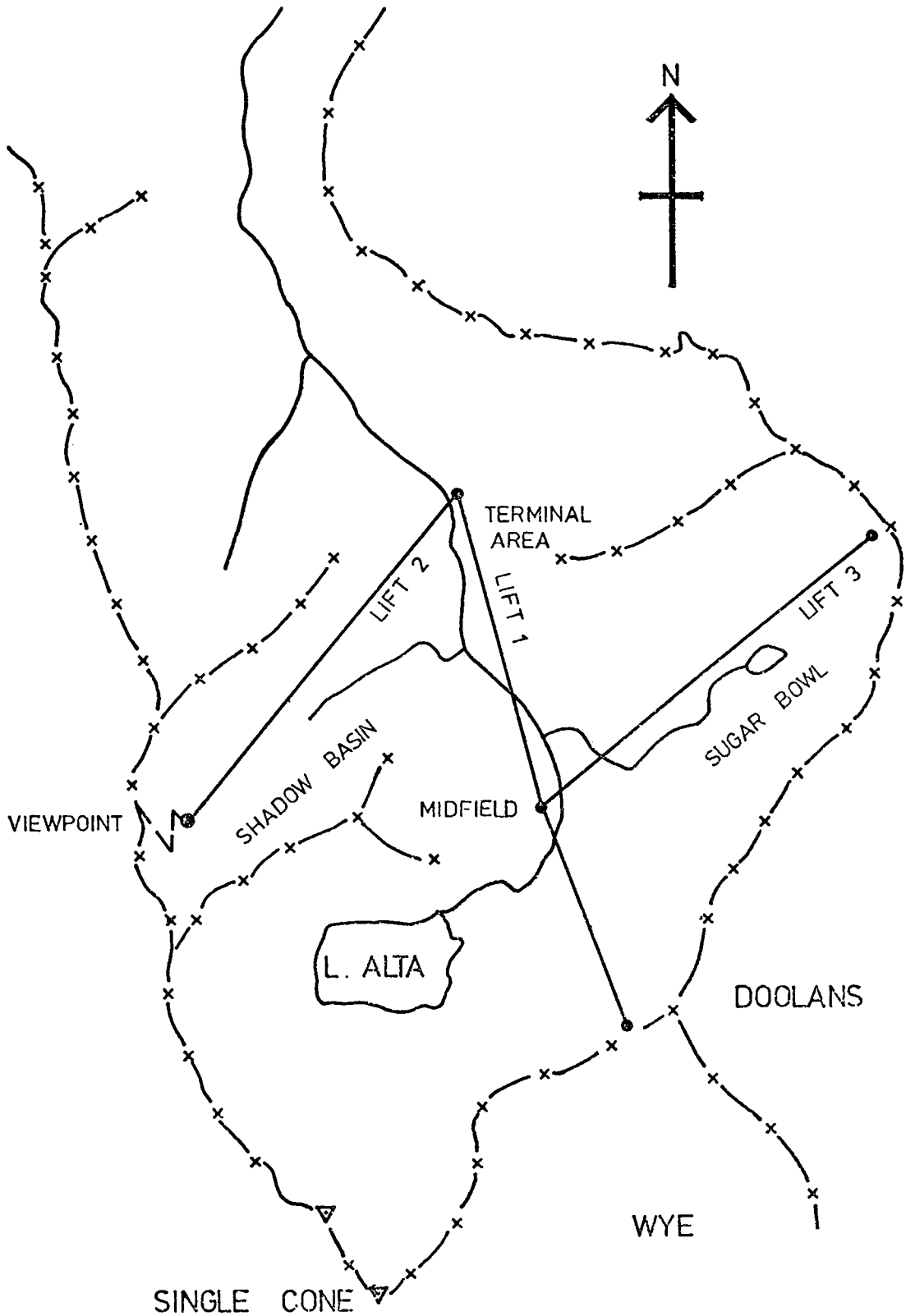


FIGURE 2 : Proposed Lift Alignment in RASTUS BURN (July 1978)

SECTION III

EVALUATION OF RASTUS BURN SKIFIELD PROPOSAL

3.1 Extent of Skiable Terrain

On visits to the Rastus Burn in the winter of 1975 and 1979, I observed the extent of terrain which, in mid to late August can usually be relied upon to be skiable. This is mid-season, and at the period of maximum snow accumulation.

My definition of "skiable" is that which I have been able to ski without impediment from scree, rocks, boulder fields or vegetation due to absence of snow cover. The ability of these "skiable" areas to sustain high density skier traffic and its suitability for skifield development are separate considerations. The total "skiable" area is approximately 80 ha.

Reference : Plan 2

3.2 Length and Reliability of Ski Season

I have found no basis for numerous claims that both an earlier and later season is available in the Rastus Burn in comparison to Coronet Peak. Rogers[12] stated **"that the month of June and October will experience greater patronage in the proposed ski area due to the certainty of snow in these months in the Rastus Burn"**. Forward[4] stated that the Rastus Burn satisfied his Company's requirement of **"a reliable ski season extending from June through October"**. Robinson[4] went further than Forward in his claims, that **"with grooming there would be ideal conditions for skiing in the Rastus Burn from early June until November each year"**.

Sir Henry Wigley surpasses all his Company's employees' claims by stating in the Mount Cook Group's Annual Report 1979[20]

> **"It is noteworthy that while Coronet Peak at this date** (25 July) **has only just become skiable, the Rastus Burn Basin has had enough snow to have been in full operation and catering for a large number of skiers for over two months"** (i.e. prior to 25 May 1979).

Reference : Photographs 4, 5, 7, 9

3.3 Factors Affecting Snow Accumulation

It appears that the basic assumption behind the Company's claims is that due to its higher elevation, the Rastus Burn receives and retains more


RASTUS

RASTUS BURN, DOOLANS, WYE

EXTENT SKIABLE TERRAIN* : solid line (all colours)
USUALLY UNSKIABLE TERRAIN : shaded

* RASTUS BURN IN MID-LATE AUGUST.

