In late 1958, just when I began to feel at home in my office at the fourth floor of Science Hall, I received a telephone call from Dr. Harry Wexler, the Chief Scientist of the U.S. Weather Bureau in Washington DC. As it turned out, this call initiated two decades of research that became highly influential for the development of staff and students at the UW Dept of Meteorology.

December 1958 had been the last month of the *International Geophysical Year* that began in July 1957, commonly abbreviated *IGY*. By international agreement of a host of participating nations the IGY was a period of world-wide intensified observations of geophysical phenomena. Precedents were two *International Polar Years* , the first in 1882/83 and the second in 1932/33; a third was planned for 1982/83. In the 1950s geophysicists felt that the that rapid progress in observing techniques warranted not to wait til 1982 but to organize the next international effort after 25 yrs and make 1957/58 a global *IGY* rather than one just for the northern hemisphere. As research assistent at the U. of Leipzig, I had made use of the intensified data from both Polar Years for evaluating macro-diffusivity of north-hemispheric circulations as factor of heat transfer from low to high latitudes [see *Beitr. Phys. Atm.*, **23**; also, Lettau,1939, Chapter 12]. Incidentally, macro-diffusivity was a topic of interest to Dr. Wexler. Any time since 1949 when we met at annual AMS meetings or special conferences, we discussed our concepts in private "get-to-gethers". Harry had been deeply interested in my boundary-layer experiment in Nebraska's prairie country [Lettau &Davidson, 1957]. While I considered the low-level jetstream documented by *Project Great Plains* as an endogenous phenomenon, Harry preferred to see it exogenously controlled by the Bermuda High. In 1961 Harry had inaugurated a USWB project to study the low-level jetstream by an east-to-west array of 12 rawin stations, from Little Rock Arkansas to Amarillo, Texas. My review [see *Bound. Layer Met.*. **50**, Fig. 2 and Fig.1] presents evidence that "Wexler's Low-Level Jetstream Experiment" proves the phenomenon to be endogenous.

Let me return to 1958. When Dr. Wexler called me at Science Hall it was in behalf of Dr. Paul Dalrymple, of the Polar and Mountain Laboratories, U.S. Army Quartermaster Laboratories, Natick, Mass. who was with him with a set of unique micrometeorological data obtained while wintering at the IGY-South Pole station. Paul, a pioneer of wind chill studies, had gotten his degree in geography and had been competent to procure the data but would like meteorological assistance for the analysis of the records. Harry felt that a thorough evaluation was very desirable and suggested that my cooperation could be beneficial. Incidentally, as research-scientist at the AFGRD in Cambridge, Massachusetts from 1947 to 57, I had been invited to attend a celebration at Natick when the U.S. Army Quartermaster inaugurated a new laboratory building with a set of walk-in cold-climate test chambers. I had gotten the impression that high-quality basic research was planned and done at Natick. My reply to Harry was that I would like to see Paul in Madison.

A few days later, Paul appeared in Science Hall. During 1956-58, he had labored 12 months at Little America V [78 deg S] and without break the following 12 months at Amundsen-Scott Station [90 deg S]. He brought with him graphs and rolls of strip charts with countless little dots supposedly representing valid temperatures along a 8-meter mast. Another 8-meter mast with anemometers provided data for the evaluation of simultaneous temperature and wind profiles. I was impressed by the quality as well as the quantity of data and agreed to cooperate in the data analysis. Paul declined to come to Madison. He said he needed "firstly to renew acquaintances with his Massachusetts based family" and that there were already "too many IGY-penguins" at Madison with all of Prof. Woollard's geophysicists on campus. Most importantly, the Natick Laboratories offered adequate office space, assistence by technical personel, and funds for my travel between Madison and Natick.

It happened that since the early 1950s my family and I used to spend summer vacations in New England at an old farm in Newfane, Vermont. The house had been bought as summer retreat by my wife's hometown friend Ilse Wolfsberg-Hochwald, Washington D.C.; the two had been together at grammar and highschool in Plauen, Saxony, and later had shared university years at Munich and Leipzig. Thus, from 1959 to 1963 our summer vacations in New England got a new twist. I became used to spend weekends with my family in Newfane, Vermont, and a few days of work at Natick, Massachusetts, with Paul and Miss Wollaston of his technical staff.

Major results from Little America V and Amundsen-Scott were tentatively published in 1963 as Natick Technical Reports and finally in 1966 by the American Geophysical Union [*Antarctic Res. Series AGU*, **9**]. Highlights are representative monthly values for the surface energy budget at the south-polar snow surface, extension of surface-layer profile structure theory to cases of extreme thermal stratification including an explanation of "sudden warmings". The data from Little America as well as Amundsen-Scott Station showed that $-\partial Ri/\partial z$ and not Ri itself is controled by inversion strength. Thus, convective mixing looses significance for extreme inversional stratification. The profiles of Deacon numbers [βv for the wind profile, and βT for temperature profile] are significally different. For strong inversion the temperature profile shows a level of inflection where $\beta T = 0$; see Addendum A. This required that the conventional theory of wind and temperature profile structure had to be supplemented to include strong inversion cases [*Bound. Layer Met.* **17** '79].

Of general importance was also documenting that the gently sloping terrain at 90 deg S has two different effects on the boundary-layer wind structure. Dominant is the "inversion wind", a thermal wind between surface and the top of the boundary layer assumed to be the 1000 m-level. We analysed the daily rawinsoundings as function of surface-wind directions from 0 to 360°; see Addendum A. Truly katabatic air motion with characteristic wind and temperature structure in the lowest 8 m-layer; occurred as a gentle breeze in contrast to coastal katabatic wind storms [*Ant.Res.Ser.* **9**, 1-12]

We constructed tautochrones of snow temperature T between the depth of vanishing diurnal or interdiurnal variation [$z' \approx 0.5$ m, $T=T'$] and of vanishing annual variation [$\{z\} \approx 6$m where $T \approx \{T\} =$ annual mean] to explain the "coreless winter" of high polar latitudes [Hann, 1919]. The pattern of monthly tautochrones is determined by the shape of the annual cycle of solar energy input. This cycle is a perfect full sine-curve near the antarctic circle but truncated to half of a sine-arc at 90 deg S. Thus. tautochrones for 90 deg S lack the symmetry of $T-\{T\}$ shown at stations near the arctic circle, for excample, Maudheim [71 deg S]; see Addendum B. The clustering of T' from April through October at 90 deg S is controlled by the surface energy budget, in direct response to the truncation of insolation. The heatflux *into the ice* during 4 months with dominant insolation is fairly approximated by

