Ascending Mt. Everest Through Soaring Flight

by Ed"Ward" Hindman, Ph.D.

Certified Consulting Meteorologist

Presented at the XIX Organisation Scientifique et Technique Internationale du Vol a Voile (OSTIV) Congress, Rieti, Italy. August, 1985.

SUMMARY

Mt. Everest has been climbed from all major approaches but one: an ascent from near it base to it summit in a sailplane using the rising air expected to flow over the massif. The diplomatic, logistical, aircraft and meteorological requirements for such a flight appear achievable. The required meteorological conditions are a deep, dry, moderately-strong, stably-stratified airflow from the southwest over the massif. A flight track is estimated through graphical analyses of expected hill-lift between Namche Bazar, Nepal, and the Everest summit 28 km to the NE. The flight analyses indicate that a soaring ascent may be possible. However, like any of the previous climbing ascents of Everest, the actual flight may be a series of climbs and retreats. Accumulated skills and knowledge plus a measure of luck should lead to a successful flight.

INTRODUCTION

The world's highest mountain, Mt. Everest, has been climbed from practically every approach since the east face was climbed in 1983 (1,2). In fact, summit attempts from Nepal are reserved through 1997 (3). Further, the extensive climbing activities since the first successful climb in 1953 have left the mountain draped with fixed ropes and littered with abandoned tent frames and spent oxygen bottles (1,4). To counter this trend, the Sagarmatha (Mt. Everest) National Park has been established. Nevertheless, there remains one unclimbed approach which should not require a reservation and will not leave debris: ascend the mountain through soaring flight. That is, use the rising air assumed to be flowing over the Everest massif to ascend in a modern sailplane from near its base to its summit.

Is a soaring flight feasible? It appears the time is right to prepare for such an attempt. Diplomatic and logistic progress has been made with the recent First Himalayan Soaring Expedition (5) in the Annapurna region (300 km west of the Everest region). The appropriate tow planes and high-performance sailplane are available. And sufficient meteorological knowledge exists to explore the feasibility of such a soaring flight.

This paper details the diplomatic, logistical, aircraft and meteorological requirements for the flight. It is concluded that, with the proper preparation, equipment and weather, Mt. Everest might be safely ascended through soaring flight.

DIPLOMATIC REQUIREMENTS

The first powered flight over Mt. Everest in 1933 established the diplomatic protocol (6,7). The British conducted the flights with the prime objective of obtaining aerial photographs with which to map the mountain. The King of Nepal granted permission for one flight with which to accomplish the mission. The first flight failed due to technical problems. A second flight was permitted by the King which was successful. The limitation on these flights, in part, was because the local Sherpa people hold the mountain to be sacred. Also, the Kingdom was essentially closed to Europeans at the time.

The respect for the sacred mountain shown in 1933 continues to this day. For example, it is customary for climbing expeditions to visit the Thyangboche monastery at the base of the mountain before proceeding to establish their base camps. Any soaring expedition into the region also should follow this custom.