SLOPE ANALYSIS BY SKIER ABILITY (RASTUS BURN only)

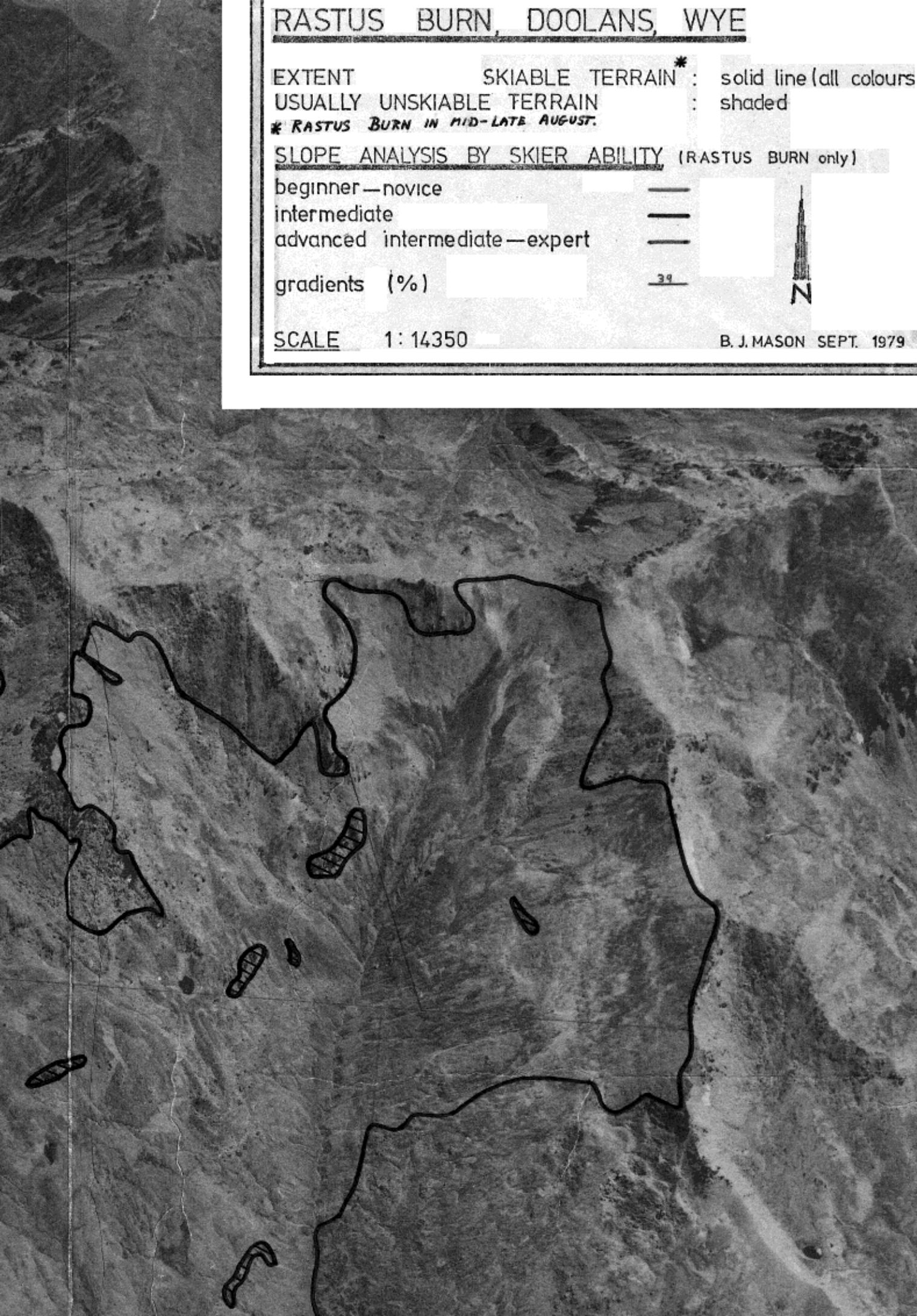
beginner—novice
intermediate
advanced intermediate—expert

gradients (%) 39

N

SCALE 1 : 14350

B. J. MASON SEPT. 1979




DOOLANS
WYE

PHOTOGRAPH 4

RASTUS BURN VALLEY
18 June 1979 D G Jardine

Development proposals as at 4 July 1978

Chair Lift 1: Bottom terminal : centre bottom
Top terminal on Wye Saddle : left skyline

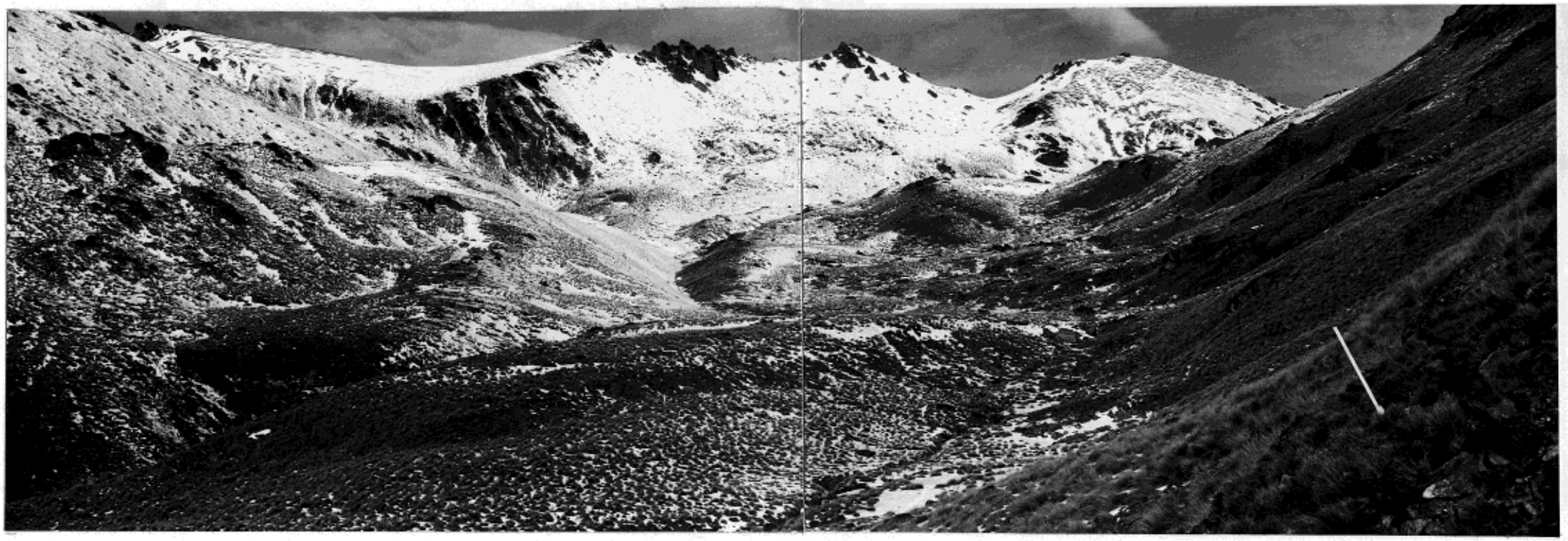
Chair Lift 2: Shadow Basin
Bottom Terminal : centre bottom
Top terminal below ridge and proposed tourist lookout on extreme right skyline

