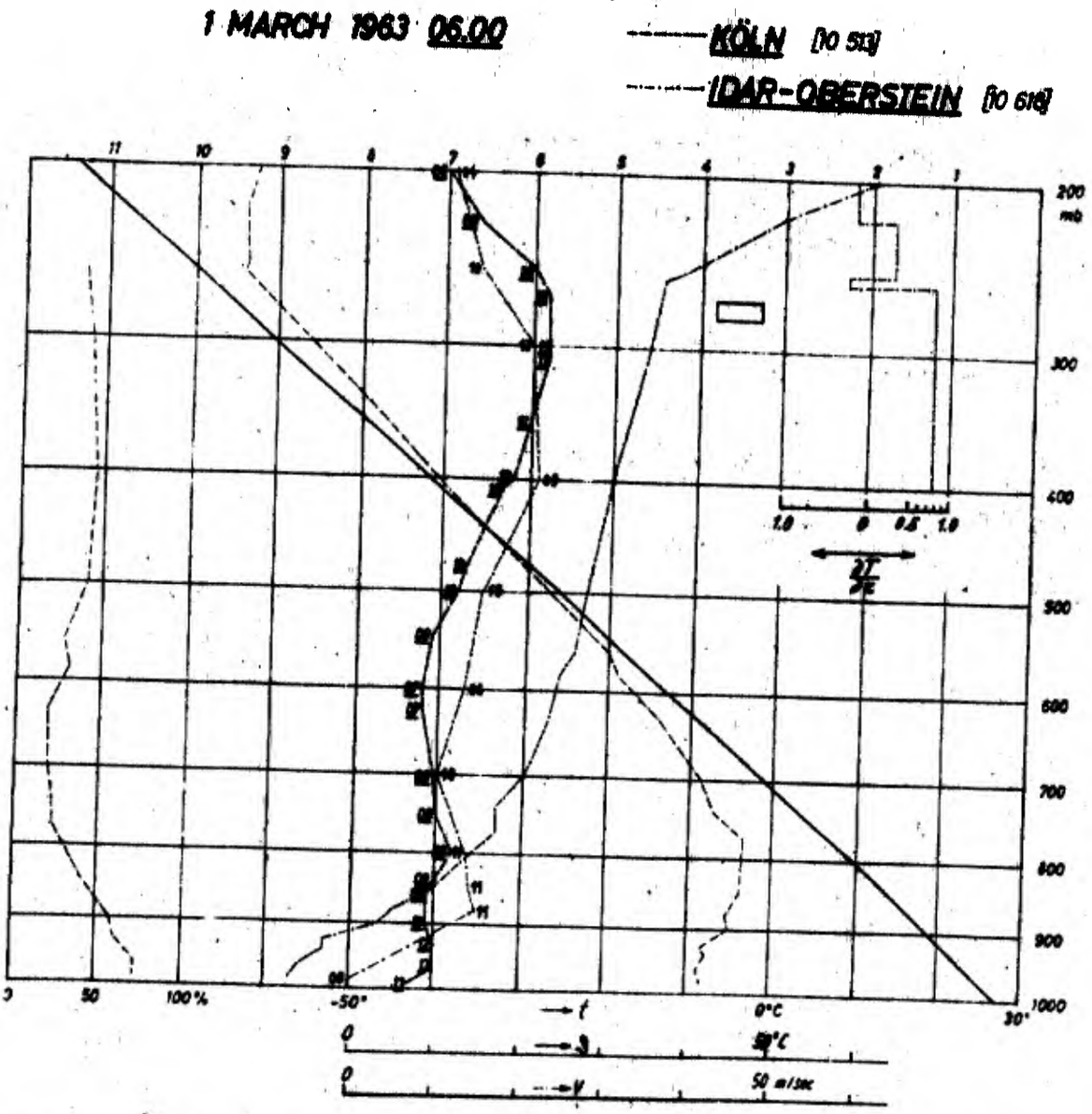


Fig.12: 1 March 1963, 06:00 : Aerologic ascents, of Köln : Wind sounding, with directions [10°] underlined; of Idar Oberstein: Wind, temperature and humidity, of Stuttgart : $p(z)$ (solid line). Small rectangle marks altitude of cirrus over Darmstadt at 11:35.

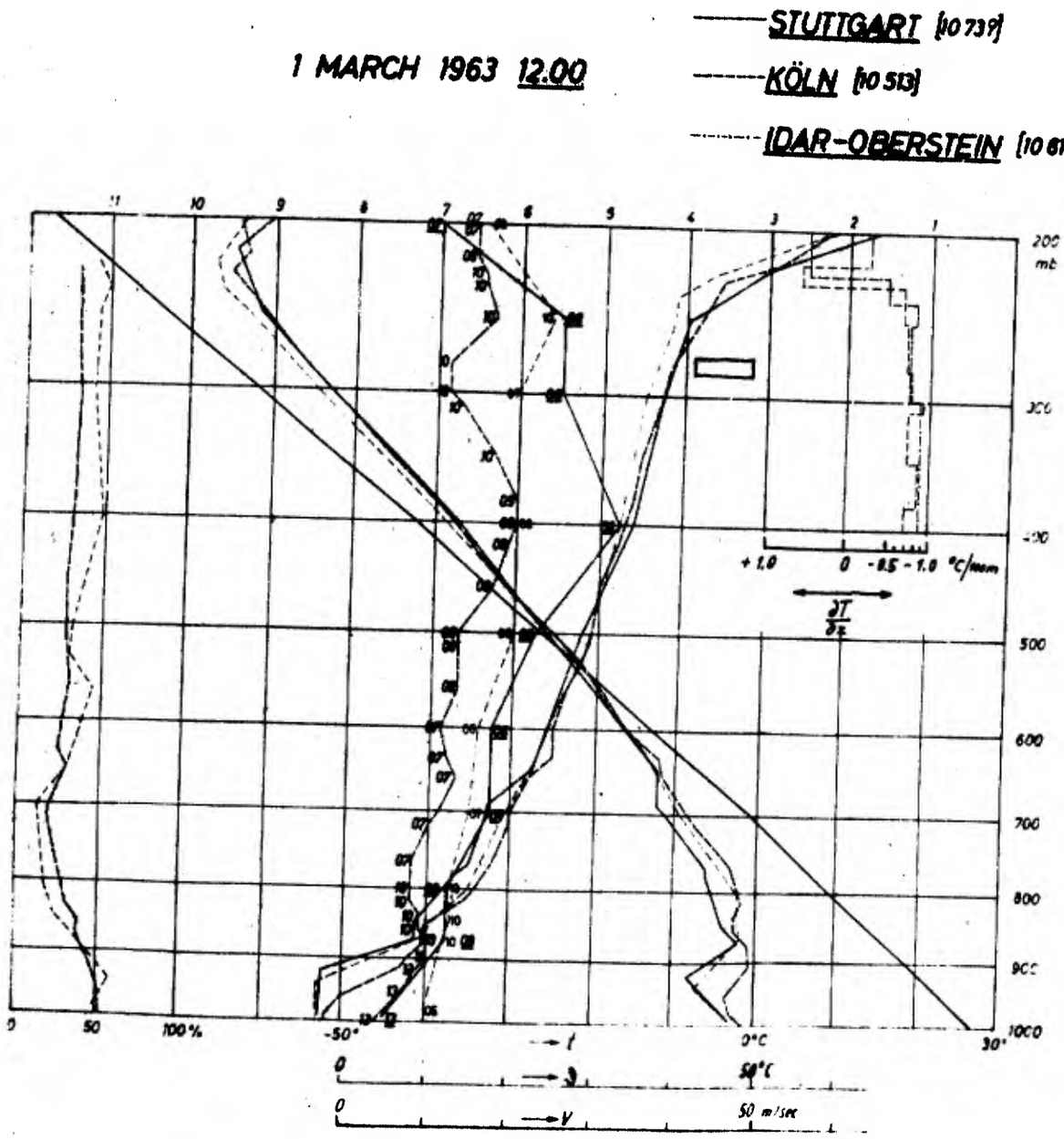


Fig.13: 1 March 1963, 12:00 : Aerologic ascents, of
Köln: Wind, temperature and humidity:
Idar-Oberstein: —"— ———"———"———"———
Stuttgart: Wind (directions [10°] underlined)
temperature and p(z);

Small rectangle marks altitude of cirrus over Darmstadt at 11:35.