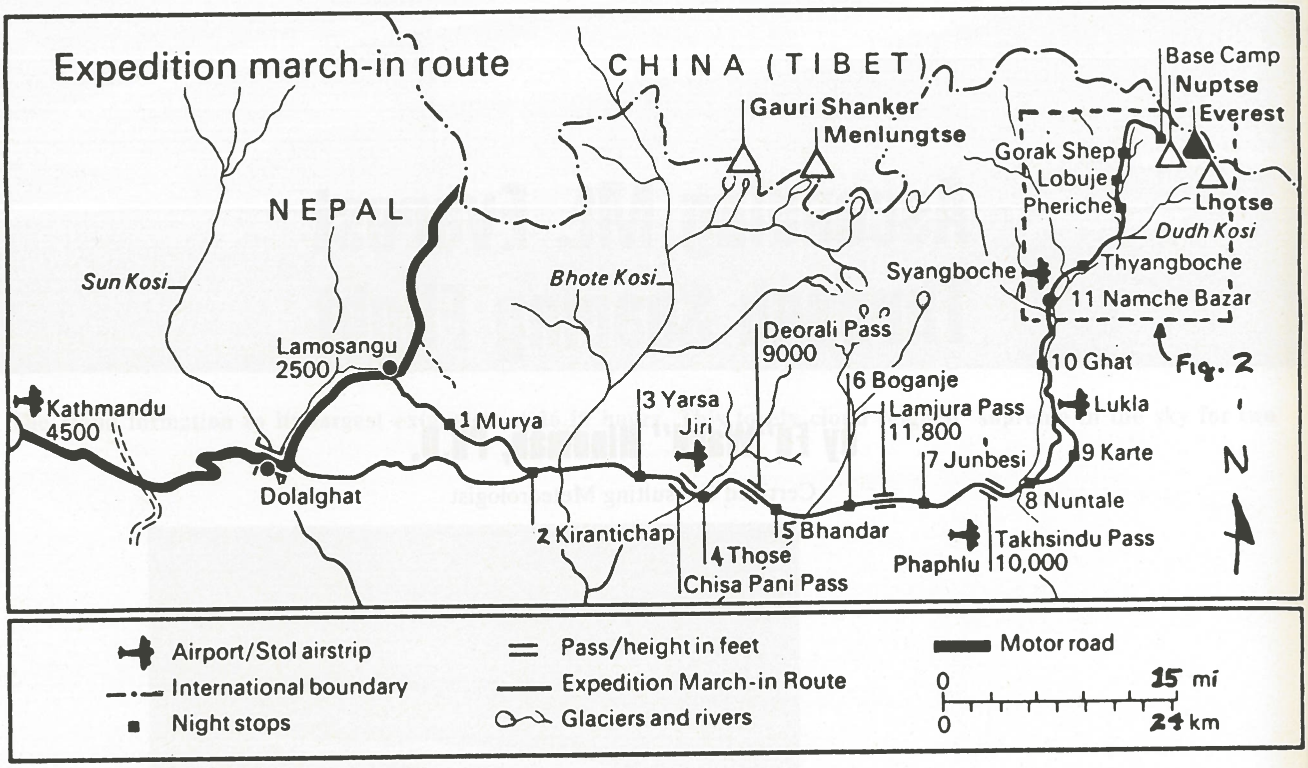

Figure 1: Locations of the STOL airstrips between Katmandu and Namche Bazar, Nepal; from (9).

The Everest region is under heavy use due to the extensive trekking (backpacking) industry as well as the expedition industry. Consequently, a soaring expedition into the region would need to establish the necessary official sanctions from His Majesty's Government (H.M.G.) of Nepal. The Interim Report of the First Himalayan Soaring Expedition lists the offices to work with: the Ministry of Tourism, the Home Ministry, the Dept. of Civil Aviation and the Royal Nepalese Meteorological Service. The report also listed an expedition representative in Nepal who apparently was a local guide.

The purpose of a sailplane ascent of Mt. Everest is consistent with the spirit of the 1933 and 1985 expeditions: to collect scientific data which will lead to new knowledge about the Himalayan region. Presently, a lack of knowledge exists about the three-dimensional airflow around the Everest massif. However, preliminary information has been obtained by the Chinese (8). Knowledge of that airflow will be a prime product of a sailplane ascent. Such knowledge should benefit aviation activities in the region.

Another motivation for a soaring ascent of Mt. Everest is to demonstrate that man's advanced technology embodied in the modern, high-performance sailplane can harmonize with the Everest environment. That is, the flight would demonstrate that the mountain can be "climbed" without pitons and fixed ropes; without leaving behind a trace of the ascent itself.

LOGISTICS

A possible site to launch the flights is the Syangboche airstrip in Namche Bazar, Nepal. The airstrip is 25 km from the 8848 m summit of Everest (see Fig. 1 and Fig. 2). The strip, which is shown in the bottom left-hand corner of Fig. 2, is 370 m long and is at an elevation of 3400 m MSL. According to W. Volkart of Pilatus Aircraft (1985, personal communication), the strip is at a 3–4 degree downhill pitch and Pilatus Porter STOL (Short Takeoff and Landing) aircraft operate from the strip. The strip is clearly visible from LANDSAT images of the region.

The sailplane and personnel required for the flights would enter Nepal by commercial air at Katmandu. The sailplane would be assembled and aero-towed from Katmandu to Namche Bazar. STOL airstrips are located along the proposed tow route, which should make the two safe (see Fig. 1). The support personnel would fly to Namche Bazar from Katmandu. All personnel should be acclimatized to the high-elevation of the airstrip prior to the flights. This acclimatization would occur in the vicinity of Namche Bazar. The Everest-View Hotel near the airstrip in Namche Bazar could serve as a base of operations.

The expedition would require a minimum of seven souls. A tow pilot and a photographer would fly in the towplane. There should be two sailplane pilots: a prime pilot and a backup. There also should be an expedition representative who could converse with the local Sherpas. An aircraft mechanic and instrument specialist should be on hand to maintain the aircraft. A meteorologist should be available to make local observations as well as utilize supporting data transmitted to Namche Bazar from the Royal Meteorological Service in Katmandu. Finally, if the soaring expedition occurred during a climbing expedition, mutually beneficial support would be possible: for example, a medical doctor with the climbers might assist the soarers and, in turn, the soaring forecast might assist the climbers.

AIRCRAFT REQUIREMENTS

The Porter aircraft has been flown around and over Mt.

Figure 2: Topography between Namche Bazar, Nepal and the summit of Mt. Everest (from Royal Geographical Soc. Mt. Everest region map). The expected flight track is illustrated with the flight times in minutes.

Everest for mapping purposes by Captain Emil J. Wick according to the onboard observer Barry C. Bishop (1985, personal communication). These flights demonstrate the high-altitude capabilities of the Porter. These capabilities should be exploited to map the regions of hill-lift between the Syangboche airstrip and the summit of Everest prior to the soaring attempts. Further, the Porter aircraft has a stalling speed of 44 knots and a minimum safe speed of about 50 knots. Therefore, a lightly loaded Porter could serve as a suitable towplane.

A light, rugged sailplane with good short-field characteristics would be needed to operate from the demanding airstrip. The author's all-metal, flap-equipped HP-14T would be a suitable single-seater sailplane. A suitable dual sailplane might be the L-13 Blanik. However, due to the short airstrip, the lighter single-seat sailplane would be preferred. Therefore, the flight calculations in this paper are based on the HP-14T performance as described by Bikle (11) and by Hindman and Clark (12).