Chair Lift 3: Sugar Bowl out of sight on left
Bottom terminal at base of Wye Saddle face

All proposed ski runs unskiable one month before the opening of the Coronet Peak skifield

Single and Double Cones (2502 m) : right of centre

PHOTOGRAPH 5



RASTUS BURN BASE AREA
8 July 1979 K D Mason

Nine days before the opening of the Coronet Peak skifield, the Rastus Burn remains unskiable. This is despite the claim by Sir Henry Wigley that the Rastus Burn could have been in full operation as a skifield prior to 25 May, until the time of Sir Henry's statement on 25 July 1979.
The Sugar Bowl is out of sight below Doolans Saddle (left skyline). Wye Saddle (right of centre). Lower slopes of Shadow Basin run on right foreground; with survey marker for No. 2 chair lift.

snow than Coronet Peak. Fitzharris[15] identifies four scales for the purposes of considering snow accumulation. On the macro scale (i.e. group of mountains), variations are controlled by synoptic scale weather patterns, that is passage of frontal systems. This can be partially monitored by the mapping of snowlines during storms. Fitzharris defines a continuous snowline as the **"elevation above which 90% of the area is covered by snow"**. A discontinuous snowline is the **"lowest elevation at which substantial snow occurred"**.

From my photographic records of Coronet Peak and the floor of the Rastus Burn during five periods of the 1979 winter, comparitive snowlines are tabulated in Table 6.

Table 6 COMPARISON OF SNOWLINE : RASTUS BURN AND CORONET PEAK WINTER 1979

	2 June (fresh fall)	8 July	25 September (fresh fall)	9 October	15 October
Discontinuous Snowline					
South face Coronet	855 m		1130 m		1280 m
Valley floor Rastus	1340 ± 45 m		1495 m		1555 m
Continuous Snowline					
South face Coronet		1495 m		1310 m	
Valley floor Rastus		1738 m		1617 m	

Mean snowline	Rastus Burn	1550 m
	Coronet Peak	1215 m

During the period of the 1979 Coronet ski season (17 July to 30 September) the continuous snowline was lower than 1190 m (lower terminal elevation). In view of my observations on my August 1975 visit to the Rastus Burn, I would expect the continuous snowline in the valley floor to be approximately 1585 m during mid-August to early September.

Therefore the continuous snowlines July to October on the Rastus Burn valley floor are between 300-400 m higher than on Coronet Peak. On the scale of a single mountain, Fitzharris[15] identifies three variables - elevation, aspect and slope.

A comparison of elevations (Table 7) shows a 320 m increase in elevation between the lower terminals at Coronet and Rastus Burn, as well as a similar increase between upper lift terminals. At an average temperature decrease with increasing altitude of -0.7° c/100 m, there is a theoretical temperature decrease of 2°C from Coronet Peak to Rastus Burn. However, any potential lowering of freezing level is more than negated by higher snowlines, as Table 6 demonstrates.

Table 7 COMPARISON OF ELEVATIONS : CORONET PEAK AND RASTUS BURN

Coronet Peak	
Lower terminal	1190 m
Summit	1647 m
Rastus Burn*	
Lift 1: lower terminal	1510 m
Lift 1: mid-field	1708 m
Lift 1: Wye Saddle	1967 m
Lift 2: lower terminal	1510 m
Lift 2: below lookout	1952 m
Lift 3: lower terminal	1708 m
Lift 3: upper terminal	2040 m

* Source: Frederick Sheppard and Partners; Plan 7131/TF4[21] (Reference: Figure 2)

Variations in snow accumulation due to differing aspects are partly induced by differences in precipitation between windward and leeward sides of a mountain[15]. However, these are more dominated by differential receipts of solar radiation with aspect, with associated differences in melt rate[15]. Figure 3 illustrates the relative angles of sun incidence on the south facing slopes of Coronet Peak and on the north facing Rastus valley floor and Wye Saddle Face.

Variations of slope affect snow retention due to snow creep or avalanching, as well as the amount of incident solar radiation, and hence melt[15].

Appendix 6 is a calculation of the maximum potential radiation received on the three lift lines proposed for the Rastus Burn, as well as for Coronet Peak. This calculation allows for both slope and aspect, and assumes no atmospheric interference.

The incident radiation or actual radiation received by a slope depends also on altitude, atmospheric conditions and shading. From figures presented by Greenland[16], the higher altitude of the Rastus Burn over Coronet Peak (about 300 m) would allow as much as 10 langleys per day more, but this is small compared to the daily totals (Appendix 6). Greenland[16] recorded that during the period June-August the actual radiation received in the Chilton Valley near Cass was 65% of the maximum possible for that altitude at latitude 45° south. This percentage includes the effects of atmospheric conditions and shading by other hills and mountains.

A "Sun Path Diagram for Helicopter Ridge", Rastus Burn[9] by Owens shows that this site in the Sugar Bowl receives a maximum of 6 hours mid-winter sunshine per day, compared to a mean of 1.75 hours per day in the Chilton Valley[16]. From my knowledge of the terrain proposed for development in the Rastus Burn, I would assume Owens' site to be fairly representative of the whole.