T'-{T}=+14±5 and compensated by heatflux *out of the ice* during 8 months with T'-{T}=-7± 2.5 °C. On my retirement at UW in 1980 I received a letter by Paul Dalrymple from which I may quote:

> *"The analysis of the South Pole micrometeorological data was and is the premier work of its kind for an extreme cold-dry environment, beneficial to the military and to our national government. -- According to the late Dr. Herfried Hoinkes {Dep. f. Geophys. & Meteorol., U. of Innsbruck, Austria, speaking in Aug. 1963 at the National Academy of Sciences 100th Anniversary Symposium at UCLA on results of the IGY} the thorough analysis of the data may be said to be the most remarkable contribution to glacial micrometeorology during the IGY. Several years later Dr. Lettau assisted us again in the planning and establishment of a micrometeorological program in a vastly different environment, the tropical dry evergreen forest of Southeast Asia. The site was on the northeast edge of the so-called Khorat Plateau in Thailand, and we had the pleasure this time of having both the Lettaus with us in the bush. Our program had matured, we now had two towers, they were 46 m high, one in a clearing one in the forest; the data were recorded on magnetic tapes.*
>
> *But this was not the end of our association. Dr.A. P. Crary, Chief Scientist, Office of Antarctic Programs, National Science Foundation, announced a new plan in 1963 to locate a wintering station from December 1965 to February 1968 in the most remote highlands of East Antarctica at about 12,000 feet elevation around 80 deg S and 25 deg East. On behalf of the U.S.Army Quartermaster Natick Laboratories I offered for evaluation of microclimatic conditions to move one of the towers and the recording system used in Thailand to what later was named Plateau Station in Antarctica."*

The tower had landing sections every four meters with ladders inbetween; eight sections were used in Antarctica. My advice concerning the planned new station was based on the assumption that the lower atmosphere over Antarctica's interior highlands will be relatively stagnant. I anticipated extreme density stratification. Hence I suggested that the customary spacing of micrometeorological sensors [with heights in geometrical progression, i.e., 0.5, 1, 2, 4, 8, 16, 32 m] be augmented by instrumentation on all landings [i.e.,additionally at 12, 20, 24, and 28 m] with sensors not only for air temperature and wind speed but also wind direction. Furthermore, I expected extreme cases of optical refraction causing extraordinary distortion of light beams in the lowest atmosphere. I suggested an array of "slanting targets" as first used around 1960 for photographing disturbances of optical refraction across Lake Mendota; evaluation of this unconventional optical method had been assigned to my Ph.D. student J.Sparkman.

U.S.Navy 'seabees' built Plateau Station in Dec.1965 with accommodations of eight wintering personnel and erected the tower in Feb.1966. Dr.Strohschein from Natick instrumented the tower one year later. Besides one person for the Natick program, two other scientists took care of geomagnetic and weather studies. Dr Dalrymple wished to give preference for wintering at Plateau Station to volunteers from the UW Meteorology Department. Anyways, it was arranged that I should be briefing volunteers selected for wintering at Plateau about the "slanting target"method and was given priority for the evaluation of photographic documentation of optical refraction disturbances.

Selected for wintering 1966 at Plateau Station in charge of the Natick program was Marty Sponholz. In 1964 Marty was at UW a M.S. student of Prof. Deland; after Prof.Deland's move to NYU, I continued as Marty's advisor for his thesis work on wind structure 50 to 150 m above an urban area; Marty got the MS degree in June '65. Additional to a snow-accumulation project using a network of bamboo stakes, Marty erected according to my instruction "slanting targets" using 10-ft bamboo poles, inclined by 45°, visible from the shelter at distances of 1000, 2000, and 3000 ft. On return to Madison Marty submitted a series of photographs. However, all were taken during the sunlit-period and showed optical distortion of intensities similar to what we knew from Sparkman's photos across Lake Mendota in winter time.

Selected for the 1967 austral winter at Plateau Station was Dr. Michael Kuhn, research assistant at Prof. Hoinkes Institut for Geophys. & Meteorology at the U. of Innsbruck, Austria. Mike was well prepared to take care of the tower instruments and the automatic recordings. On the way south he stopped at Madison I showed him Marty's photos and suggested that it would be worthwhile for Mike to install commercially available electric X-Mas outdoor lights on Marty's slanted bamboo poles.

A year later, Mike returned home via Madison and left for my evaluation copies of nearly all his photos of the illuminated slanted targets. I was delighted to see the most phantastic optical distortions. I added two extremes which I named "inverted ghost" and "upright ghost" at the opposite ends of the classical scale of phenomena, that ranges from superior mirage, stooping, looming, to neutral, followed by sinking, towering, and inferior mirage ; see Addendum C. The T-profiles in the atmosphere's lowest 3 m above the inner antarctic iceshield implied by air density gradients as cause of optical refraction were occasionally truly weird. The profiles ranged from one extreme of an elevated T-maximum near 1.5 m, to strongly height-decreasing inversions, $\partial T/\partial z>0$, via isothermy, to more or less strongly height-decreasing lapse, $\partial T/\partial z<0$, to the opposite extreme of an elevated T-minimum near 1.5 m. For his own evaluation Mike Kuhn preserved his fascinating color photos of astronomical refraction targeting the sun's apparent "meandering" above and below the horizon near thebegin as well as near theend of the polar night at Plateau Station.

During the three years of occupation at Plateau Station the lowest T was -86.4°C= -124.5°F on 20 July 1968. Significant results of the micrometeorology program are published by the American Geophysical Union [*Ant. Res.Series* , **25**]. Air temperature, wind speed and direction documented the physical and dynamic pecularities of this extraordinary microclimate near the crest of the antarctic icesheet. We discussed pronounced regularities of temperature and wind structure by evaluation of monthly averages for each hour. A not anticipitated bonus resulted from the unusually dense spacing of wind vanes. Namely, a systematically height-increasing *contra-solem* Ekman turning of the horizontal vector of air motion within the atmosphere's lowest lowest 32 m.

Ekman turning of the wind vanes was systematically accompanied by speed increase from lower to higher levels. During the polar night, it was controlled by inversion strength as defined by hourly means of ΔT= air temperature difference from 32 to 0.5 m, separated into eight classes. Wind turning from 0.5 to 32 m amounted to 15 deg for *Class 1* [ΔT =3.5°C] and an extraordinary 50 deg,i.e., a nearly complete Ekman spiral, for *Class 8* [$\Delta T = 21^\circ C$]; see Addendum D. During the months with sunlight, especially the relatively warm February and March, the Ekman turning is controlled by the surface energy budget. An unprecedented diurnal variation of 'spiral shapes' was documented: *small angle and low speed* near noon varied gradually into *wide angle and relatively high speed* near midnight; see Addendum E. Conventionally the Richardson number [Ri] is employed as scaling factor for low-level wind structure. As previously found at Little America V and the pole station the data from Plateau Station confirm that $-\partial Ri/\partial z$ and not Ri itself is controled by inversion strength. The profiles of Deacon number for strong inversion show that the level of inflection occurrred most frequently around 6 m at Plateau Station , significantly higher than the 2.5 m at the South Pole.