It will be shown in a later section of this paper that hill-lift (mountain-wave) regions may exist which might enable a soaring ascent of Mt. Everest. These estimates, based on analyses of expected airflow, need to be verified before a soaring expedition can be planned. Assuming the estimates are verified and soaring flights are possible, then just before a soaring flight begins, the slope winds should be rechecked. A Porter aircraft equipped with a glider variometer and flown following the procedures of Sand and Auer (13) would be able to make the necessary slope (vertical) wind measurements.

The sailplane also should be instrumented to record vertical wind speed, temperature and pressure. The measurements made from the sailplane, as well as those from the towplane, would be used to define the three-dimensional airflow over and around the Everest massif. Defining this airflow is a primary goal of the flights.

A motorglider was employed by the First Himalayan Soaring Expedition to fulfill the aircraft requirements; powered flight as well as soaring flight. However, it may be that a motorglider might not be able to operate from the high-elevation and short Syangboche airstrip. Also, the necessary mapping of the high-altitude hill-lift regions above 6100 m may be above the ceiling of a motorglider. It is envisioned that the soaring portion of the flight would be in close proximity to the mountain slopes in order to climb in the shallow slope currents. Such flying will require the more maneuverable single-place sailplane. As a result of these consideration, a motorglider might not be able to fulfill the aircraft requirements for an Everest ascent.

METEOROLOGICAL REQUIREMENTS

The topography of the Everest massif will require a specific set of meteorological conditions to enable a soaring flight. The topography is illustrated in Fig. 2. Between the Syangboche airstrip and the Everest pyramid, three significant NW-SE oriented ridges occur: the ridge containing Khumbui Yul Lha peak, the ridge containing Taboche peak and the Nuptse ridge.

The NW-SE oriented ridges require a SW flow to produce significant hill-lift. The flow should be deep so both the low-elevation peaks and high-elevation peaks experience SW flow. The flow should not exceed about 50 knots to permit the sailplane to penetrate safely back to the airstrip. However, the flow should not be below about 30 knots. Otherwise, the hill-lift may not be deep enough to lift the sailplane to a sufficiently high altitude above the ridges to permit safe downwind flight toward Mt. Everest. The flow should be stably-stratified and dry to suppress convective cloud development but permit substantial hill-lift development. Thus, the required meteorological conditions are a deep, dry, 30–50 knot, stably-stratified, southwesterly airflow. The airflow should be steady-state for at least 90 minutes because the expected flight time is 76 minutes (discussed in a following section).

Which time of the year would the required meteorological conditions most likely occur? The British flight expedition in 1933 encountered clear, dry and moderate winds on their Himalayan flights in April. The climatological data from Ramage (14) supports this finding. In April the jet stream is typically north of the Himalayas and the mountain-peak winds can be on the order of 50 knots. Further, April is a post-winter and pre-monsoon month, hence relatively dry and days can be cloud-free. Finally, Ramage reports that waves in the Westerlies still have amplitude in April. Thus, pre-trough winds would be from the SW. From these findings April appears to be the optimum month to attempt a soaring flight of Everest, although the pre-winter and post-monsoon month of October also might be suitable. Successful climbs of Everest on foot have occurred in both months. The weather during these climbs is believed to be similar to that required for a soaring ascent.

A soaring flight may be feasible on the north face of Everest. Gao (8) reports observing lee waves downwind of Everest during April-May period. Such a flight was not explored in this paper because the logistics appear much more difficult than approaching the mountain from Nepal.

FLIGHT SIMULATION

Assuming that the optimum meteorological conditions occur on a given day, is an ascent of Everest through soaring flight feasible? To answer this question, a flight track of the HP-14T was calculated in a simulated airflow. The airflow was constructed using the following five steps.

First, the topography in Fig. 2 between the airstrip and the Everest summit was plotted in cross-section as shown in Fig. 3. Note the cross-section in Fig. 3 has the same vertical and horizontal scales. Three significant ridges (Khumbui Yul Lha, Taboche and Nuptse) between the airstrip and the summit are well defined in the figure.

The second step was to draw expected streamlines based on the topography. The streamlines are illustrated in Fig. 4. These streamlines are assumed to represent a stable airflow with a constant speed of 25 m/s and constant direction in the plane of the figure. This step in the simulation was the most critical because the orientation and spacing of the streamlines governs the vertical wind-speed values. The streamlines represent a two-dimensional airflow for infinitely long ridges. In reality, the airflow will not be completely two-dimensional, nor are the ridges completely two-dimensional; they have higher peaks. Consequently, three-dimensional airflow calculations should have been undertaken but were beyond the resources available for this paper. Three-dimensional numerical simulation models do exist (15).