By comparison, Coronet Peak is shaded mid-winter (Figure 3), other than the crests of some promontories, and the southwest Greengates face. Owens[9] has concluded that during the months July-September, the Rastus Burn has a similar proportion of clear days to Coronet Peak. Therefore there is unlikely to be a significant atmospheric difference that would affect comparitive radiation receipts. Pollock[17] recorded only a 10% difference in actual radiation receipts between Mount Brewster on the Main Divide, and the Old Man Range in Central Otago. Considering that Cass is in a similar climate district to the Wakatipu district[18], extrapolation of Greenland's results provides a fair indication of radiation receipts on Coronet Peak and in the Rastus Burn. Without actual measurement of solar radiation receipts at these sites, I assume that they are similar to that recorded in the Chilton Valley. The higher altitudes of Coronet Peak and Rastus Burn could allow a slightly larger radiation receipts than the

MIDDAY SUN ANGLE — CORONET PEAK and RASTUS BURN

MID WINTERS DAY to EQUINOX

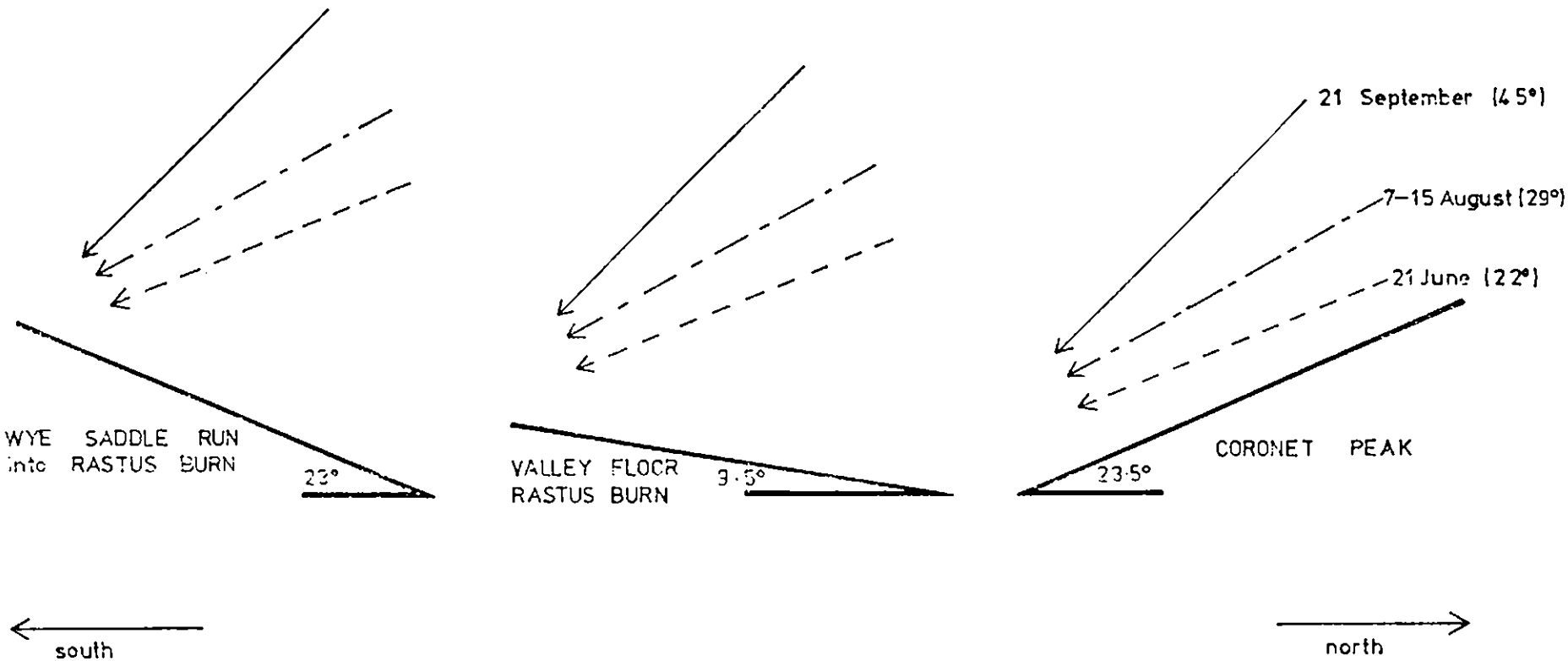
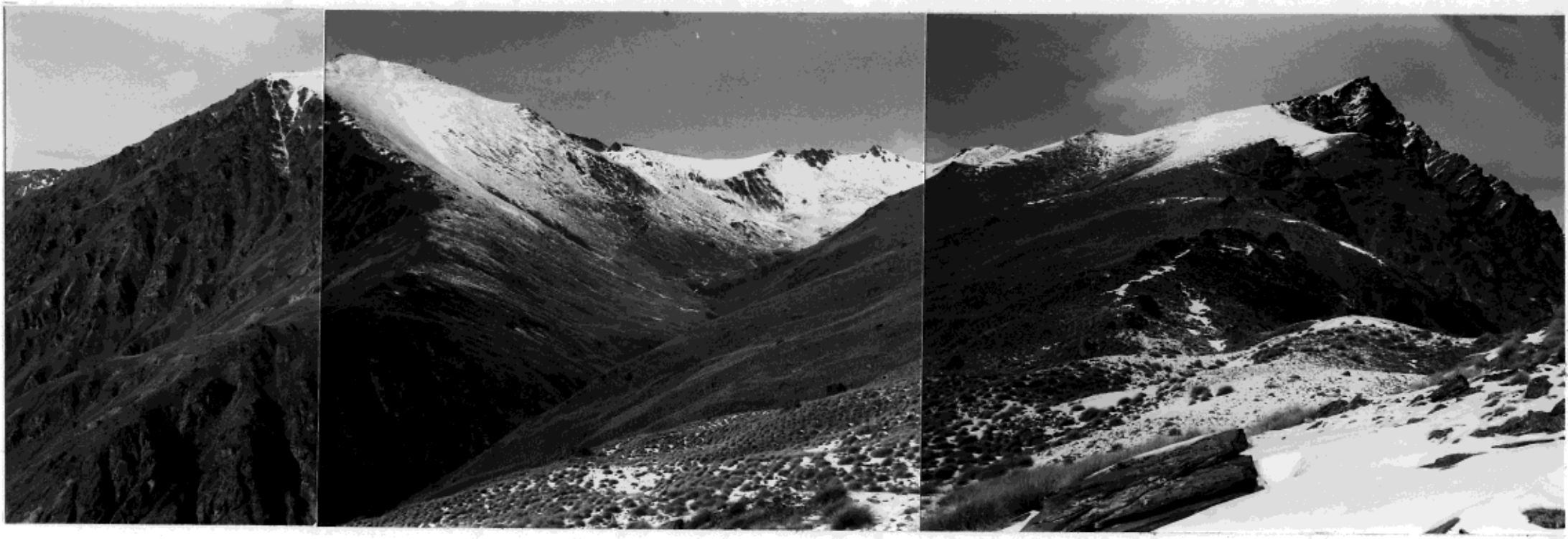