In 1970 Dr. L.Quam of the American Association for the Advancement of Science invited my contribution to a special volume on Research in the Antarctic [*Amer.Ass.Adv.Scie.*, **93**]. I choose a title that expressed my growing conviction of climate and weather in Antarctica being endogenous to a degree as on no other continent on earth. I highlighted our study of optical refraction anomalies at Plateau Station and the rational explanation of the "Coreless Winter" by comparing tautochrones of monthly snow temperatures at Amundsen-Scott [90 deg S], Plateau [79 deg S] and Maudheim [71 deg S]. My approach included the discussion of *Siple's Puzzle* [Siple, 1959] using our results shown in Appendix B. Dr. Paul Siple, a veteran of the Byrd expeditions at the series of Little America Stations 1933/36, was the first US scientist to stay yearround at the south pole in preparation of the IGY wintering station. Excerpts from his narrations follow. Immediate after arrival at 90 deg S in November '56, he started digging and found$\{z\} \approx 5.5$m and $\{T\} \approx -53^\circ C$ which is $31^\circ C$ below the warmest summer temperatures on the polar plateau determined 1909 by Amundsen and confirmed by Scott. Siple concluded correctly that the annual mean at the pole is close to his {T}. His diggings near Little America sites had shown that the temperature of the coldest month will be as much below {T} as the warmest month is above it. For the polar plateau, $31^\circ C$ below $-53^\circ C$ gave $-84^\circ C \approx -120^\circ F$. At the end of the 1957 winter night Siple commented that it was one of the most puzzling things about the winter at the south pole that temperature did not hit his predicted low. The T-curve which he had expected to round normally at the bottom, instead flattened out. Siple obviously was not aware of the literature when concluding : '*We could only hypothecate that the normal curve was flattened out by mixing action of the winds*'. Actually, Siple's diggings established the typical high-sommer tautochrone for 90 degS and the basis of prediction was its mirror image around a vertical given by the annual mean. As shown in Addendum B this is legitimate at latitudes near the antarctic circle but not at the pole simply due to the truly endogenous factor of zero-insolation during six months and the polar surface energy budget.

I believe a counterpart to the "coreless winter" is what I called "topless or peakless summer"; documented by temperature records during the IGY from the wintering station on *Ice-Island T3* ; see addendum F. Ice islands are floating in the Arctic Ocean and are most likely to have calved from the ice shelfs of Ellesmere Island. The known larger ones have a thicknes of about 50 m, surface areas of several hundred square kilometers, and are elevated by about 5 m above the surrounding arctic packice.

The energy consumed for melting at the upper surface truncates the summer arc of netradiation causing surface temperaturs around 0°C during the two warmest months of July and August. For comparison, in Northeast Greenland, the shore station Nord at 81.6 N has a sharp July peak of 4.7°C

One of Schwerdtfeger's MS-students, Tom Frostman , volunteered and was selected to winter at Plateau Station during 1968. However, the station was plagued with difficulties. In Otober, the electrically heated insulation at the fuel-line junction caught fire; that situation was quickly brought under control. However, unrepairable damages of the recording equipment had caused a premature end to the Natick micrometeorology program. The three-year scientific program at Plateau was terminated and the station deactivated on Jan. 29, 1969. The tower was left standing. Three years of data and snow fall estimates suggest that accumulation has the order of 0.1 m per year. On this basis, the tower will be burried about 320 years after the station was abandoned.

It is hard for me to find the right words to honor appropriately the willpower of all the scientific observers. They had to withstand extreme hardships in antarctic winters and yet, Paul D., Mike K., and Marty S. brought home valuable results. Marty S. was not afraid to let us know how he among the small group of people isolated completely from civilisation during the polar night at Plateau Station felt as human beings. He likens their isolated life to that of *magi* , the members of the Zoroastrian priestly caste of the ancient Persians with their eternal struggle between good and evil [Sponholz, 1980]

The period of antarctic research produced some direct as well as indirect benefits for the UW Dept. of Meteorology. Werner Schwerdtfeger and I co-authored a report on the dynamics of he surface-wind regime over the interior of Antarctica. Werner S. wrote a monograph: *Weather and Climate of the Antarctic*. Of my graduate students Walt Dabberdt evaluated antarctic data in his Ph.D. thesis and was employed as post-graduate at Natick, Mass.; Allen Riordan wintered in Dry Valley, Antarctica, and used his recordings as mainstay for his Ph.D. thesis. Charles Stearns, starting as my research assistant and as project associate managing the graduate student experiments on the ice of Lake Mendota, rose 'through the ranks'. As professor, Stearns developed a substantial research program using networks of automatic weather stations (AWS) in Antarctica, including a special network on the Greenland Crest.. He and his Ph.D. student David Bromwich edited Vol. 61 of Antarctic Research Series, with many contributions of their own. Among the AWS on the Ross Ice Shelf, Stearns named one at 79.9 deg S *Schwerdtfeger Station* and one at 82.6 deg S *Lettau Station*. Both of us acknowledged this as benchmarks for what had been stated on page 10 of the 1963-brochure: *Meteorology at Wisconsin, a Plan for the Future*: : "A U. of Wisconsin motto is *'the boundaries of the campus are the boundaries of the State.'* It is just as true that the boundaries of the Meteorology Department are the boundaries of the world, for its field programs did extends from the South Pole to the Arctic, from beneath the surface of the earth to the edge of interplanetary space."

H.L.Biobibliography

American Association for the Advancement of Science : Antarctic atmosphere as a test tube for meteorological theories; Publication No. **93**; '72, 443 - 475.