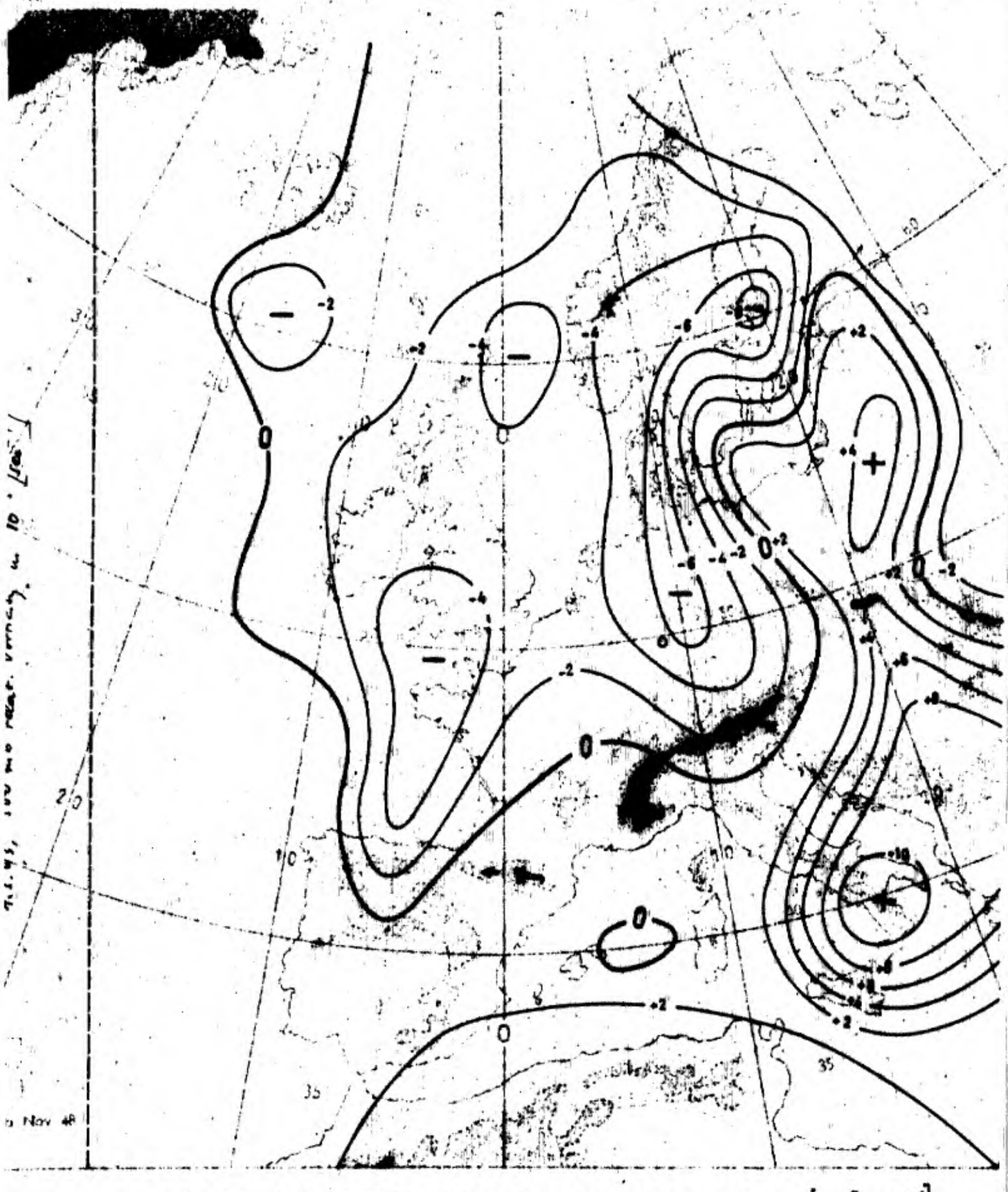


Fig. 14: 1 March 1963, 12:00 : 500 mb relative vorticity $[10^{-5}\ sec^{-1}]$.

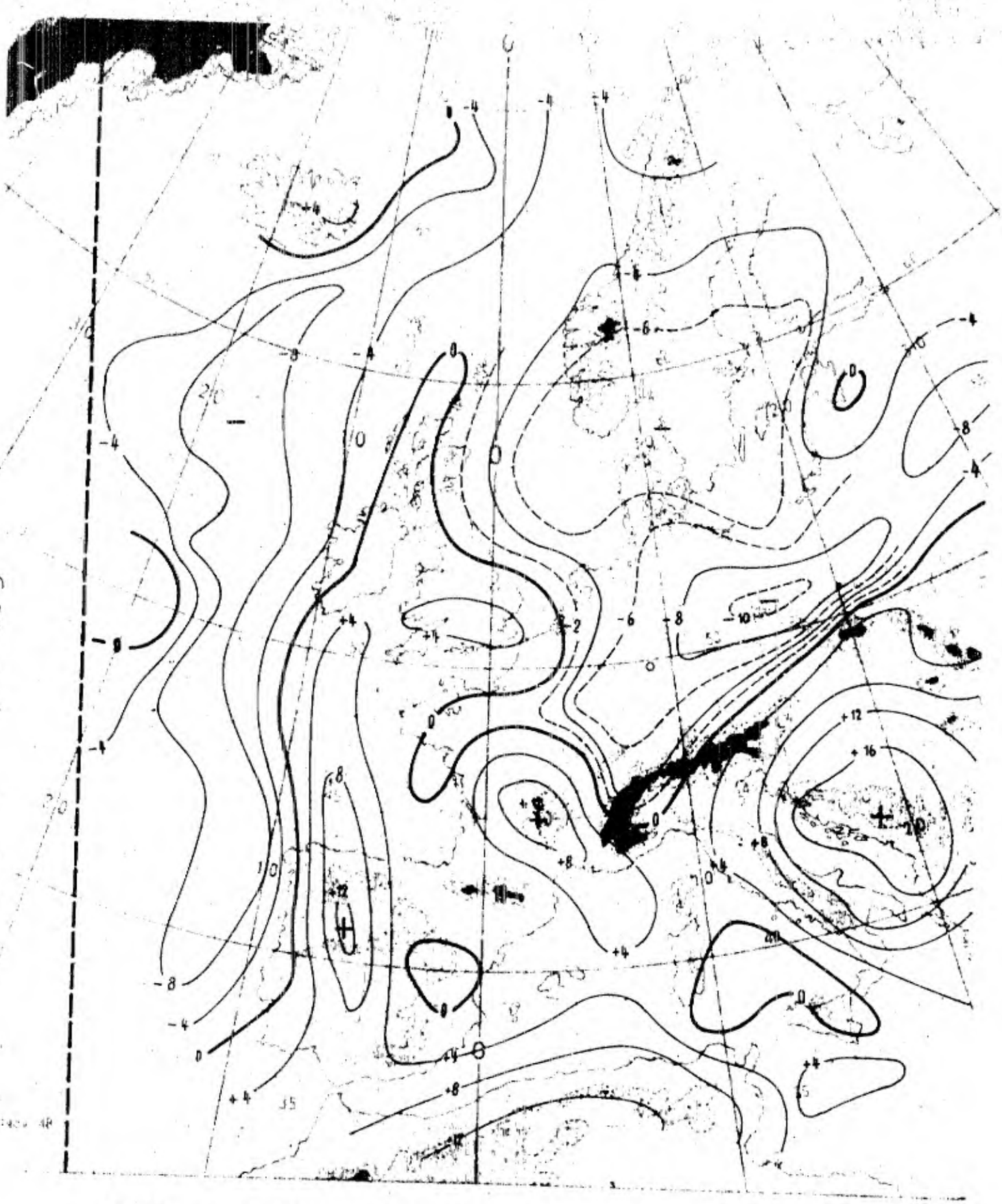


Fig.15 : 1 March 1963, 12h00 : 500 mb relative vorticity $\left[10^{-5}\ sec^{-1}\right]$.

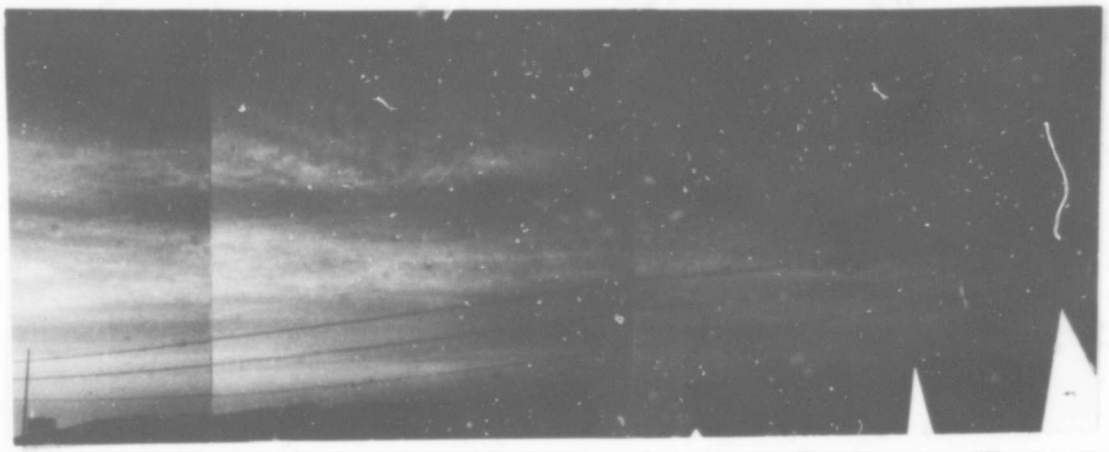


Fig. 1 : 14 Febr. 1964, 8:15 : Panorama toward SW.

Fig. 2 : 14 Febr. 1964: Isonephs at 3 hour intervals, "8" corresponds to 100% cloud cover.