FIGURE 3

PHOTOGRAPH 6



RASTUS BURN FROM NORTHERN END OF REMARKABLES ESCARPMENT
7 July 1979 K D Mason

Proposed base area in apex of valley (centre). Access road alignment across face towards and below photo point. Double Cone (right).
The effect of slope gradient and aspect on snow retention is graphically illustrated by this photograph. The steep north facing slope on the left is snow-free to 1920m a.s.l., while the west-north-west basin behind has a continuous snowline down to 1650 m. A north facing slope (right) is snow free up to 1830 m. Due to a lower receipt of solar radiation on the gently graded valley floor, also with a north aspect, the snowline is down to approx 1700 m. Even a slight orientation away from the incident radiation greatly assists snow retention. The right hand half of the slope on the right with a north-east aspect (appears at 8 o'clock to Double Cone) has significantly greater snow cover than the similarly graded adjacent slope to the left with a north aspect.

Chilton Valley, thus perhaps as much as 70-75% of maximum possible radiation is actually received by horizontal surfaces on Coronet Peak and Rastus Burn.

The effects of shading and slope aspects indicate that Coronet Peak can receive a maximum of 31 langleys per day and that Rastus Burn can receive a maximum of 350 langleys per day in the period June-August. (These values are overall weighted means: Appendix 6).

Thus the proposed Rastus Burn ski runs receive approximately 11-12 times the amount of radiation as the Coronet Peak skifield. This figure does not allow for the much higher sunshine hours in the Rastus Burn, and is therefore very conservative. The major impact that aspect and slope have on snow retention, is graphically illustrated by Photograph 6 where the steep (approx 40-45°) north-facing ridge-end east of the Rastus Burn is snow free to 1920 m.

3.4 Slope Analysis

Using the Branch/Rowan slope classification system, I have measured the slope gradients of all areas I have observed to be "skiable". These are classified into three groups of beginner-novice, intermediate, and advanced intermediate - expert, and shown on Plan 2.

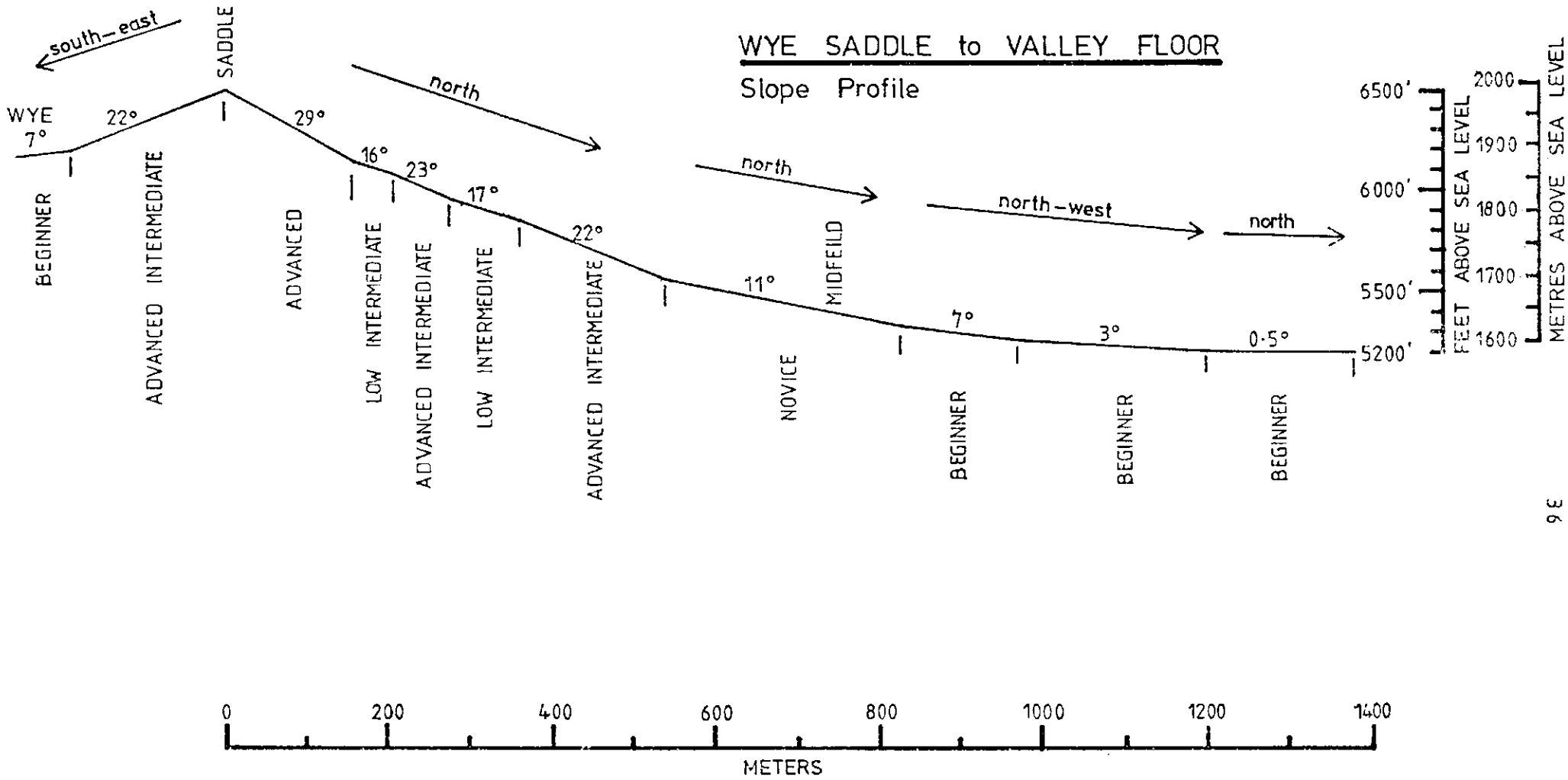
Figures 4-6 are slope profile diagrams of the three proposed ski runs.