Antarctic J.United States : Thermal response to albedo reduction on Antarctic snow-modeling results, **12** '77, 134-36 - Dynamics of the surface-wind regime over theinterior of Antarctaic (with W. Schwerdtfeger), **12** '77, 155-58

Antarctic Res.Series AGU : A case study of katabatic flow on the south polar plateau, **9** '66, 1-12 - South Pole micrometeorology program (with P. Dalrymple & S. Wollaston), **9** '66, 13-57 - Air temperature and two-dimensional wind profiles in the lowest 32 m as function of bulk stability at Plateau Station (with A. Riordan and M. Kuhn), **25** '77, 77-91 - Stability related wind spiraling in the lowest 32 m above Plateau Station (with M. Kuhn and A. Riordan), **25** '77, 93-111

Beitr. Physik Atmosph. : Luftmassen and Energie Austasch zwischen niederen und hohen Breiten der Nordhalbkugel während des Polarjahres 1932/33, **23** '35, 45-75 - Theoretical wind spirals in the boundary layer of a barotropic atmosphere, **35** '62, 195-212

Boundary Layer Meteorol.: Variangular wind spirals (with W. Dabberdt), 1 '70, 64-79 - Climatonomical modeling of temperature response to dust contamination of Antarctic snow surfaces, **12** '77, 213-29 - Wind and temperature profile prediction for diabatic surface layers including strong inversion cases, **17** '79,443-64, - The O'Neill experiment of 1953, **50**,'90,1-9

References

Hann, J.,1911: *Handbuch der Klimatologie*, vol.III, 635 pp; Engelhorn, Stuttgart

Lettau, H.,1939: *Atmosphärsche Turbulenz* Academ. Verlag, Leipzig, 288 pp

Lettau, H (with B.Davidson), 1957: *Exploring the Atmosphere's First Mile - Project Great Plains* Two volumes; Pergamon Press, New York, London, Paris, 578 pp.

Putnins, P.,1970: The Climate of Greenland, in *World Survey of Climatology*; vol. 14, chap. 2, 1 - 128, Elsevier Sci., New York

Schwerdtfeger, W.,1984: *Weather and Climate of the Antarctic*, Vol. 15: *Developments in Atmospheric Sciences*; Elsevier Science, New York, 261 pp

Siple, P.,1959:*90 Degrees South* ; The Story of the American South Pole Conquest ; Putnam's Sons, New York, 222 pp

Sponholz, M.,1980: *Among the magi ; research tracks in the desert snow* <BASE HREF>"http://205.174.118.254/nspt/magi/magiol.htm"

Stearns, C. & D.Bromwich [editors],1993: *Antarctic Meteorology and Climatology:Studies based on automatic Weather Stations* [10 papers by a variety of authors] Amer. Geophys.Union, Antarctic Research Series Vol. **61**, 209 pp

Addendum A

Results of the analysis of windspeed and temperature profiles recorded by Paul Dalrymple during the winternight of 1958 at the South Pole.

Reference: P. Dalrymple, H. Lettau, and S. Wollaston, 1966: South Pole Micrometeorology Program. *Antarctic Research Series [Amer. Geophys. Union]* Vol. 9 pp 13 - 57.

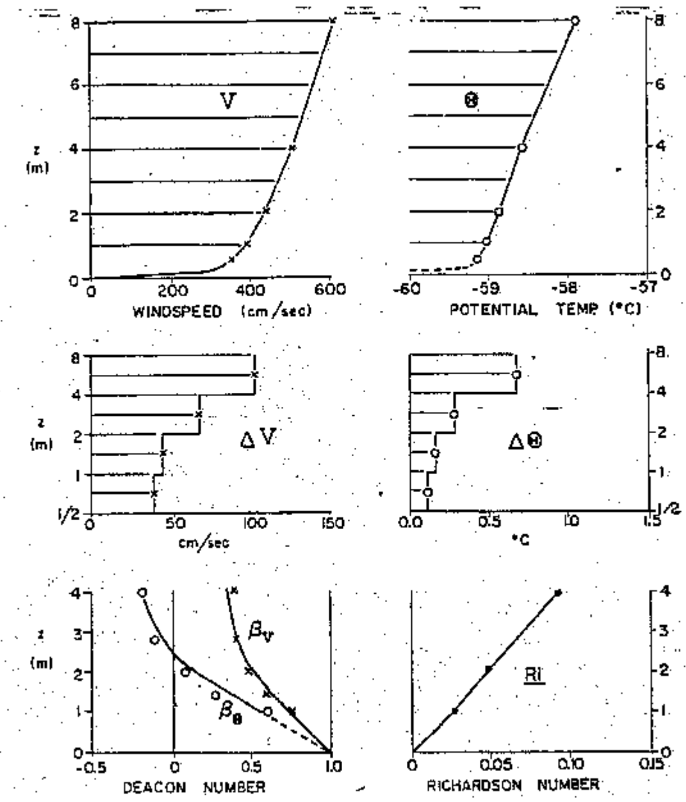


Fig. 1. Structure of vertical profiles of wind speed (V, cm s^{-1}) and potential temperature (θ, °C) in the lower 8 m of atmosphere at the South Pole (Amundsen–Scott Station). Shown are representative averages of the thirty individual hourly runs observed during the winter night of 1958 for which the 1-m Richardson number was between 0.023 and 0.025. The ΔV and $\Delta\theta$ profiles indicate the layers between instrument levels from 0.5 to 8 m. Also shown are computed Deacon and Richardson numbers. Note the inflection point of the θ-profile near $2\frac{1}{2}$ m where the Deacon number for temperature changes from positive to negative value.

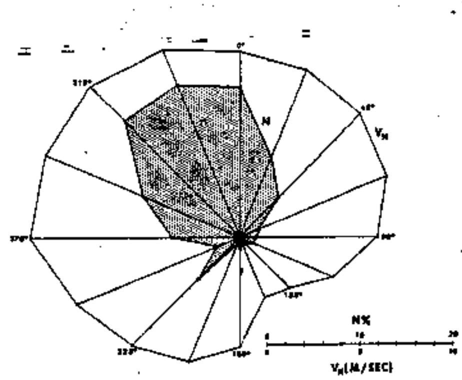


Fig. 11. Relative frequency (N, %) and speed (V_H, m/sec) of winds at the top of the inversion as a function of azimuth (α_H, Deg) at South Pole (273 cases, March 22 to September 24, 1958).