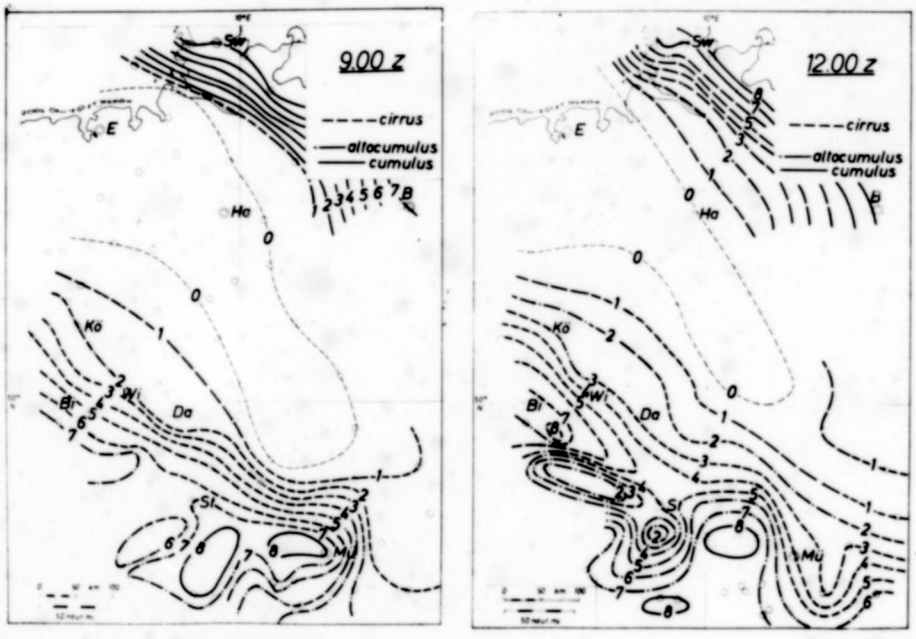


Fig. 3a: Portion of ci-band still in state of lateral growth. Photographic taking axis was changed from one to the other picture!

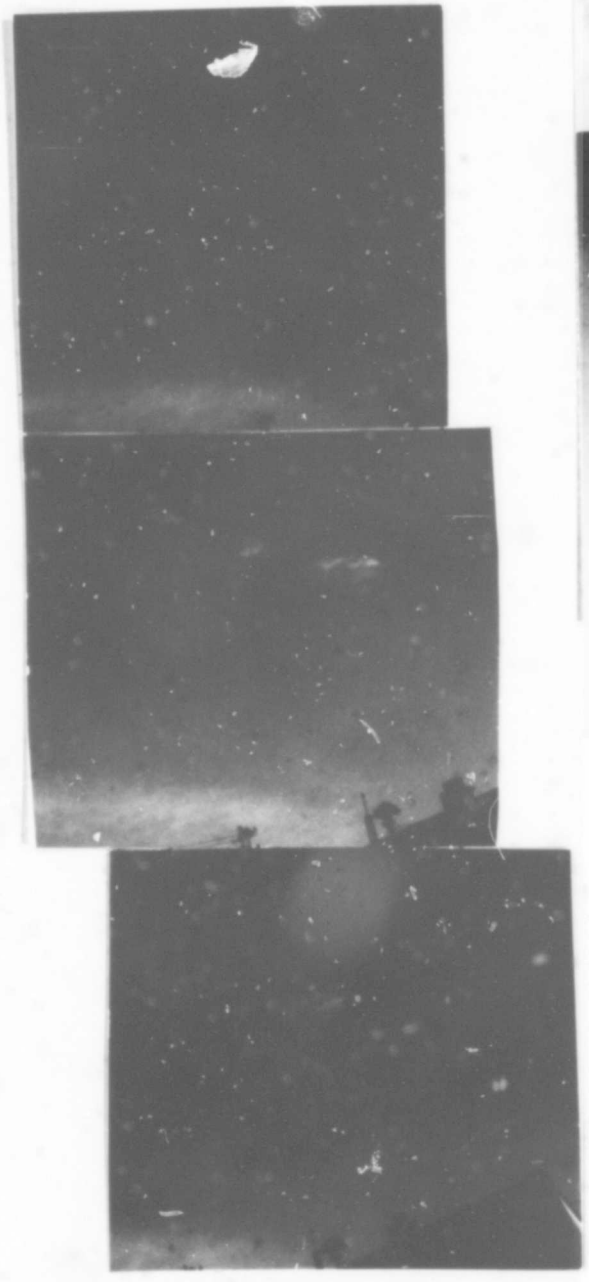
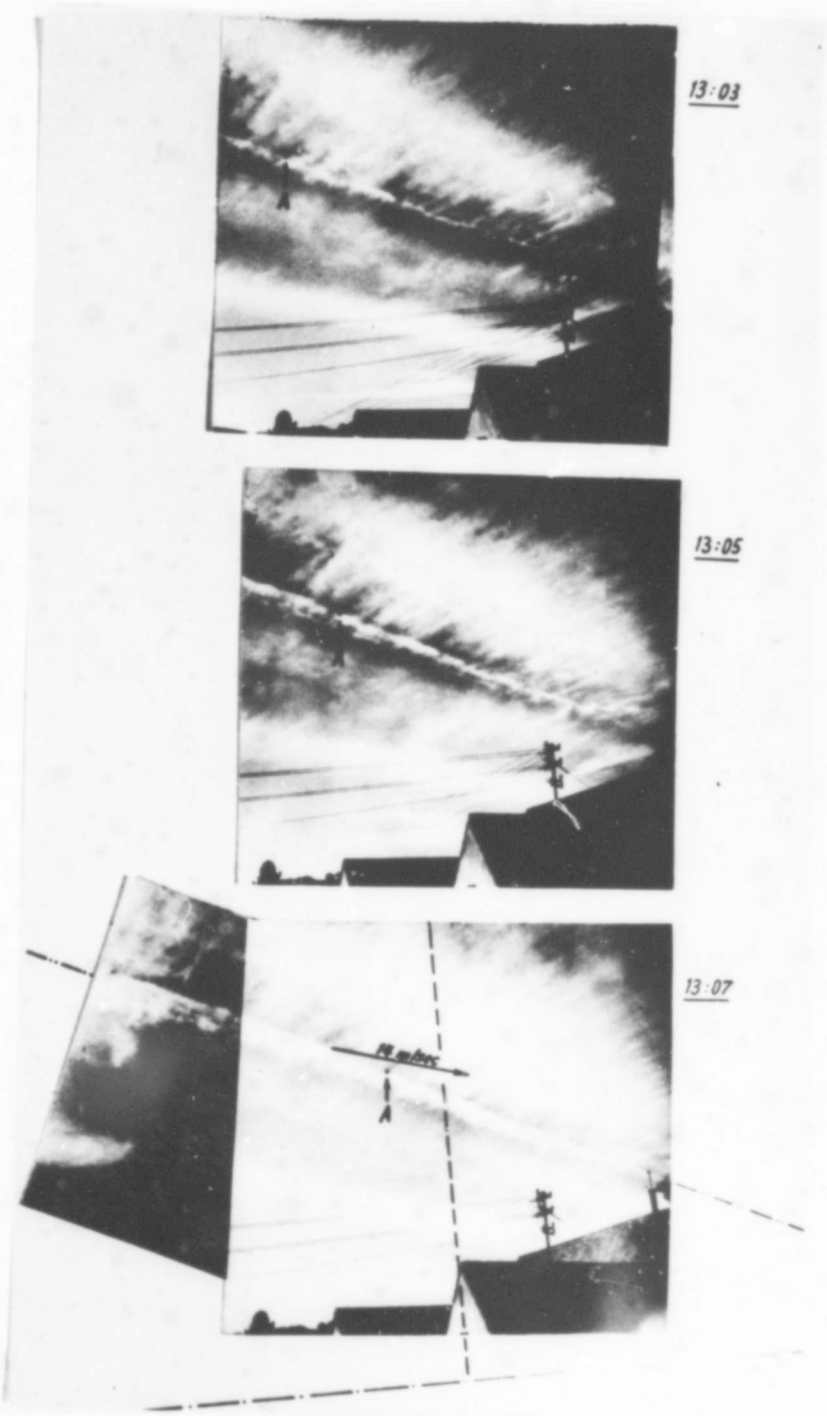
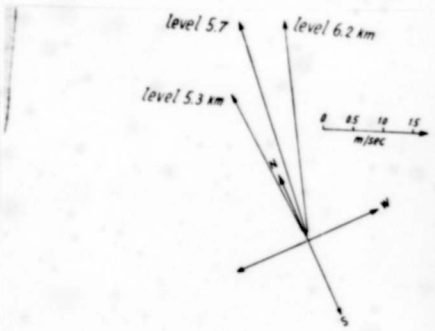


Fig. 3b: Portion of growing ci-band.

Fig. 4a: Panorama of flattened ci-band, taken from zenit toward WNW.

Fig. 4b: Photographic sequence of portion of narrow ci-band.





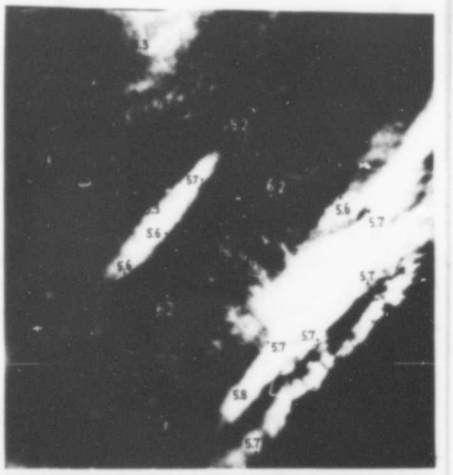
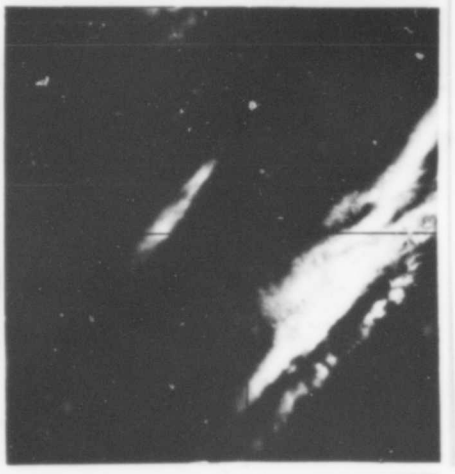


Fig. 5: 14 Febr. 1964, 14:40: Topography, motion vectors and stereo view of low band and other clouds.