LIFT 1: Wye Saddle and Valley Floor

Wye Saddle Section:

This is a relatively narrow run approx 200 m vertical from a saddle between the Wye and Rastus catchments. It is an advanced slope with two short low intermediate steps midway. The underlying surface is coarse scree with small boulders in the upper half, and tussock with small boulders on the lower slopes. The upper section consists of a steep (29°) slope leading into a concave depression which confines skier movement to the fall-line in the base of the depression.

Snow tends to drift into this depression, and to persist longer on this north-facing slope than on the adjacent slopes. Despite this, however, I have observed the top of the larger rocks and scattered scree to either protrude above the surface, or to be visible just below the surface, during the months of August and September at the period of



Vertical Drop : 380m (1250')

Distance : 1400m (4593')

FIGURE 4

maximum snow accumulation. Any attempt to ski out onto the less confined adjacent slopes are quickly curtailed due to the danger of widespread scree protruding through the snow cover (Photograph 7).

On both occasions that I have skied or walked this run during the 1979 season, there has been a wind or partial melt crest, making uncomfortable skiing conditions. Due to its north aspect and slope (Figure 4) I would expect severe melt crusting on this slope, particularly in the latter half of the season.

The lower portion of this run consists of a final step (22°) leading to the gentler slopes in the valley floor. It is predominently a tussock covered slope with occasional small boulders. Due to its closer proximity to the snowline, north aspect and slope, it tends to be thin on snow cover.

On all occasions I have seen it during winter months the tops of the tussock either protrude or are visible below the surface.

Due to inadequate snow cover this run could not sustain a density of skier use in any way approaching that of a skifield. Any attempts to remove offending rocks would require more than the removal of an occasional small boulder. It would require replacement of the total scree slope. Overall the slope receives a mean maximum potential of 640 langleys/day on 7 August (Appendix 6).

Valley Floor Section:

The valley floor is of beginner and novice gradient from below the Lake Alta moraine, down the true left bank of the Burn, to the continuous August snowline at approx 1585 m. I would not expect the slopes below this level to have a continuous snow cover mid-season, except immediately after a substantial snowfall (e.g. Photograph 8 on 25 September 1979). The proposed terminal for Lifts 1 and 2 is some 60 m below the continuous August snowline.

The upper novice slopes which are in the vicinity of the proposed midfield terminal consist of both medium height tussock with scattered small rocks and occasional small boulders. These would not have been skiable before the time of the opening of Coronet Peak season on 17.7.79.

Photograph 5 shows the beginner terrain from midfield to the 1585m snowline (mid-foreground). There is a more substantial tussock cover overall with scattered medium size boulders. Slope width varies from quite narrow

PHOTOGRAPH 7

RASTUS BURN FROM WYE SADDLE
8 July 1979 K D Mason

Sugar Bowl on right. Despite there being snow cover on upper slopes, these are unusable for skiing due to compaction on to coarse scree near snow surface (e.g. left foreground) and extensive rock hazard. Coronet Peak directly opposite lower Rastus Burn Valley.

to wide, due to the steeper side slopes above and the incised Rastus Burn which bisects the valley floor. This effectively precludes use of the slopes on the true right (east) bank. I skied this slope on 2.9.75 and again on 25.10.79 and found rocks and tussock protruding on both occasions.

Overall, the valley floor receives a mean maximum potential of 460 langleys/day on 7 August (Appendix 6).