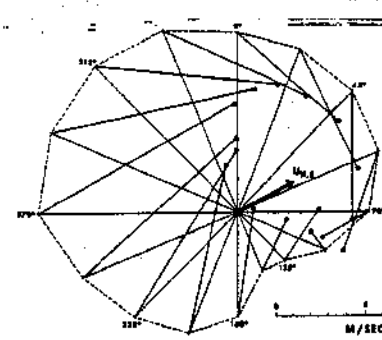
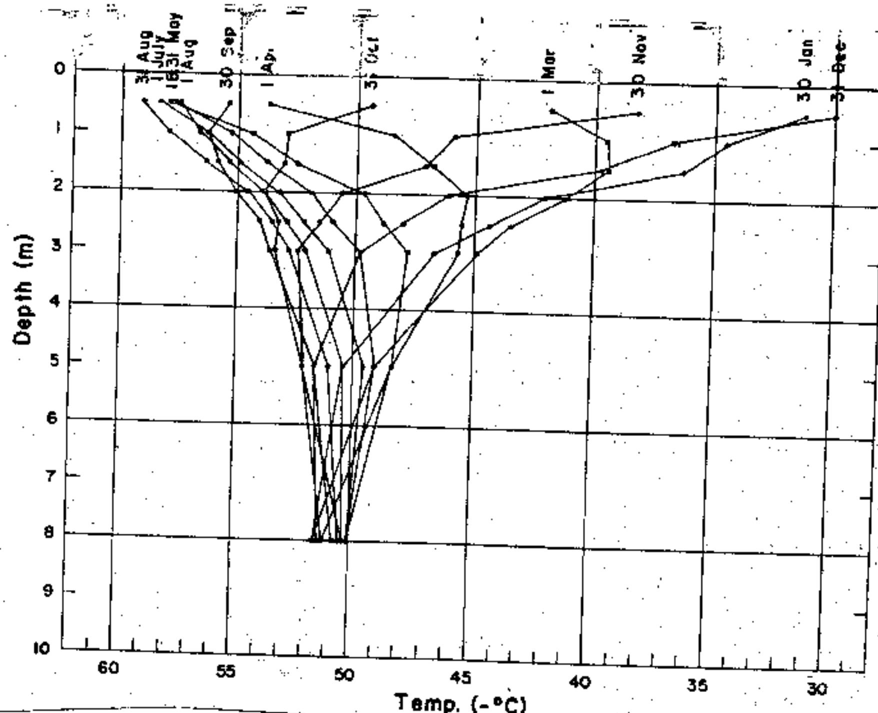
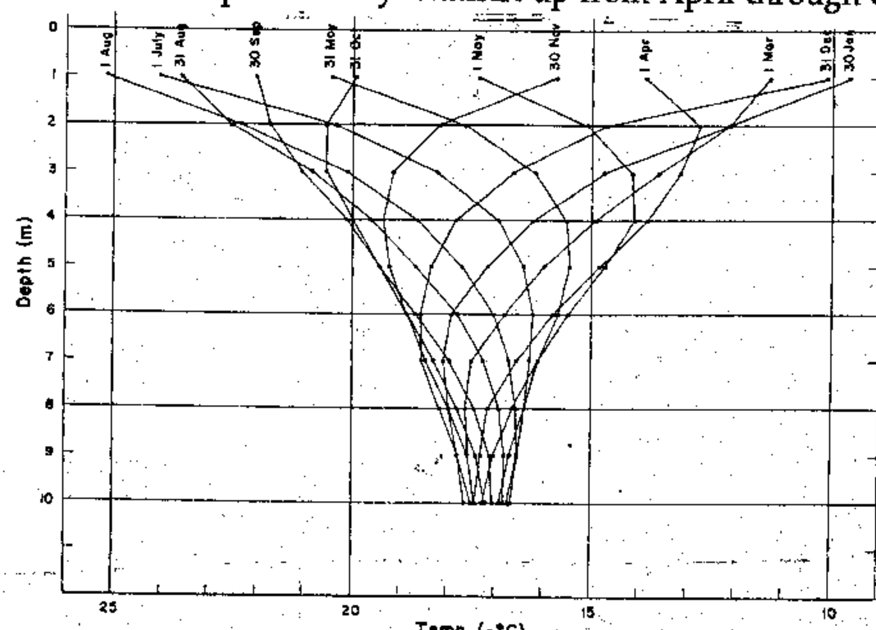


Fig. 12. Thermal wind in the inversion layer ($U_{H,s}$) con[illegible] structed from mean vector differences between wind a[illegible] surface (V_s) and at top of the inversion (V_H, m/sec) as [illegible] function of azimuth α_H, Deg) at South Pole (273 case[illegible] March 22 to September 24, 1958).

The "coreless winter" at high polar latitudes illustrated by tautochrones of snow temperature from surface layers to depth of small departure from the annual mean {T}



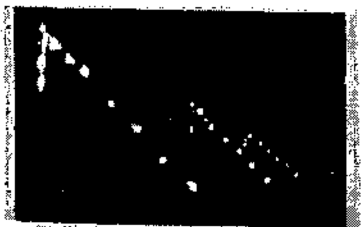
At Amundsen-Scott [90 deg.S] 1957-1958: {T}≈ -51°C; in the layer above 2m, seven T-profiles are clustered with T<{T} and five are widely spaced with T>{T}; this asymmetry is due to truncation of the insolation cycle during the polar winternight, but heatflux down from the end of October to March is compensated by heatflux up from April through October.



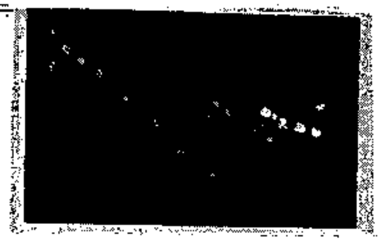
Maudheim [71 deg.S] 1950-1951: {T}≈ -17°C; note the nearly perfect symmetry of T-profiles with respect to {T} due to nearly sinusoidal cycle of surface insolation, accompanied by a nearly sinusoidal wave of heatflux into and out of the snow.

Addendum C

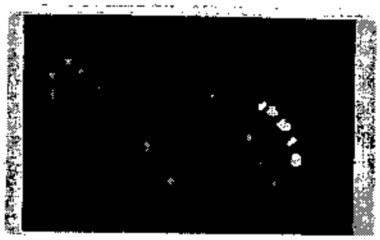
Sample of M.Kuhn's telelens-camera photos in the winternight of 1967 of the illuminated slantline targets at 1000, 2000, and 3000 feet from the shelter at Plateau Station, supplemented by H. Lettau's schematic interpretation of optical distortion due to dependency of the refractive index on air temperature.--Reference: H. Lettau, 1971: Antarctic atmosphere as a test tube for meteorological theories, in *Research in the Antarctic*, [Dr.Quom,ed.] *Americ. Assoc. for the Advancement of Science*, Publication No.93, pp 443 - 447



UNDISTORTED Targets, indicating neutral or isothermal surface layer [Photo No. 54]