The streamlines in Fig. 4 were drawn neglecting the presence of lee-waves. The uniform nature of the streamlines on the left hand edge of Fig. 4 may undulate in reality indicating the presence of lee-waves triggered by upwind ridges. However, the undulation may not be significant. For example, the British Everest pilots (6,7) did not mention any significant up- or down-drafts along their flight track 30 km upwind of the peak at an altitude of 10 km. They mentioned strong lift just upwind of the SW face and strong sink in the "plume"

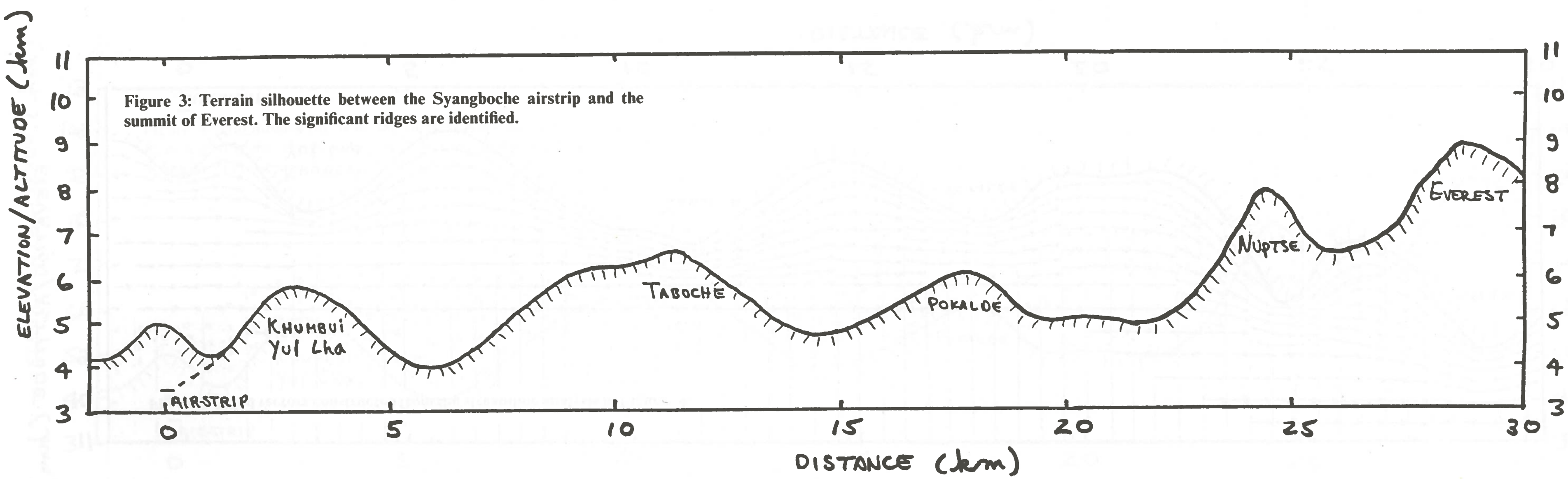

Figure 3: Terrain silhouette between the Syangboche airstrip and the summit of Everest. The significant ridges are identified.

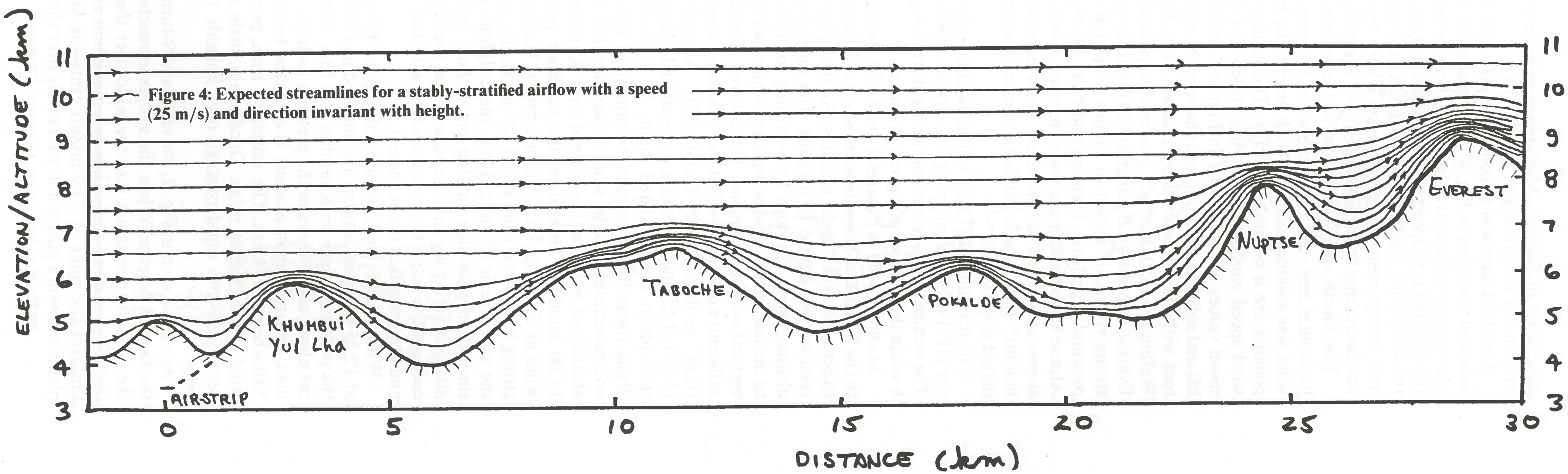

Figure 4: Expected streamlines for a stably-stratified airflow with a speed (25 m/s) and direction invariant with height.

downwind of Everest. Methods of calculating lee-wave air motion are available (eg., 16).