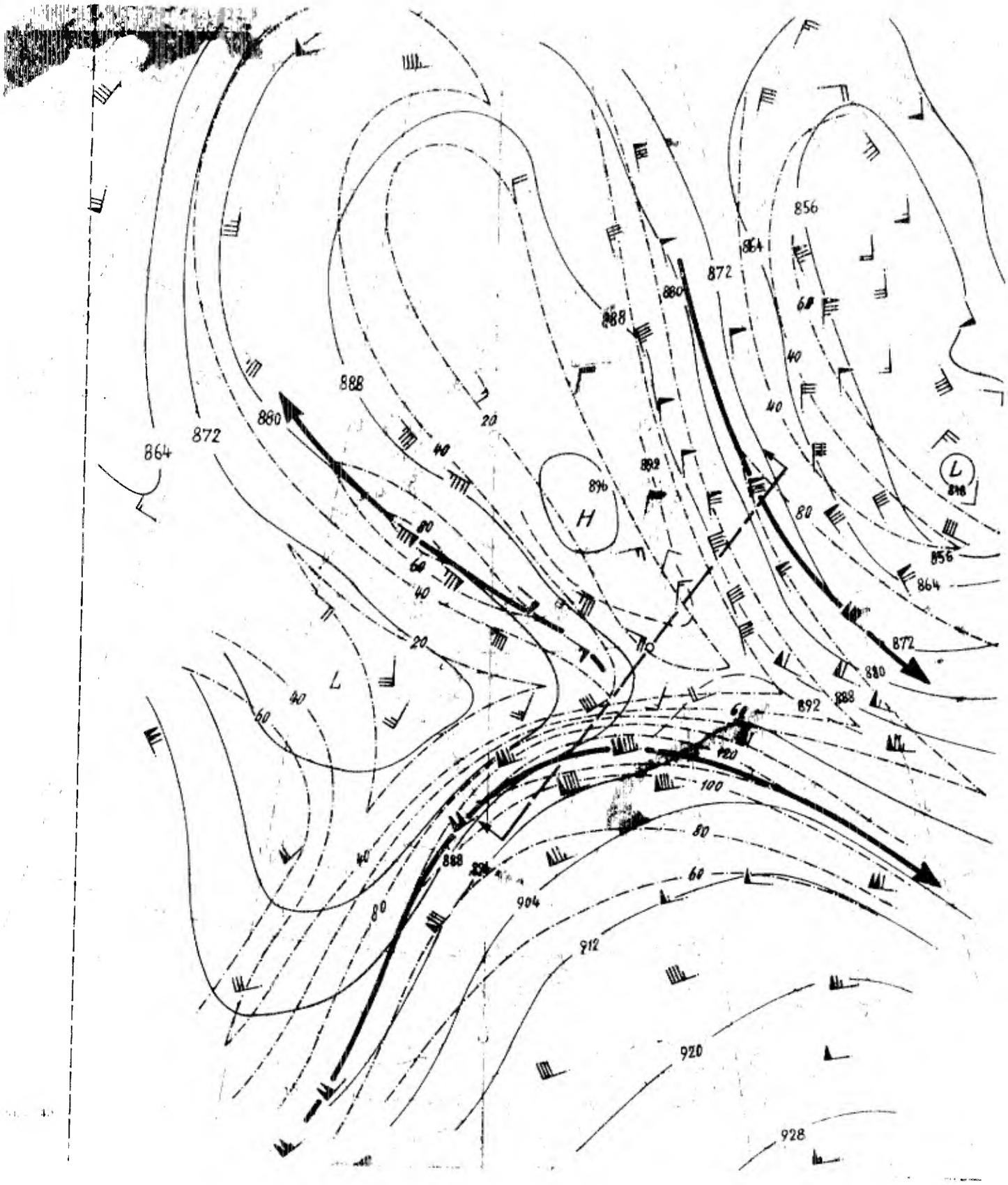


Fig. 6 : 14 Febr. 1964 . 12:00 : 300 mb contours [10 gpm] , isotachs [knots] (dash — dotted), and jet stream axes.

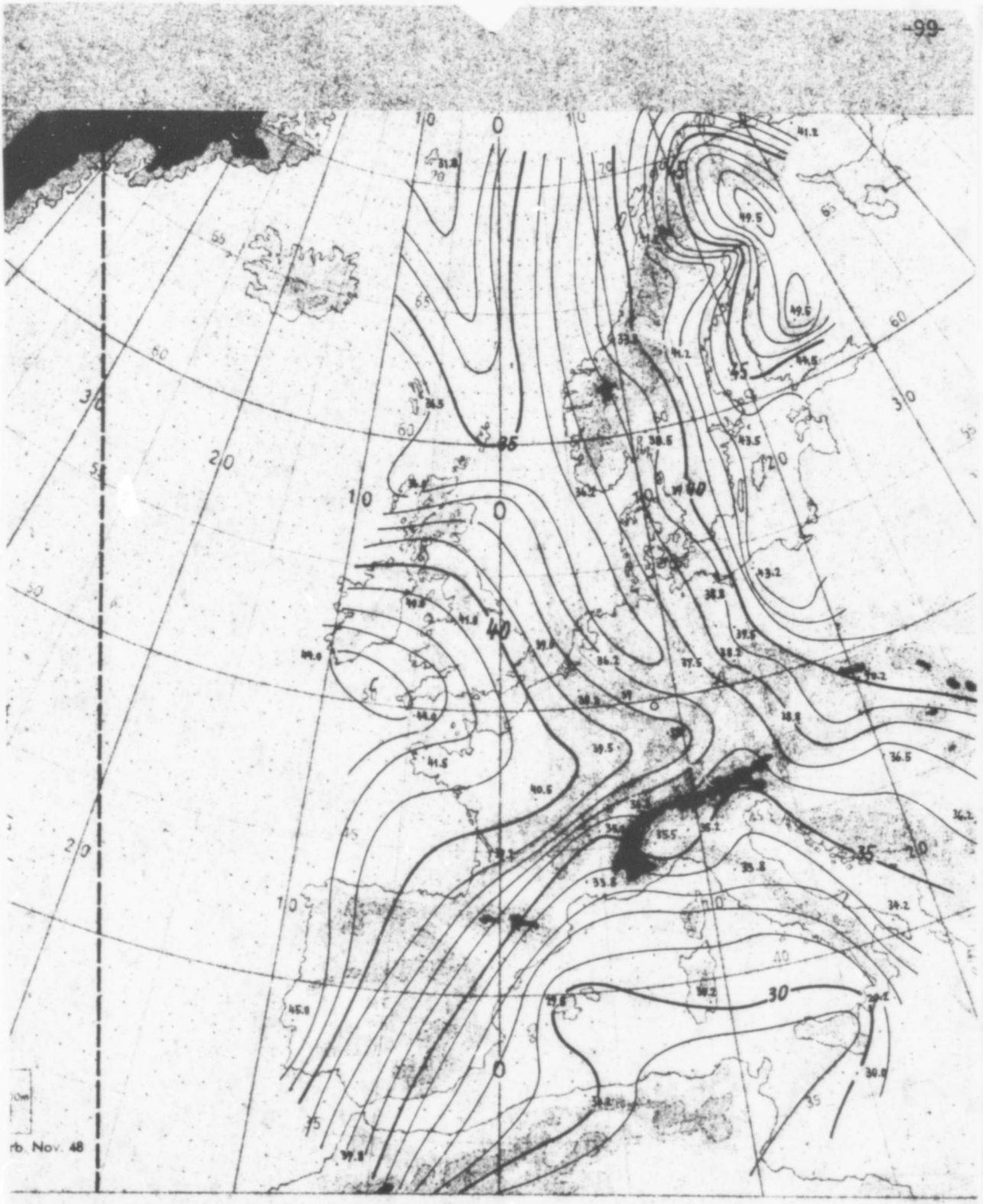


Fig. 7: 14 Febr. 1964, 12:00 : 400 mb isotherms [-°C].