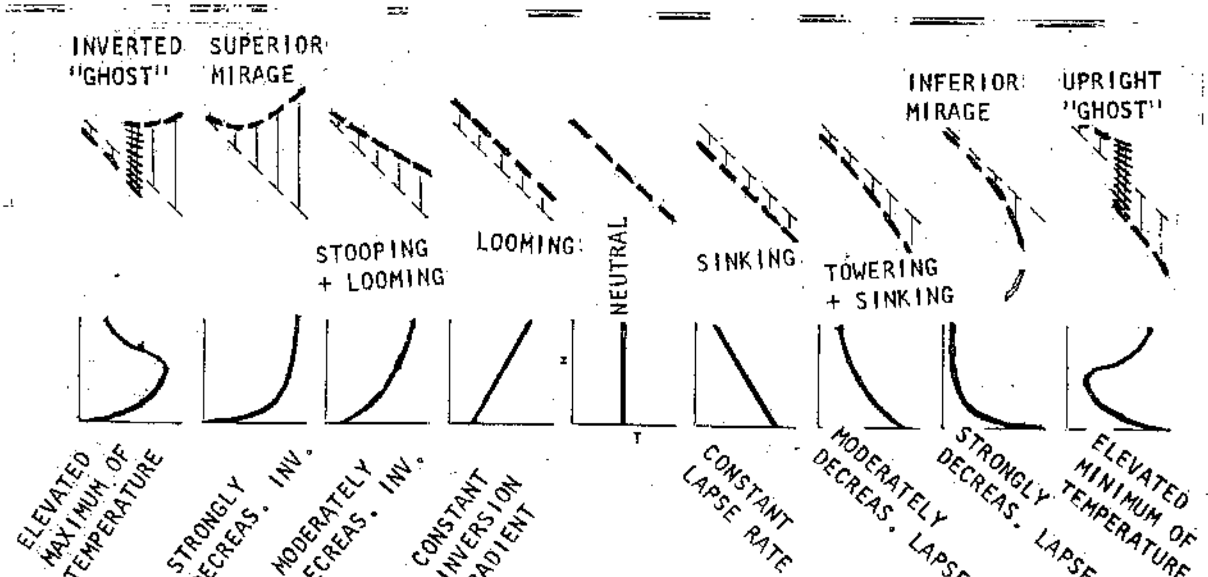
STOOPING & LOOMING, indicating moderately height-decreasing strong inversion [Photo No. 224]



STOOPING & LOOMING for upper part, TOWERING & SINKING for lower part, indicating temperature inversion over lapse [Photo No. 162]

UPRIGHT "GHOST", indicating pronounced case of 'elevated minimum of temperature' [PHOTO No.34]

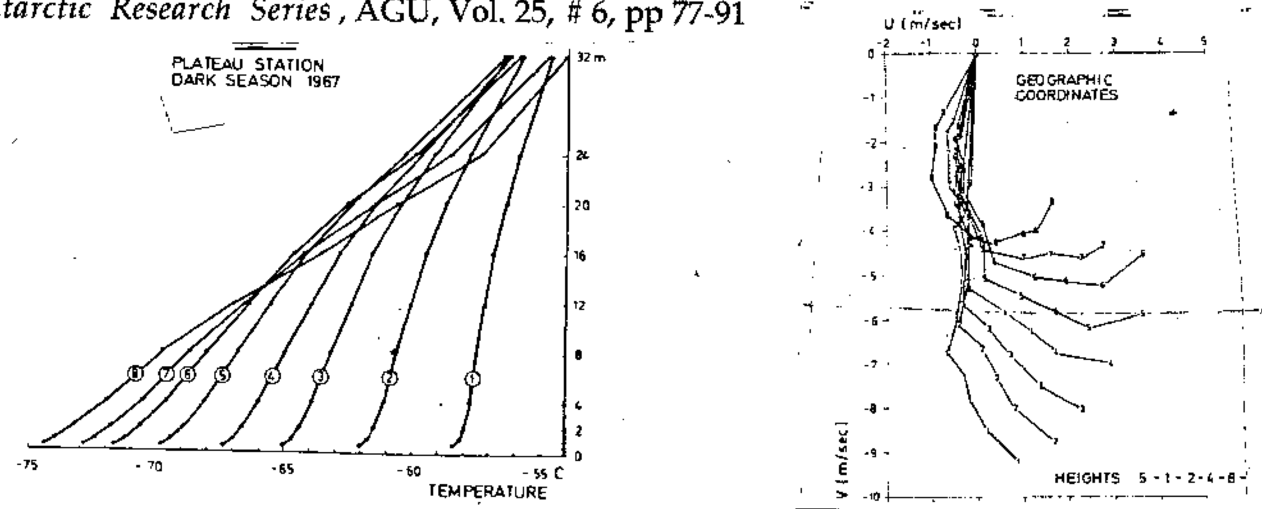
Selected photos of the illuminated slantline targets, three of which show optical distortions due to anomalous vertical gradients of air temperature on the Antarctic Plateau.



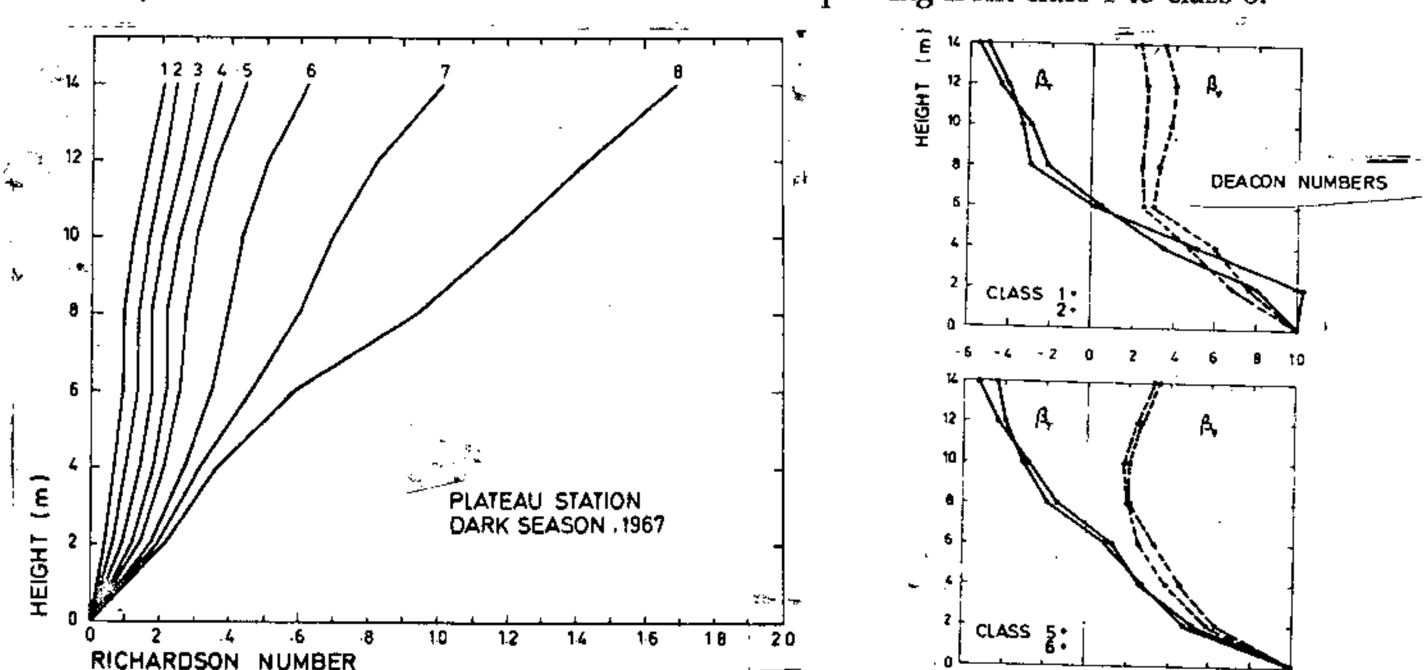
Heavy dashes illustrate how a slantline target [thin dashes] is optically distorted by atmospheric refraction if vertical profiles of air temperature [surface to 4 m] are as indicated in the lower part. Conventional notation of optical phenomena is supplemented by two extremes ['super mirages'] suggested to be called inverted and upright "ghosts".