The third step was to construct wind vectors from the assumed streamlines in Fig. 4. The procedure for accomplishing this step is illustrated in Fig. 5. It can be seen in Fig. 5 that the horizontal airspeed was assumed constant independent of the streamline spacing. This assumption is probably reasonable except near the ridge crests where the airflow would accelerate due to the convergency of the streamlines.

The fourth step was to resolve the vectors in Fig. 5 into horizontal and vertical components. Because the horizontal wind was assumed constant with height, the horizontal components are a constant 25 m/s. The values of the vertical wind speed components are illustrated in Fig. 6. The wind speed values are isoplethed in Figure 7 revealing regions of lift and sink. The location and shape of the hill-lift are consistent with those reported by Ludlam (17), Scorer (18) and Wallington (19). Further, photos of cap-clouds covering the Everest summit by Bonington (20) provide support that the strong rising air shown in Figure 7 upwind of the Everest pyramid is realistic. Fleming and Faux (9) reported that the Alpine Chough bird has been observed above 6700 m on the slopes of Everest. Could these birds have soared to these heights? If so, that is further evidence in support of the predicted slope flows.

The fifth and final step was to calculate the flight track of the HP-14T sailplane using the airflow depicted in Figure 7. The vertical cross-section of the flight track is given in Figure 8 while the plan view is given in Figure 2.

As can be seen in Figures 2 and 8, the two from the airstrip to the hill-lift on the windward slope of Khumbui Yul Lha is expected to take eight minutes. At that point the sailplane releases into strong 10 m/s lift. The sailplane quickly gains altitude along the slope by S-turning to drift downwind due to the horizontal wind component while ascending due to the vertical wind component. The S-turns should be done with sufficient airspeed to offset any gusts and avoid any "sinister traps" as discussed by Combs (21). An indicated airspeed (IAS) of 55 knots is a safe airspeed and, therefore, was used throughout the simulated flight. At 9.75 minutes into the flight, the sailplane reaches the summit of Khumbui Yul Lha and penetrates into the wind to stop the drift. The maximum altitude of 6.30 km is achieved over Khumbui Yul Lha at 11.00 minutes. Thereafter, the sailplane penetrates downwind at 55 knots IAS (40 m/s true). However, due to the strong horizontal wind speed (25 m/s), the ground speed of the sailplane is 65 m/s. Thus, the sailplane passes quickly through the lee-side sinking air without losing significant altitude. (If strong sink is encountered, the flight should proceed up the ridge to its intersection with the Taboche ridge and the transition occur there.)

When the lift on the windward slope of Taboche is reached at 12.25 minutes, S-turns are initiated in a fashion similar to the previous climb on Khumbui Yul Lha. The remainder of the climb also follows in the previous fashion. At 24.00 minutes, the maximum altitude is expected to be reached over Taboche of 7.54 km. The sailplane, then, penetrates downwind to the Nuptse ridge. Once again, little altitude is lost because of the rapid passage over Pokalde to the Nuptse ridge.

As can be seen in Fig. 2, the sailplane S-turns as it ascents the face of Nuptse. When the sailplane reaches the crest of the ridge, it penetrates into the wind over the ridge line. It continues to climb and achieves a maximum altitude of 8.76 km over the ridge at 33.0 minutes into the flight. The sailplane is now in a position to pass safely over the strong sink in

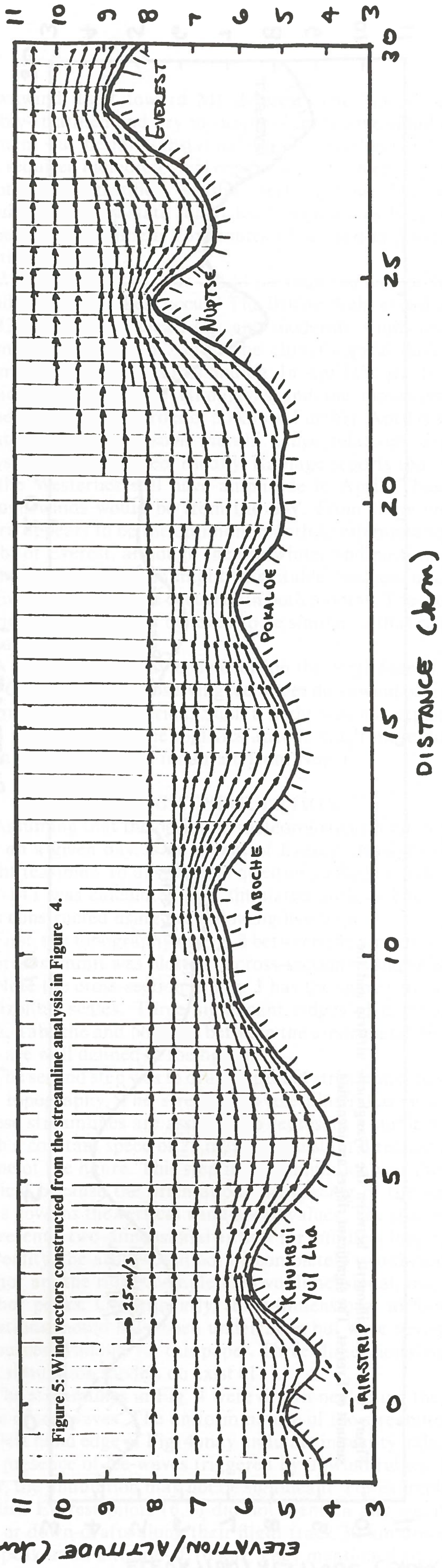

Figure 5: Wind vectors constructed from the streamline analysis in Figure 4.