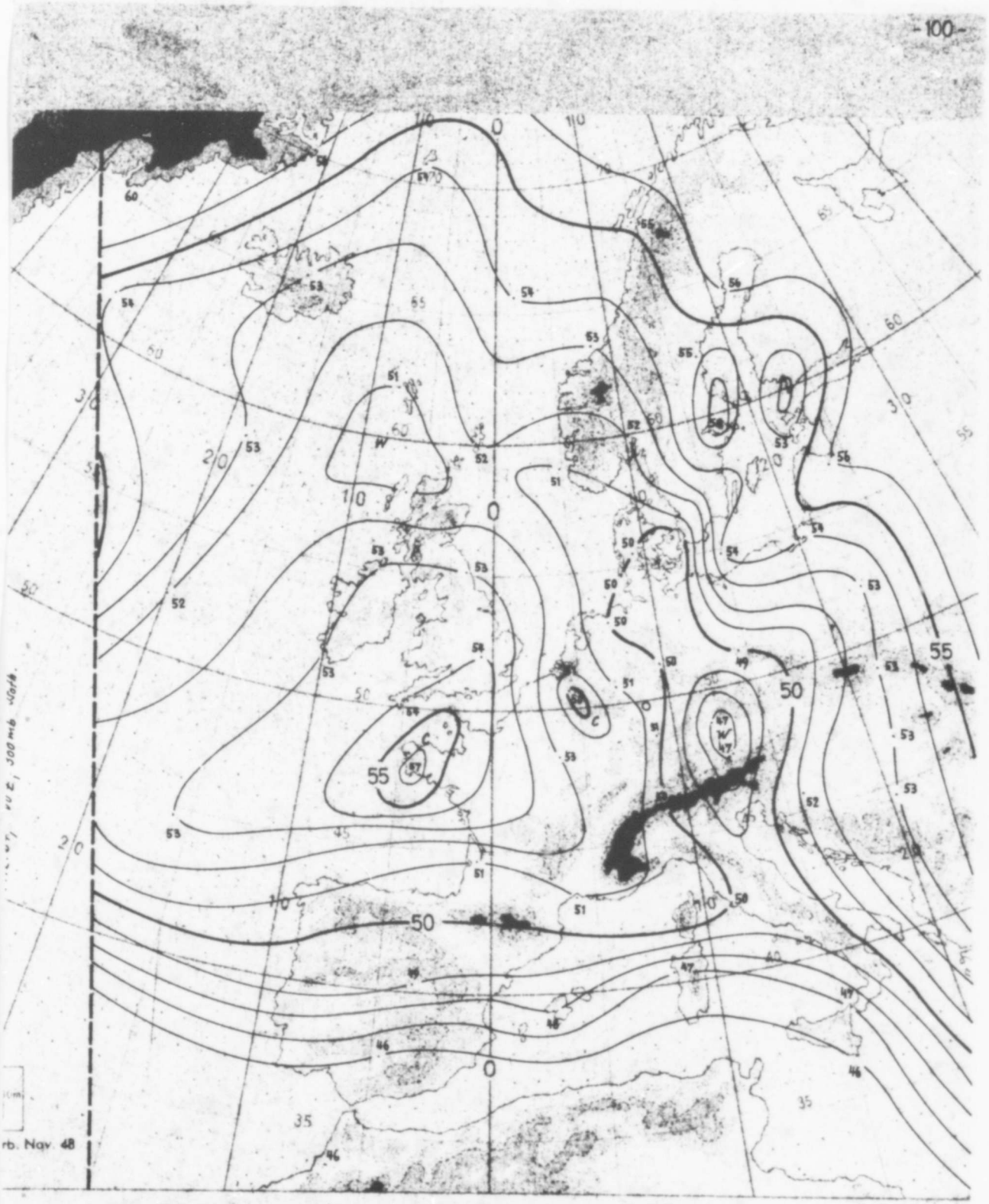


Fig. 81 14 Febr. 1964, 0100 Z 300 mb isotherms [-°C] ; trace of tropopause, far remote of photographed ci, was omitted.

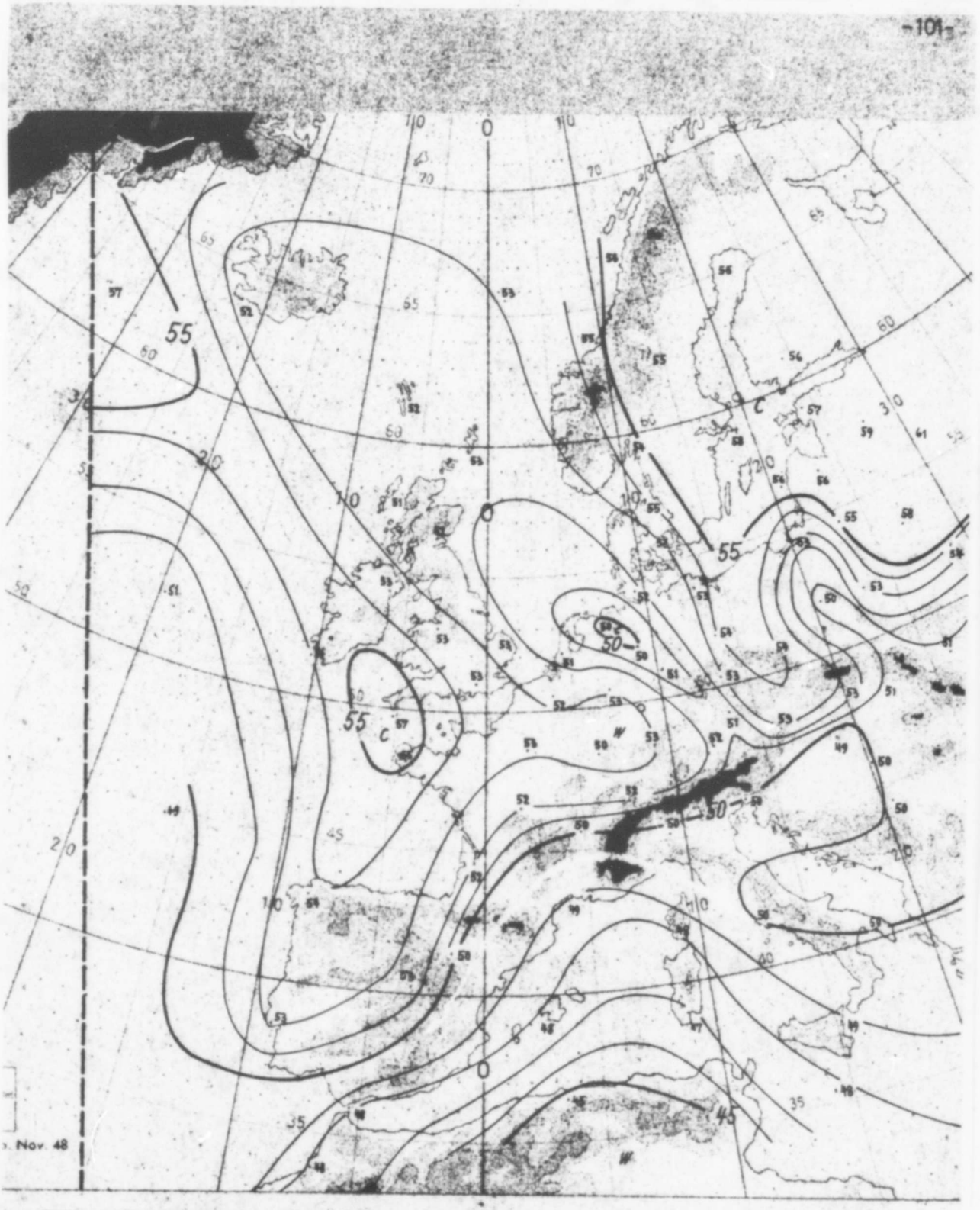


Fig. 9: 14 Febr. 1964, 12:00 : 300 mb isotherms [-°C], trace of tropopause, far remote of photographed oi, was omitted.

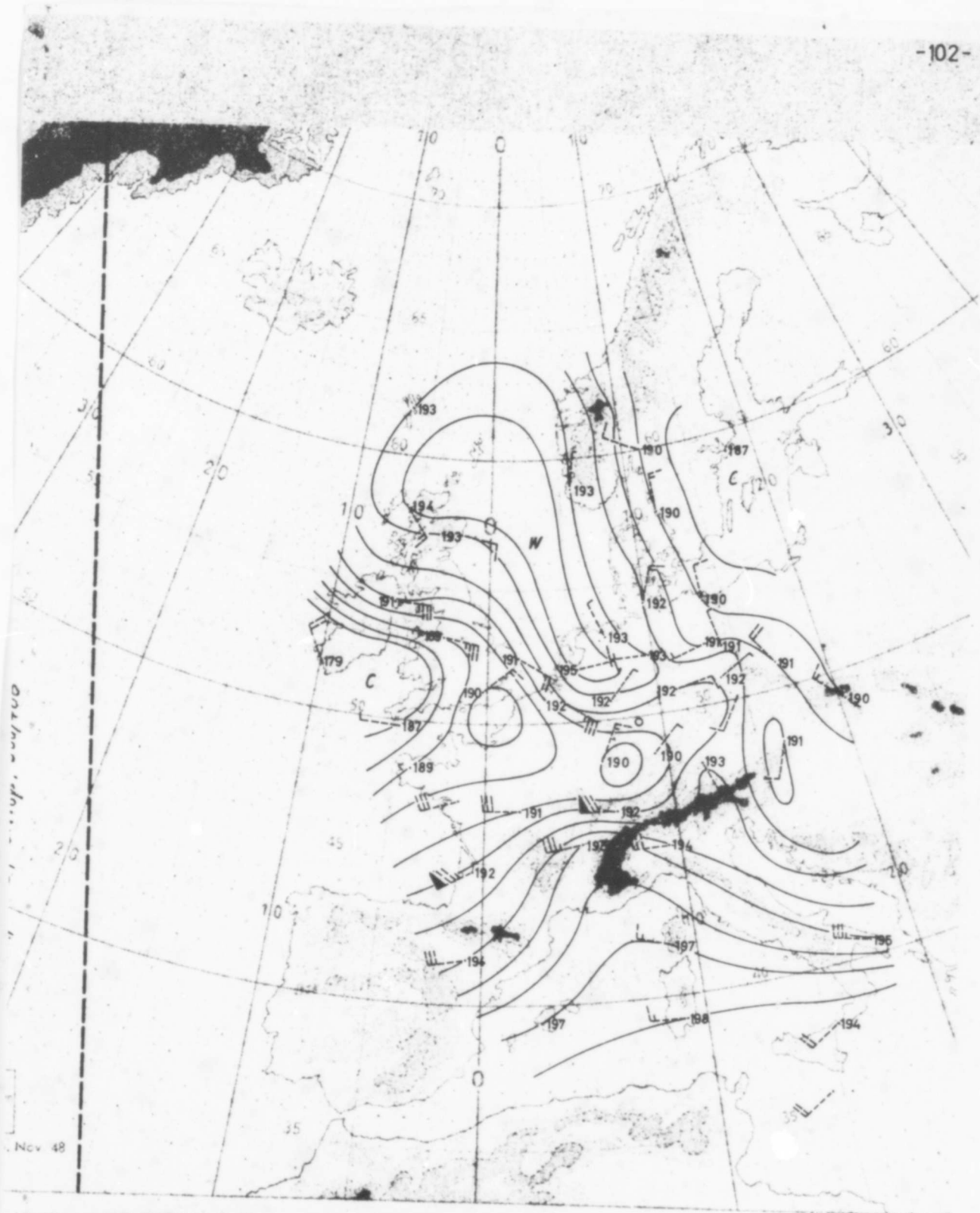


Fig.10: 14 Febr. 1964, 12:00 : 300/400 mb relative topography [10 gpm] .