Addendum D

Evaluations of air temperature, windspeed and direction at the 32m-tower at Plateau Station [79.2 deg S, elevation 3624 m] for the sunless perioddocument an extraordinarily large variability of boundary-layer structure controlled by inversion strength.
Reference: H.Lettau, A.Riordan, and M.Kuhn, 1977: Air temperature and two-dimensional wind profiles as function of bulk stability -- Meteorological studies at Plateau Station. *Antarctic Research Series*, AGU, Vol. 25, # 6, pp 77-91

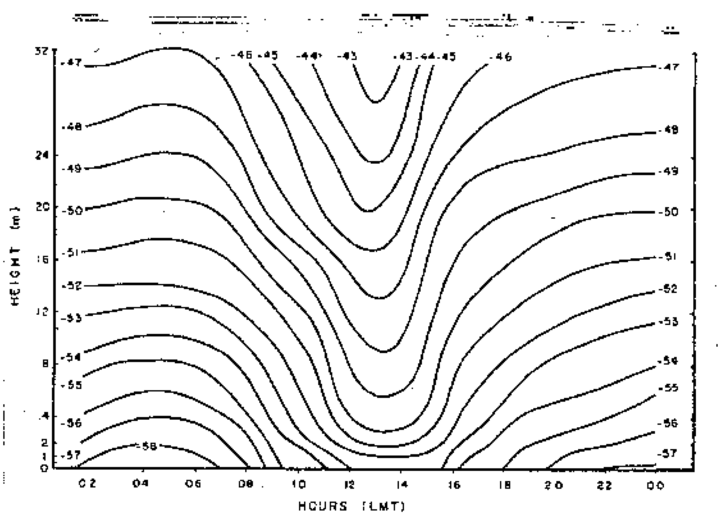


Inversion strength is used to generate classes 1 through 8 for evaluation of hourly averages ; note the systematic increase of counter-clockwise wind-spiraling from class 1 to class 8.

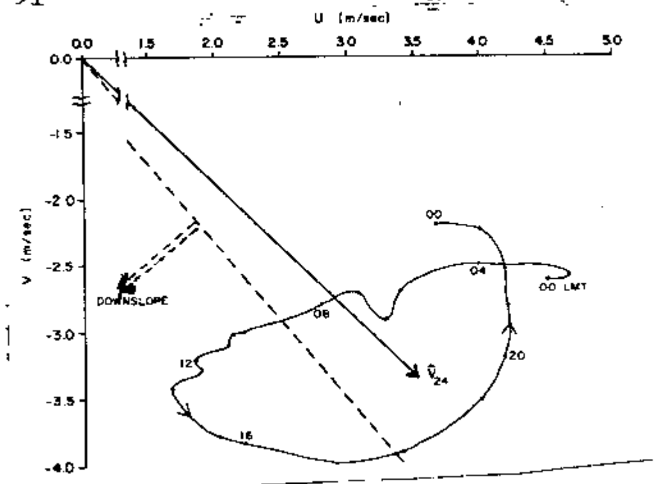


Vertical profiles of Richardson Numbers [a conventional dimensionless measure of thermodynamic stability] between the surface and 14 m is essentially controlled by inversion strength [class 1 through 8]. Vertical profiles of Deacon Numbers [Lettau's dimensionless measure of profile curvature] for temperature [full curves] as well as for windspeedprofile [dashed curves] for class 1 & 2 are essentially the same as for class 5 & 6. Note that the β_T -profile inflection point occurs near 6 m while near 2 m at 90 deg. S.

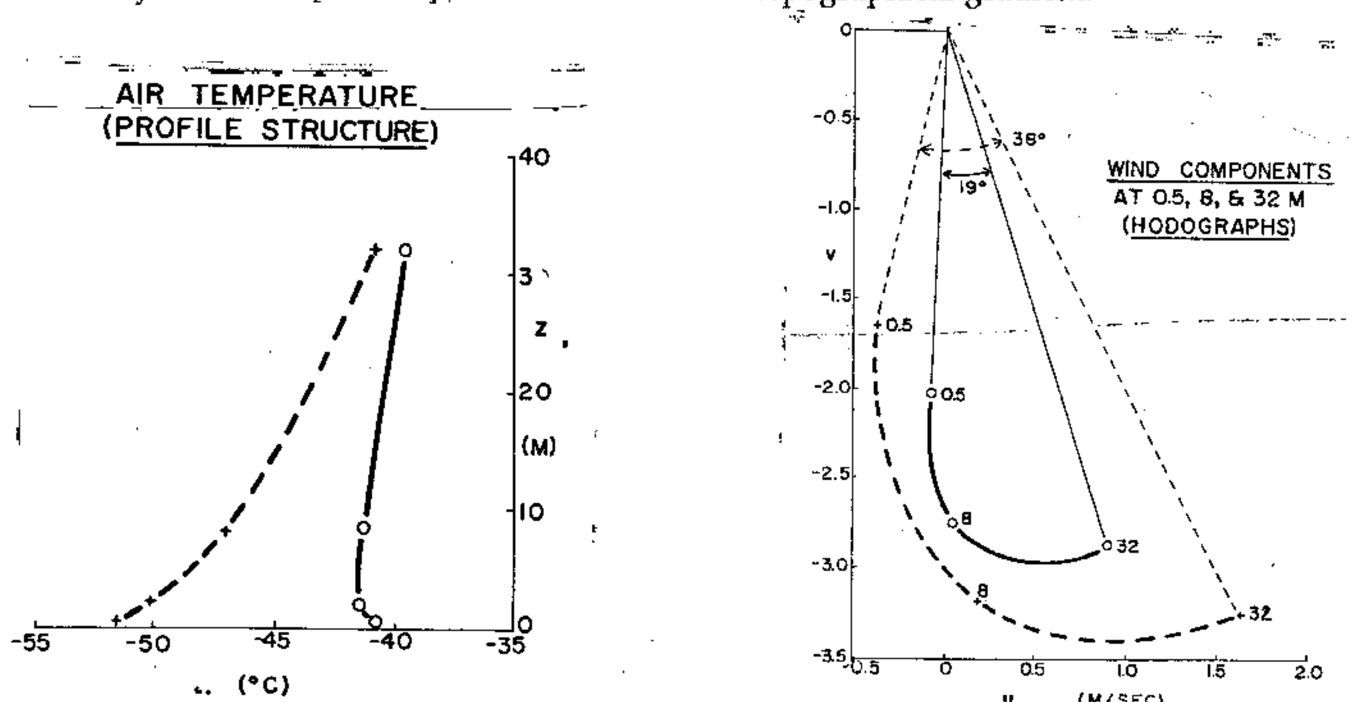
Air temperature, windspeed and direction recordings at the 32m-tower at Plateau Station [79.2 deg S, elevation 3624 m]. Sample of evaluations for February and March [sunlit period] showing pronounced 24-hourly variations.
Reference: H.Lettau, A.Riordan, and M.Kuhn, 1977: Air temperature and two-dimensional wind profiles as function of bulk stability -- Meteorological studies at Plateau Station. *Antarctic Research Series*, AGU, Vol. 25, # 6, pp 77-91