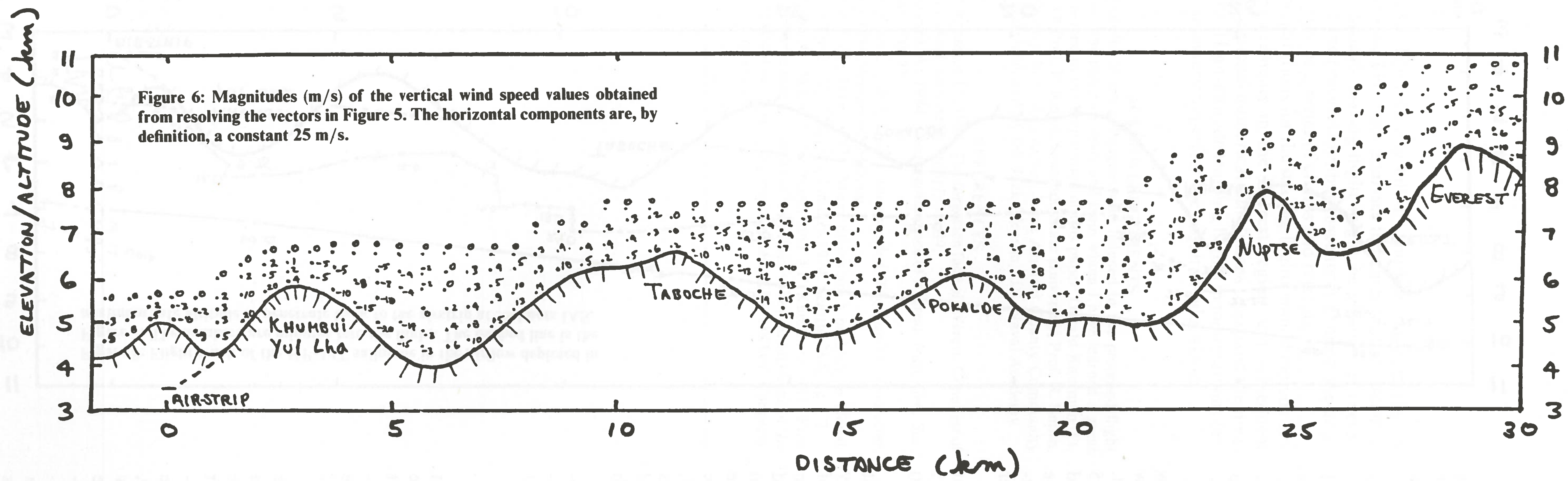

Figure 6: Magnitudes (m/s) of the vertical wind speed values obtained from resolving the vectors in Figure 5. The horizontal components are, by definition, a constant 25 m/s.

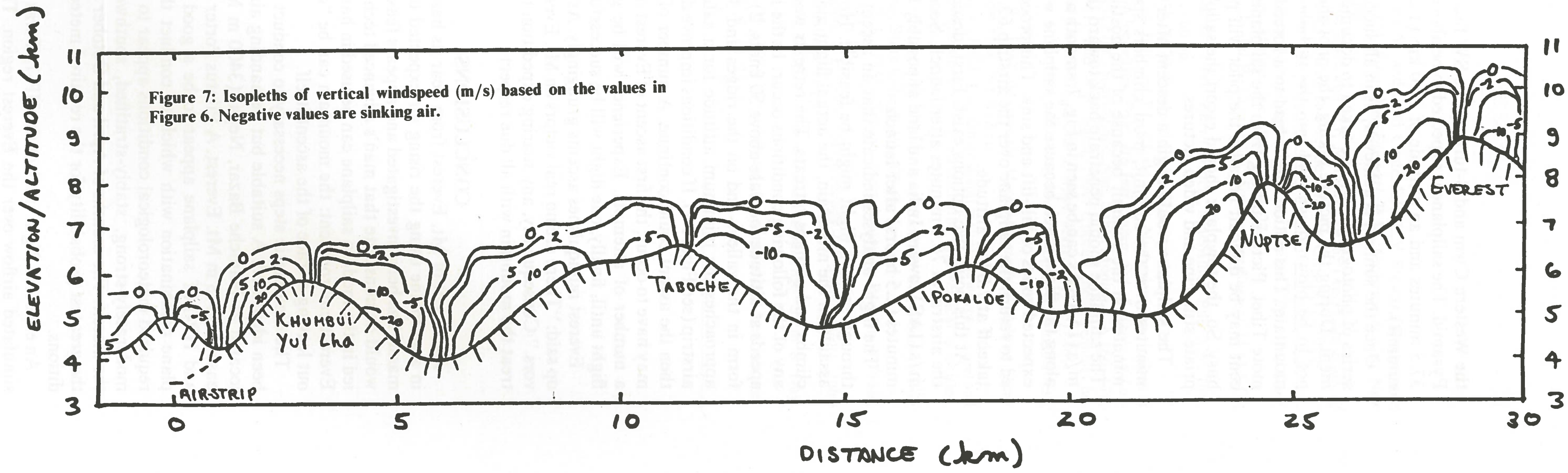

Figure 7: Isopleths of vertical windspeed (m/s) based on the values in Figure 6. Negative values are sinking air.

the Western Cwm and S-turn up the SW face of the Everest Pyramid. The sailplane is expected to be above the summit at 37.5 minutes and an altitude of 10.0 km (1.2 km above the summit).