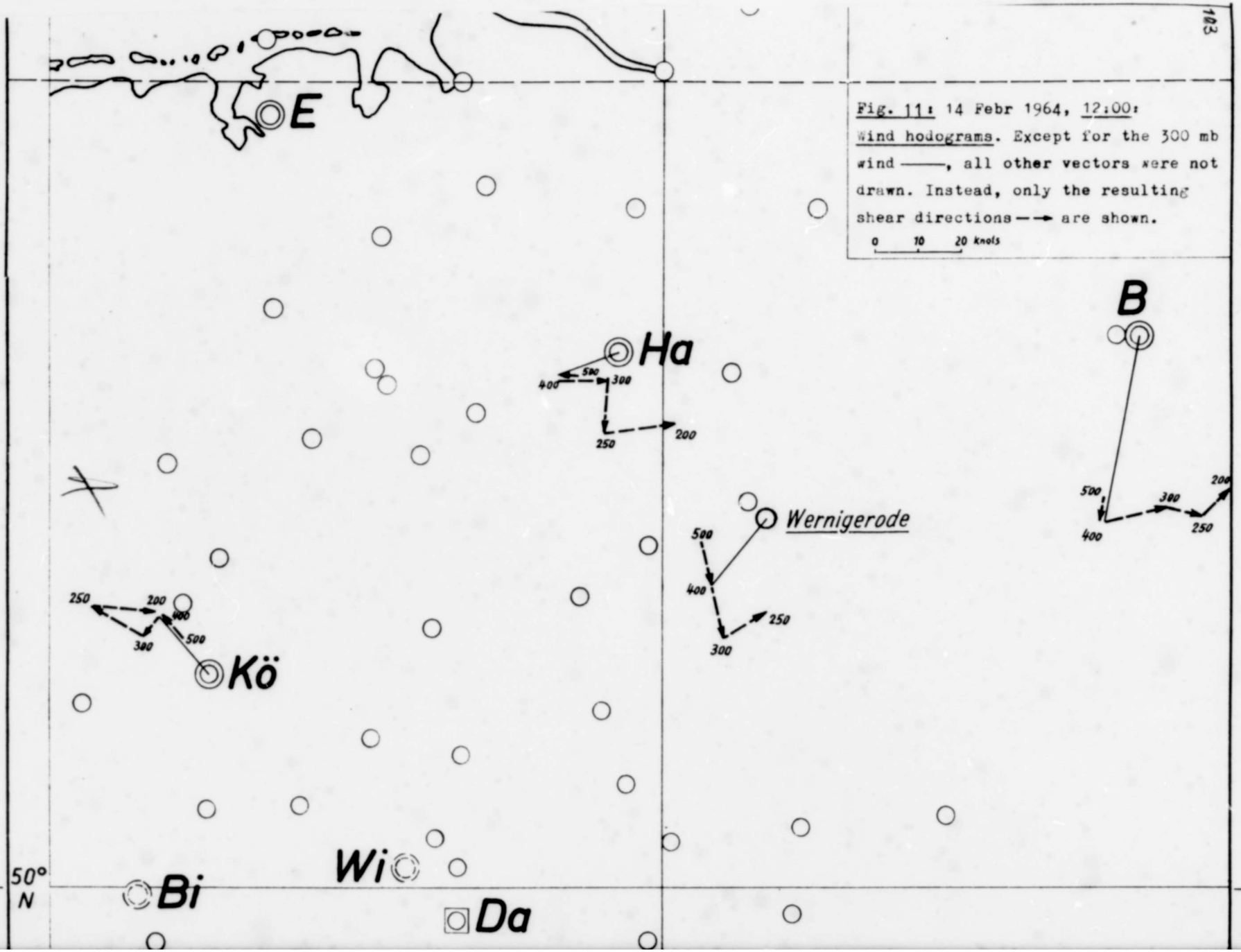
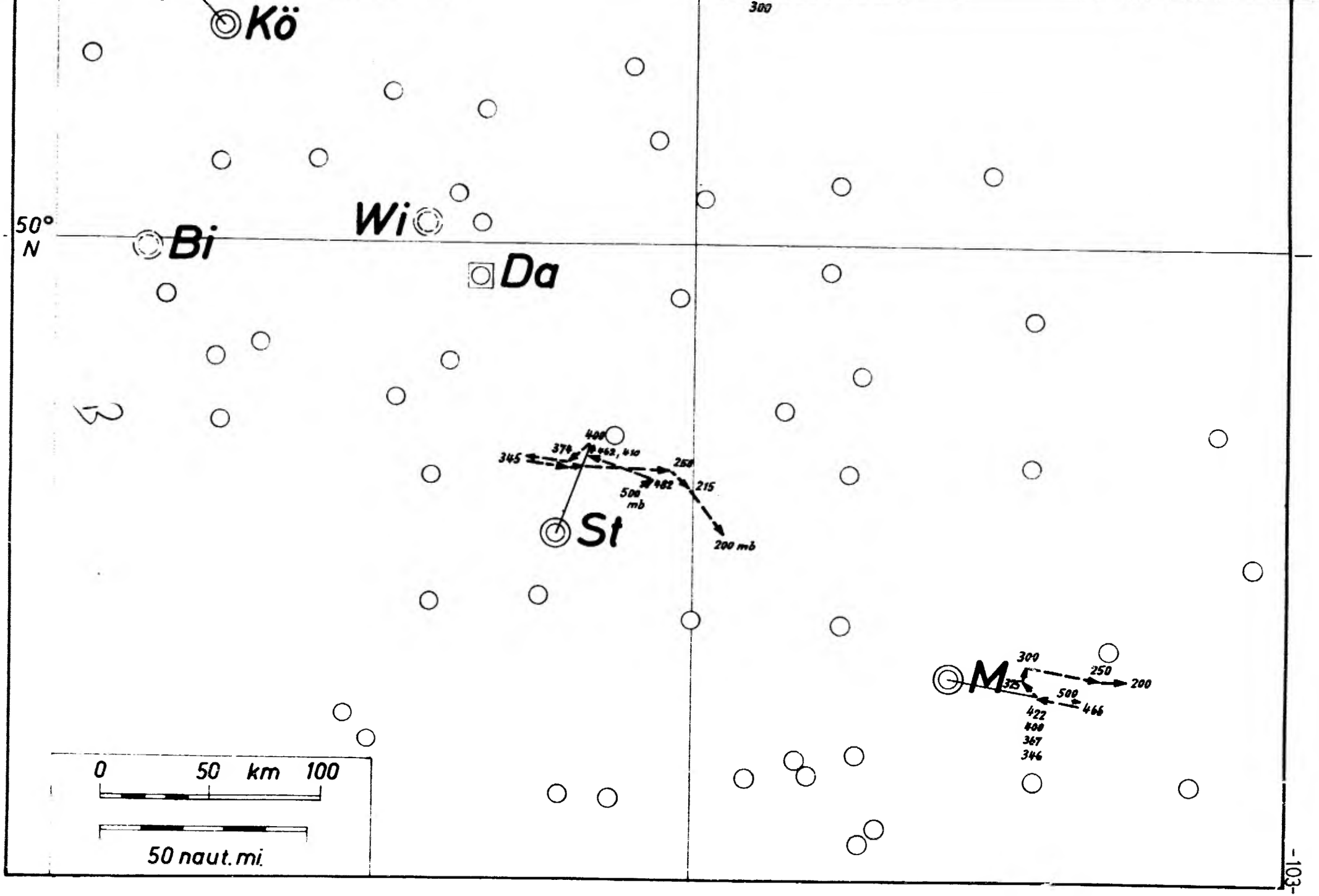


Fig. 11: 14 Febr 1964, 12:00: Wind hodograms. Except for the 300 mb wind ——, all other vectors were not drawn. Instead, only the resulting shear directions —→ are shown.