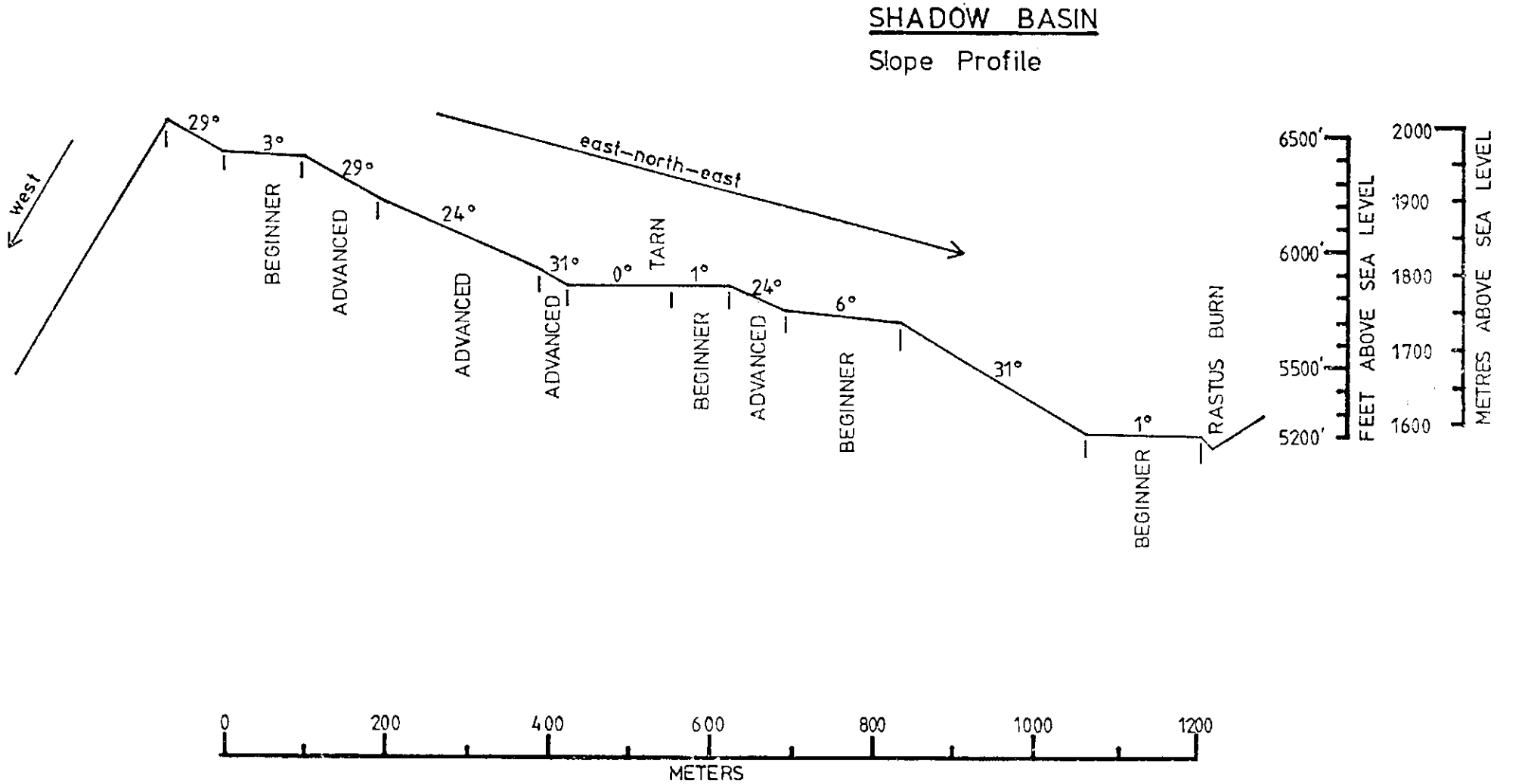
LIFT 2: Shadow Basin

This proposed lift line starts at the lower terminal at approx 1525 m and rises to approx 1950 m below the proposed lookout point. Of this total vertical height of 425 m, only the upper 240 m is normally skiable mid-season. I have indicated this on the slope profile diagram (Figure 5) and Plan 2.

There is a small sub-basin of beginner gradient at the top of the lift line with an advanced slope 24-31° leading down to a tarn on the middle shelf. I have visited this slope on several occasions and skied it once on 25.9.79. Each occasion I have found it very marginal as a ski run due to inadequate snow cover. The whole slope has a coarse scree base with larger rock scattered over it generally. On 25.9.79 I had to carefully pick my way down between rocks constantly aware of many more rocks visible below the surface. With the passage of more than a few skiers, the most favourable line would become worn out. There is absolutely no way this slope, even with grooming could seriously be considered as a ski run.

On a lower shelf is a beginner area, with an advanced slope between it and the tarn on the middle shelf. Assuming that this run had sufficient snow cover to sustain high density skier traffic, there is a very poor separation of ability levels. It is essential to separate faster skiers from beginner areas, and for this reason only the lower shelf has any potential as a beginner area.

There is a steep (31°) slope fromthe lower shelf to the valley floor which I have not observed to be skiable. I have climbed upwards once, on skis on 25.9.79, but would have had great difficulty in descending the slope due to inadequate snow cover. Due to its proximity to the snowline, steepness and aspect (east-north-east) I have observed this slope to be one of the first slopes in the Rastus Basin to clear of snow after a fresh fall. It receives a maximum potential of 520 langleys per day compared to a mean of 440 langleys/day for the whole run on 7 August (photographs 4, 5, 8, 9).



Vertical Drop : 213m (700')
Distance : 850m (2790')

FIGURE 5

PHOTOGRAPH 8

RASTUS BURN : SHADOW BASIN FROM LOWER SUGAR BOWL
25 September 1979 B J Mason

Immediately after a heavy snowfall, indicating normal maximum snowcover. Note light snowcover on wind exposed shoulders. Proposed tourist lookout on ridge (top left). The upper section of the basin consists of a partially snow covered boulder slope. Two level steps occur midway down the basin, the upper one contains a large tarn. The lower slope above the valley floor base area (right of centre) shows tussock protruding across most of this slope which normally becomes unskiable within 1-2 days of a heavy snowfall. This is due to its steep gradient (60%) and east-north-east aspect. Note snow drift on near (uphill) side of foreground rocks, indicating up-valley wind direction. Large corniced drifts (not shown) on Wye and Doolans side of main ridges indicate that northerly winds transport significant quantities of snow out of the Rastus Burn for deposition in these southerly basins.

Smooth snow covered slopes to the right of the Shadow Basin are skiable at this date, down to the valley floor. Due to the north-east aspect however, these slopes do not retain a usable snow cover for very long. See Photograph 9 (right) for comparison of same slopes.

The remainder of the proposed ski run in the valley floor is below the 1585 m continuous snowline.

LIFT 3 : Sugar Bowl

The upper terminal of this proposed lift is on the ridge crest at 2044 m with the lower terminal midfield at 1700 m. The upper 150 m of the proposed line is on a slope of approx 34° (67%) with the slope strewn with boulders over its total height, and a line of bluffs below the ridge crest. A skier would need to be more than expert to handle this slope (Photograph 7).

The basin has a low, rounded shoulder dividing it into two halves. The northern half has an extensive boulder field, many of the individual boulders being the size of small houses. The scale and general distribution of these boulders precludes any prospect of skifield use unless there are large scale earthworks. Most of this half faces west-south-west and has a separate drainage from the other half to the south of the shoulder. The shoulder itself has more isolated boulders in its upper section, providing only limited impediment to skier movement. However, the lower part of the shoulder (Helicopter Ridge) is particularly windswept with the prevailing wind flowing up-valley with extensive patches of small rocks exposed (Photograph 8).

The reliably skiable area is confined to the south of the shoulder crest and is marked as the extent of skiable terrain on Plan 2. Figure 6 shows the slope profile down the fall-line of the basin floor. It has a south-west aspect and receives an overall maximum potential radiation of 190 langleys/day on 7 August. It has the most favourable aspect for snow retention, of all slopes in the Rastus Burn.

It is predominantly beginner terrain with short low intermediate slopes at the head of the basin and midway. There are no transitional novice slopes between. The exit from the basin is down to a 26° advanced slope into the creek bed, from which there would be a 22° slope to climb to reach the proposed lower lift terminal midfield. The alternative is to traverse advanced slopes on the true right bank of the creek until a crossing can be found leading onto the main valley floor slopes at approx 1675 m.