Once the summit is achieved, as in all successful climbs, a series of photographs will be taken to document the achievement. During the picture taking, the pilot should be careful not to be blown downwind into the turbulent wake of the mountain. This action might lead to a forced landing in remote Tibet. Picture taking from the sailplane during the ascent may be difficult because the pilot will probably be too busy. So, the towplane should escort the sailplane for appropriate still, cine and video pictures.

The sailplane would begin a descent after spending a few minutes over the summit; most climbers spend only a few minutes on the summit because of the hostile environment. The sailplane should penetrate back toward the airstrip at 55 m/s (IAS). As can be seen in Fig. 7, smooth air is anticipated along the flight track because the sailplane will be above the expected zones of hill-lift and sink. This procedure is expected to return the sailplane over the airstrip 63.0 minutes after takeoff at 7.0 km altitude.

At this point two options exist. First, descend and land at the airstrip at 76.0 minutes after launch. Second, glide at 55 m/s (IAS) toward India and land at possibly Darbhanga 150 minutes (2.5 hours) after launch.

The flight analyses indicate that an ascent of Mt. Everest through soaring flight might be feasible. However, like any assault on the mountain, the actual flight may be a series of climbs and perhaps retreats. The retreats would occur when any of the following conditions occur: 1) the horizontal wind speeds at altitude increase above 50 knots, 2) clouds begin to form in the valleys and on the ridges and 3) the sailplane approaches the minimum altitude for a safe return to the airstrip (see Figure 8). If conditions improve during a retreat, then the ascent could continue. A number of soaring flights may have to occur; the first ascent of Everest on foot required a number of attempts. Experience will be gained on each flight until, finally, one flight will be successful.

Everest relinquishes ascents grudgingly. As Barry C. Bishop said: "There are no real victors on Mt. Everest, only survivors." Consequently, any soaring expedition to Everest must treat the mountain with all due respect.

CONCLUSIONS

An ascent of Mt. Everest from near its base to its summit in a sailplane using the rising air expected to flow over the massif has been investigated and appears feasible. The flight would demonstrate that man's advanced technology embodied in the modern sailplane can be used in harmony with the Everest environment: the mountain can be "climbed" without leaving a trace of the ascent itself.

The diplomatic steps necessary to conduct the flight have been identified. A suitable but demanding airstrip has been located at Namche Bazar, Nepal (3400 m MSL) near the base of 8848 m Mt. Everest. A Pilatus Porter STOL aircraft and HP-14T sailplane appear to be a good towplane-sailplane combination with which to conduct the flights. The required meteorological conditions appear to be a deep, dry, moderately-strong, stably-stratified, southwesterly airflow the massif. The months of April and October appear to have the greatest probability for the required meteorological conditions.

An expected flight track of the HP-14T was calculated in a simulated airflow over the Everest region. The airflow was constructed from streamlines which were drawn based on the