0 10 20 knots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378
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482
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200 mb
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367
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km
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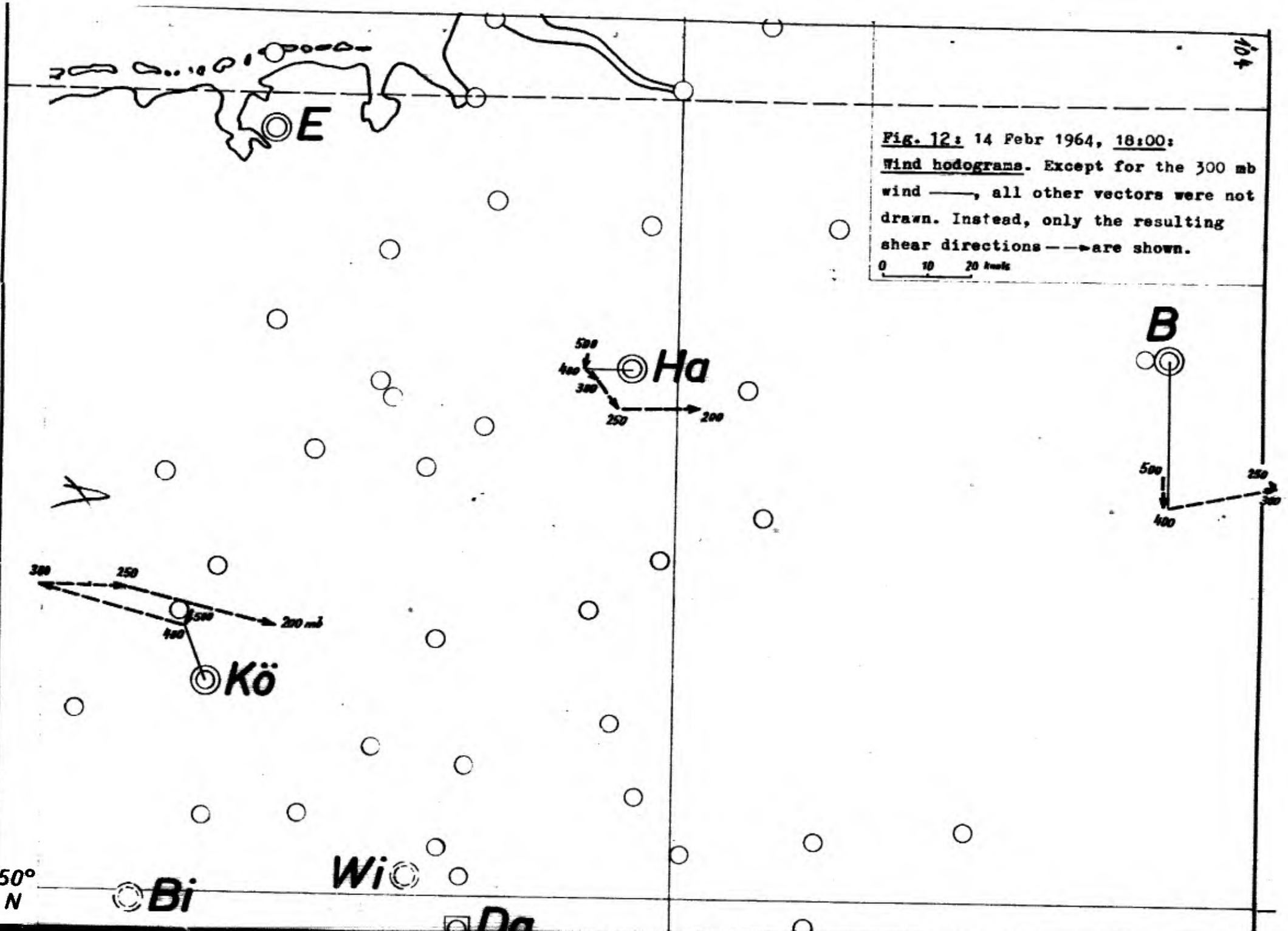
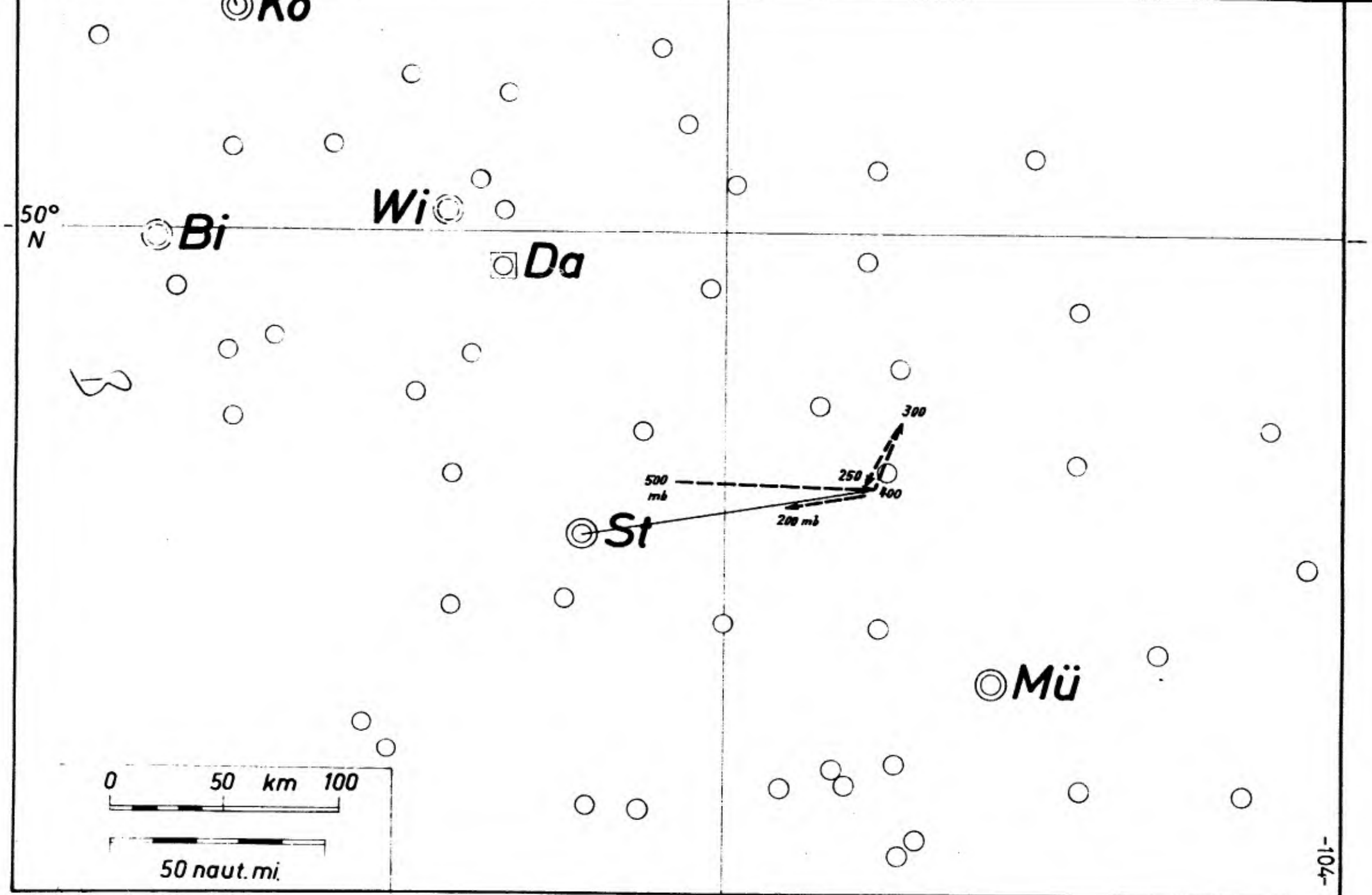


Fig. 12: 14 Febr 1964, 18:00:
Wind hodograms. Except for the 300 mb wind ——, all other vectors were not drawn. Instead, only the resulting shear directions ——→ are shown.
0 10 20 knots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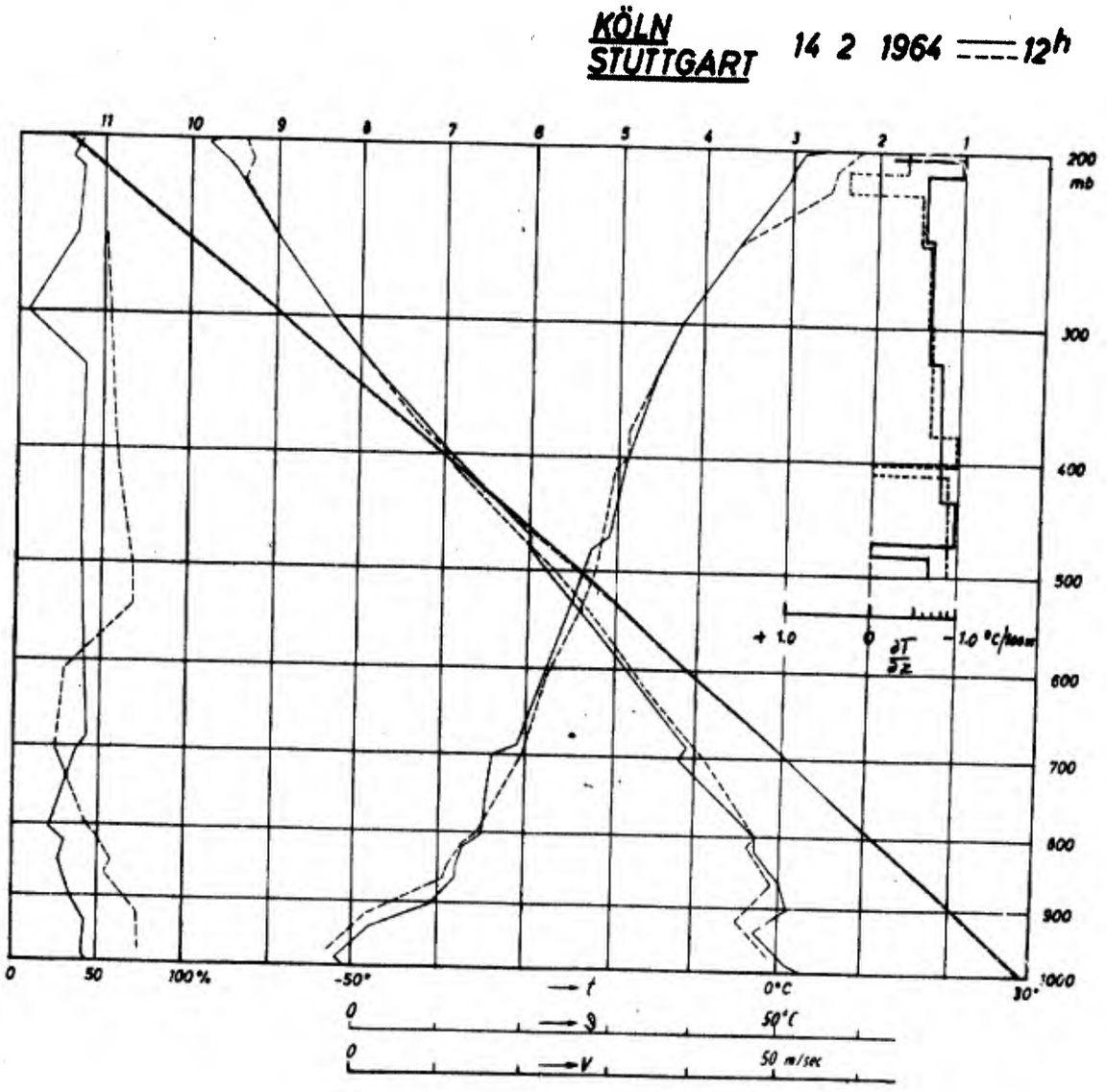