Mean daily isotherms [Celsius], March 1967



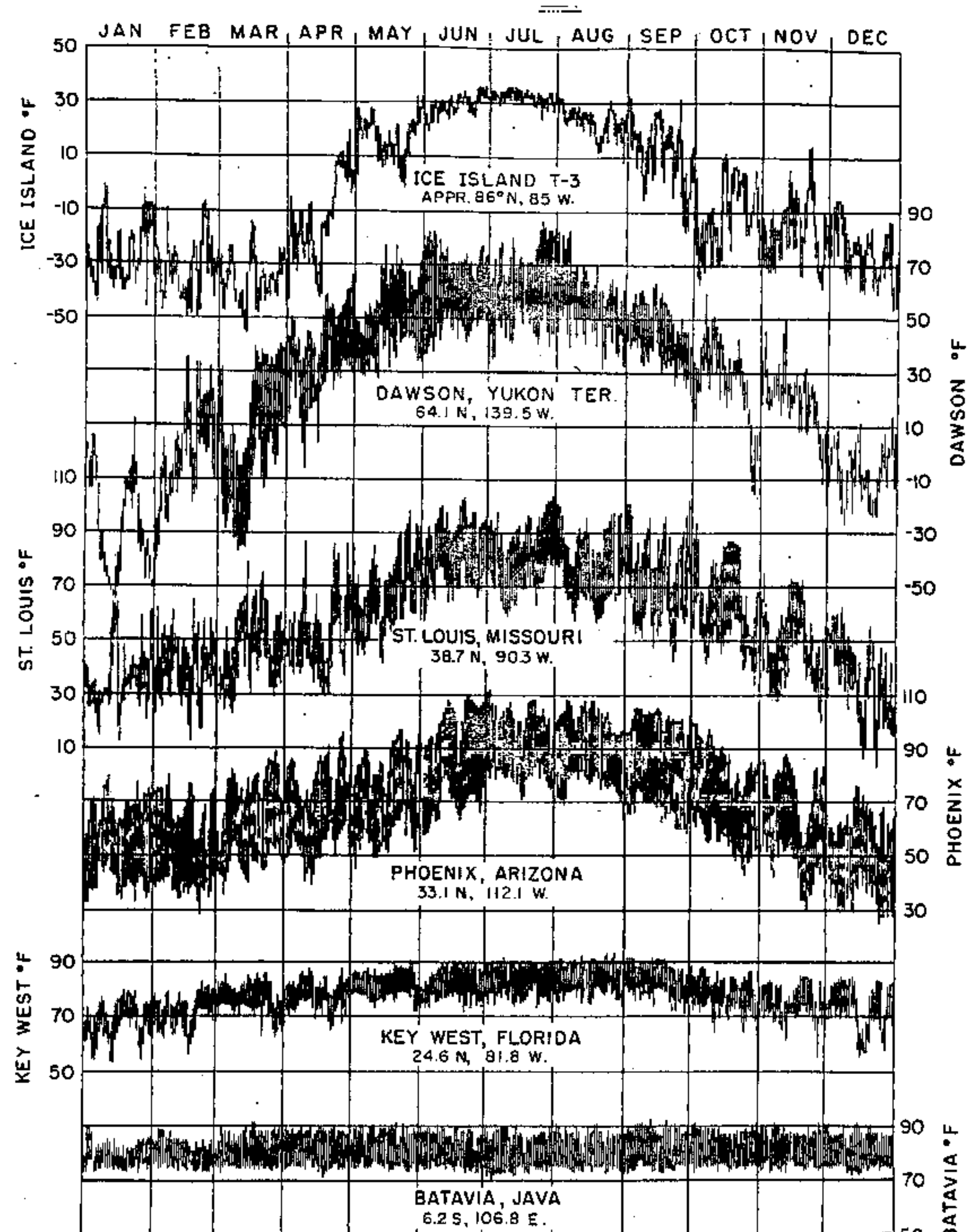
Hodograph of hourly positions of the wind vector at the 24 m level, averages for Febuary, 1967, showing effect of the topographical gradient.



Temperature and wind component averages for February 1967 and local-mean-hours of 11 [circles] and 23 [crosses] show nearly perfect spiral structure with Ekman Angles of 19 degrees for nearly isothermal stratification and 38 degrees for strong inversion.

Addendum F

The "coreless or topless summer " of ice islands floating within the arctic packice, documented by extremely small diurnal/interdiurnal variation of surface temperature in the months of June and July while at Greenland's Northice Station [78 deg N, 2343 m] June-July mean temperatures of 11°F vary between average maxima of 20°F and minima of 6°F.



Annual trends of daily extremes of standard surface temperature, from the tropics to the arctic, illustrating the systematic poleward increase of amplitude of annual and inter-diurnal variations. The truncation of summer maxima on the ice island indicates persistent summer melt. Source: H.Lettau & D. Haugan, 1960; *Handbook of Geophysics*