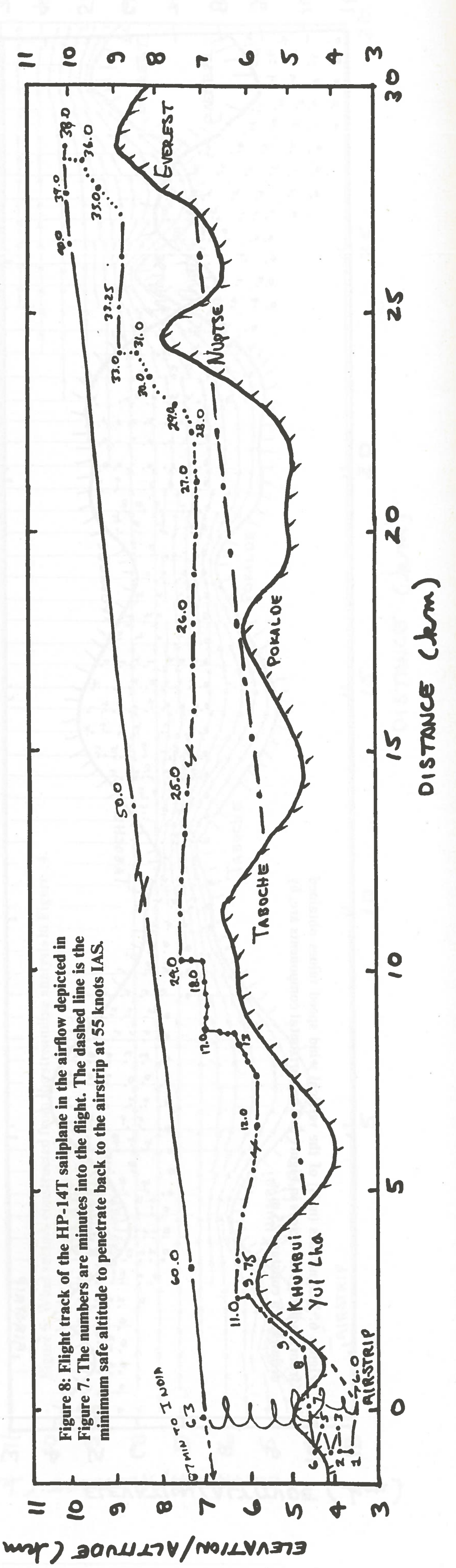

Figure 8: Flight track of the HP-14T sailplane in the airflow depicted in Figure 7. The numbers are minutes into the flight. The dashed line is the minimum safe altitude to penetrate back to the airstrip at 55 knots IAS.

topography. The resulting hill-lift and hill-sink patterns appear realistic. The flight analyses indicates that an ascent of Everest through soaring flight might be feasible. However, like any of the previous climbing ascents of Everest, the actual flight may be a series of climbs and retreats.

The preparations for the soaring flights should include airflow measurements in the Everest region and subsequent three-dimensional numerical simulations to expand the measurements. High-altitude training flights in mountainous terrain are necessary to perfect the required pilot skills.

ACKNOWLEDGEMENTS

I am grateful to my colleagues who listened to the proposed flight develop over the past two years and from whom I have learned a great deal that helped in the preparation of this paper: Gerald Kaufman, Ft. Collins, CO; Prof. E. Reiter, Colorado State University; Prof. R. Smith, Yale University; Prof. Rea Keech, Anne Arundel County Community College, Maryland; and LCDR Jack Gleason, U.S. Naval Academy.

REFERENCES

(1.) Morrissey, J.D., 1984: The forgotten face of Everest, Conquest of the summit. *Natl. Geo. Mag., 166/1,* 78–89,

(2) Harvard, A., 1984: The forgotten face of Everest, *Natl. Geo. Soc. Mag., 166/1,* 70–77.

(3) The Capital, 1984: Reservations needed. *The Capital Newsletter,* 26 October 1984, Annapolis, MD, pg. 3.

(4) The Seattle Times, 1974: Many hikers are a problem in Nepal. *The Seattle Times Newspaper,* 1 January 1974, Seattle, WA, pg. C2.

(5) Reinhardt, M.E., B. Neininger and J.P. Kuettner, 1985: First results of airborne measurements of mountain-valley circulations in the Kali Gandaki valley, Nepal, by motorglider. XIX OSTIV Congress, Rieti, Italy, August 1985.

(6) Fellows, P.F.M. and Lord Clydesdale, L.V. Stewart Blacker and P.T. Etherton, 1934: *First Over Everest!,* R.M. McBride & Co., New York, NY 264 pp.

(7) Clydesdale, Lord and D.F. M'Intire, 1936: *The Pilots Book of Everest.* Doubleday, Doran & Co., Inc., Garden City, NY, 270 pp.

(8) Gao, D., 1981: Explorative studies of meso- and micro-scale systems and waves over Qomoolangma Feng (Mt. Everest). *Ppts. 2nd Conf. Mt. Meteor.,* Am. Meteor. Soc., Boston, 24–27.

(9) Fleming, J. and R. Faux, 1977: *Soldiers on Everest.* H.M.S.O., London, 238 pp.

(10) Sheffield, C., 1981: *Earth Watch.* MacMillan Pub. Co., Inc., New York, NY, 160 pp.

(11) Bikle, P.F., 1970: Polars of Eight. *Soaring, 34/6,* 16–21.

(12) Hindman, E.E. and T.L. Clark, 1984: Numerical simulations of soaring flights in lee-waves. *Proc. 4th Intl. Symp. Sci. & Tech. of Low Spd. & Motorless Flgt.,* Soaring Soc. Am., Santa Monica, CA 166–171.

(13) Auer, A.H. and W.R. Sand, 1966: Updraft measurements beneath the base of Cu and Cb clouds. *J. Appl. Meteor., 5.* 461–466.

(14) Ramage, C.S., 1971: *Monsoon Meteorology.* Academic Press, New York, NY, 296 pp.

(15) Pielke, R., 1984: *Mesoscale Meteorological Modelling.* Academic Press, New York, NY 612 pp.

(16) Foldvik, A., 1962: Two-dimensional mountain waves—a method for the rapid computation of lee wavelengths and vertical velocities. *Quart. J. Roy. Meteor. Soc., 88,* 271–285.

(17) Ludlan, F.H., 1980: *Clouds and Storms,* The Pennsylvania State Univ. Press, State College, PA 405 pp.

(18) Scorer, R.S., 1958: *Natural Aerodynamics.* Pergamon Press, New York, NY, 312 pp.

(19) Wallington, C.E., 1977: *Meteorology for Glider Pilots.* John Murray, Ltd., London, 331 pp.

(20) Bonington, C., 1973: *The Ultimate Challenge.* Stein & Day, New York, NY, 352 pp.

(21) Combs, H., 1984: That beautiful mountain and here sinister trap. *Soaring, 48/9,* 20–23.