Fig. 13: 14 Febr 1964, 12:00 :
temperature, humidity and p(z).

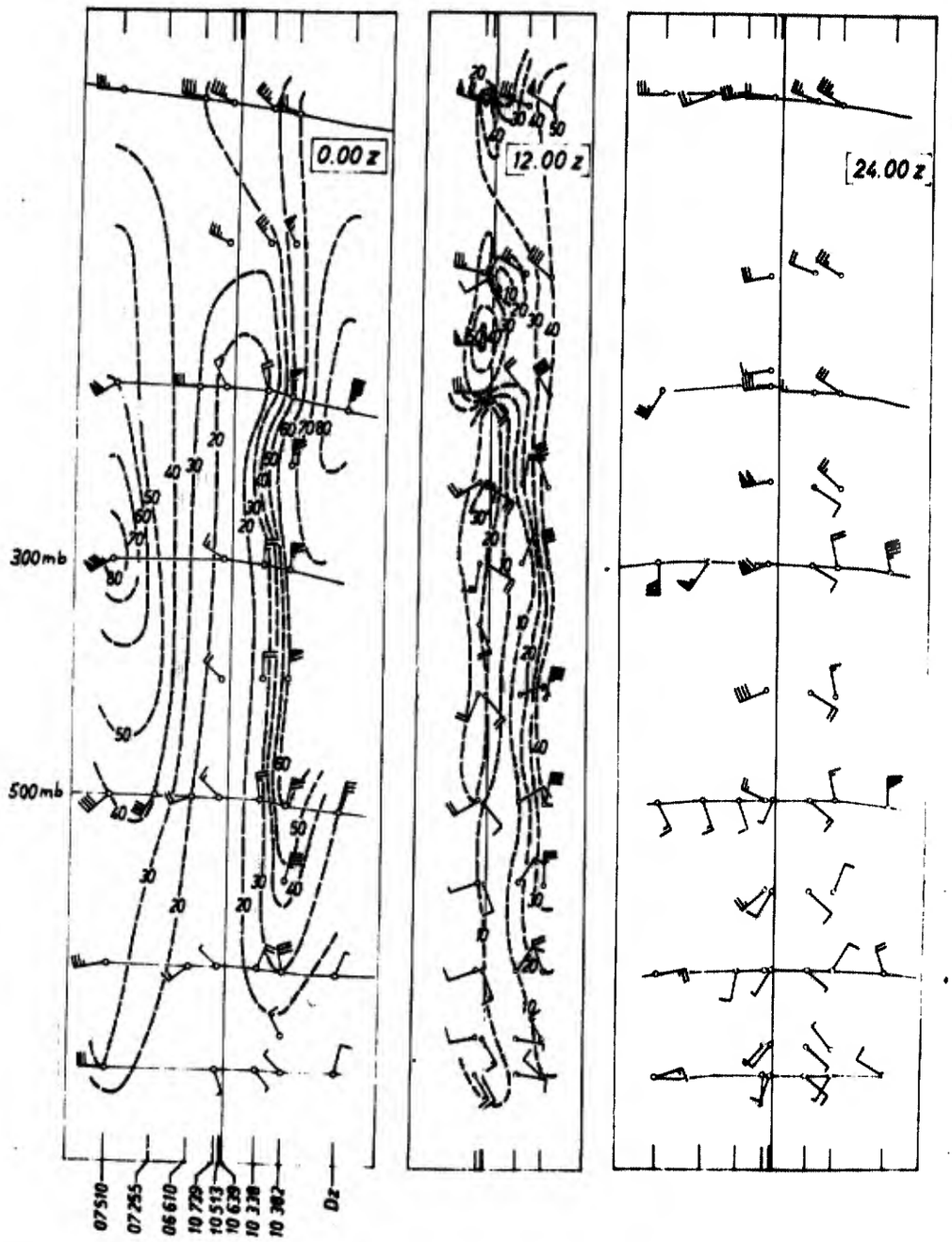

Fig. 14: 14 Febr. 1964: Wind cross sections at 00:00, 12:00 and 24:00; for position, see Fig. 6.

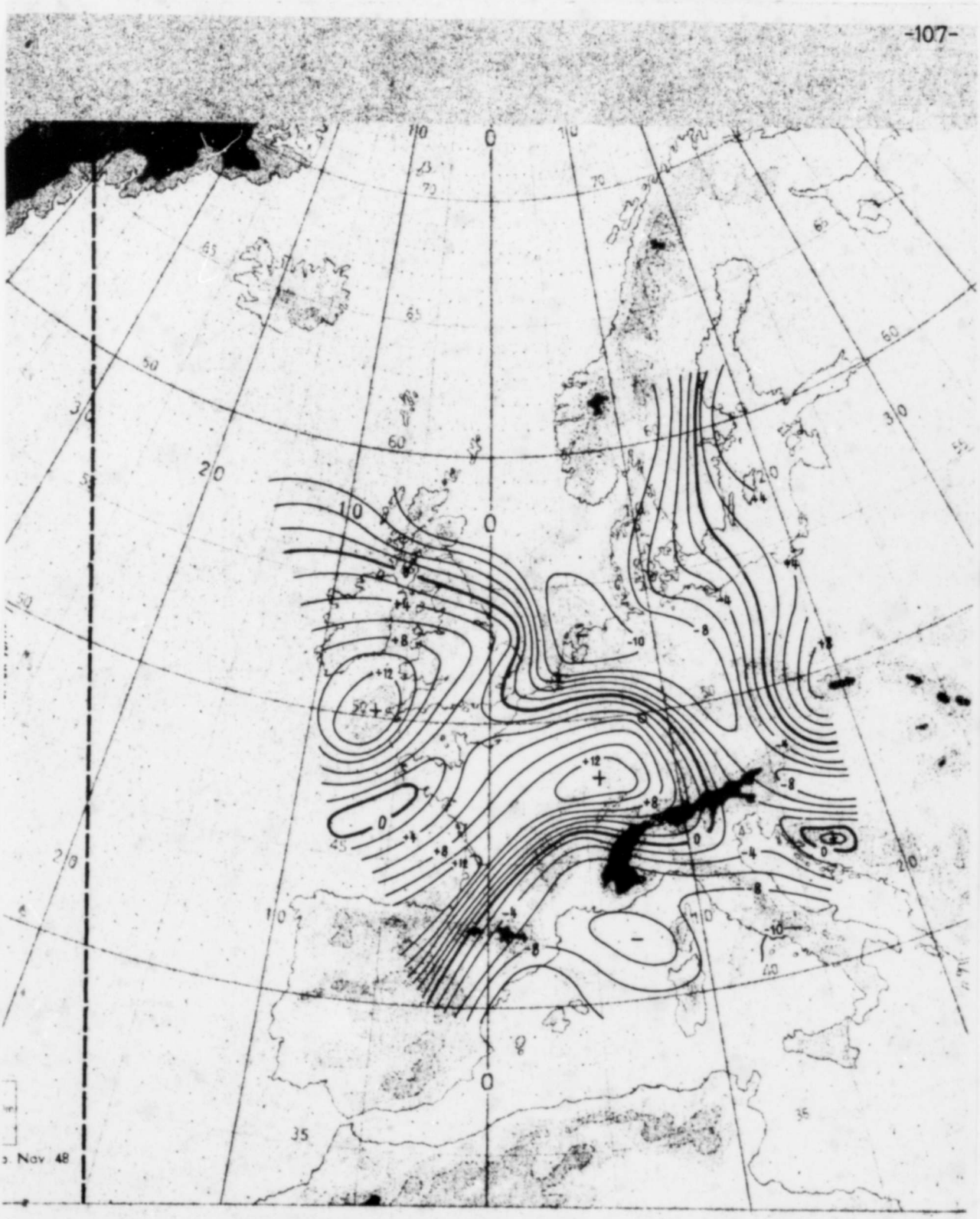

Fig. 15 : 14 Febr. 1964, 12:00 : 300 mb relative vorticity $[10^{-5}sec^{-1}]$