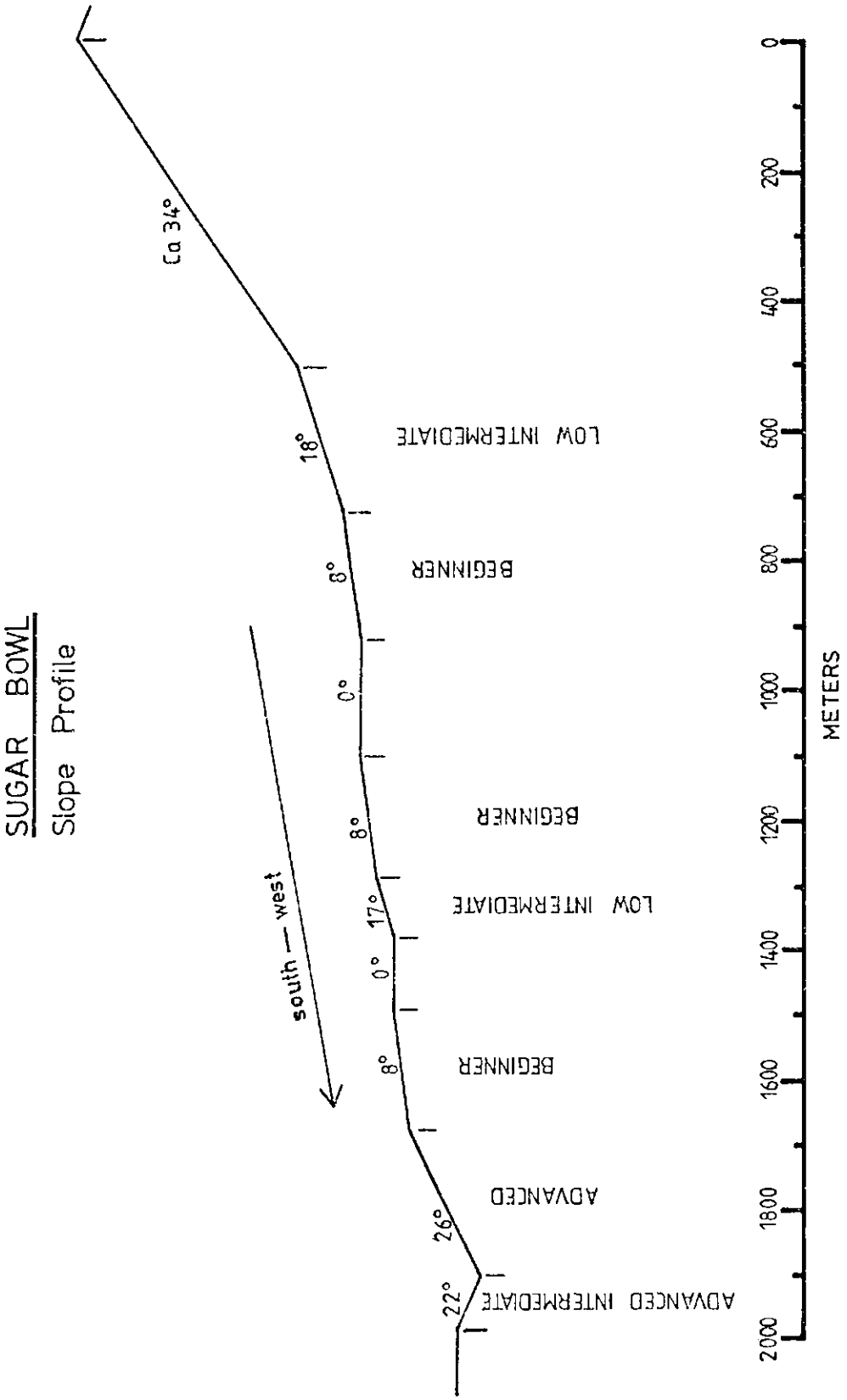

SUGAR BOWL
Slope Profile
south — west
Ca 34°
18°
8°
0°
8°
17°
0°
8°
26°
22°
LOW INTERMEDIATE
BEGINNER
BEGINNER
LOW INTERMEDIATE
BEGINNER
ADVANCED
ADVANCED INTERMEDIATE
0
200
400
600
800
1000
1200
1400
1600
1800
2000
METERS
Vertical Drop : 150m (500')
Distance : 1400m (4593')
6800'
6500'
6000'
5600'
FEET ABOVE SEA LEVEL
2100
2000
1900
1800
1700
METRES ABOVE SEA LEVEL

FIGURE 6

Alternative Ski Slopes in the Rastus Burn

An earlier proposed alignment for Lift 1 was to the Doolans Saddle with the ski run down the north facing expert slopes into the Sugar Bowl. The saddle is very windswept with the slope itself loosing its snowcover ahead of most other slopes. There are two other basins further down valley; one, an advanced slope on the east side of the valley has a variable snowline making servicing by lift very difficult. The ridge crests suffer from strong winds (Photograph 6); on the opposite side of the valley is an advanced intermediate slope which is very prominent when viewed from downvalley or from Coronet Peak. It faces north and north-east and experiences highly variable snowlines (Photographs 4, 6).

There are no other slopes within the Rastus Burn which have any potential for skifield development.

3.5 Slope Capacities and Development Constraints

Only the Sugar Bowl and two other small slopes appear to have adequate snow cover mid-season, to be considered as capable of sustaining skifield density usage. They are all of beginner gradient and are:

(a) Lower Step of Shadow Basin:

There is 1 ha at 1708 m with a gradient of 10%, 120 m above the main valley floor. Robinson's objections[4] to running chairlifts at low speed for ingress and egress would have to be overcome and/or for egress a very gently graded ski trail would need to be constructed from the lip of the step to the valley floor in an up-valley direction. Due to the steep side slope (approx 31°)(photograph 5) by necessity this trail would be relatively narrow to avoid large side batters, and to minimise visual impact. Being located on a sunny, often snow free slope, the trail is unlikely to retain snow cover over its entire length under ski traffic. The presence of bluffs and rock outcrops may necessitate steeper pitches on such a trail, than what can be comfortable handled by beginner skiers. Allowing for relative narrowness, the maximum grade could not be much more than 1:10 (10%). This would require a trail length of approx 600 m, allowing a 60 m drop to the rising valley floor. The trail planned by the Mount Cook Company is approx 400 m long with a grade of 1:6.6 (15%) which is the maximum beginner gradient. This would create difficulty for beginners learning on the 10% slope above.

Once on the valley floor, in the vicinity of the proposed midfield terminal, the problem remains of transport down the valley to the car parks. The logistics of utilising this potential beginners' slope plus the problem of the evacuation of relatively immobile beginners to shelter when there are sudden weather changes make it unattractive as a development option.

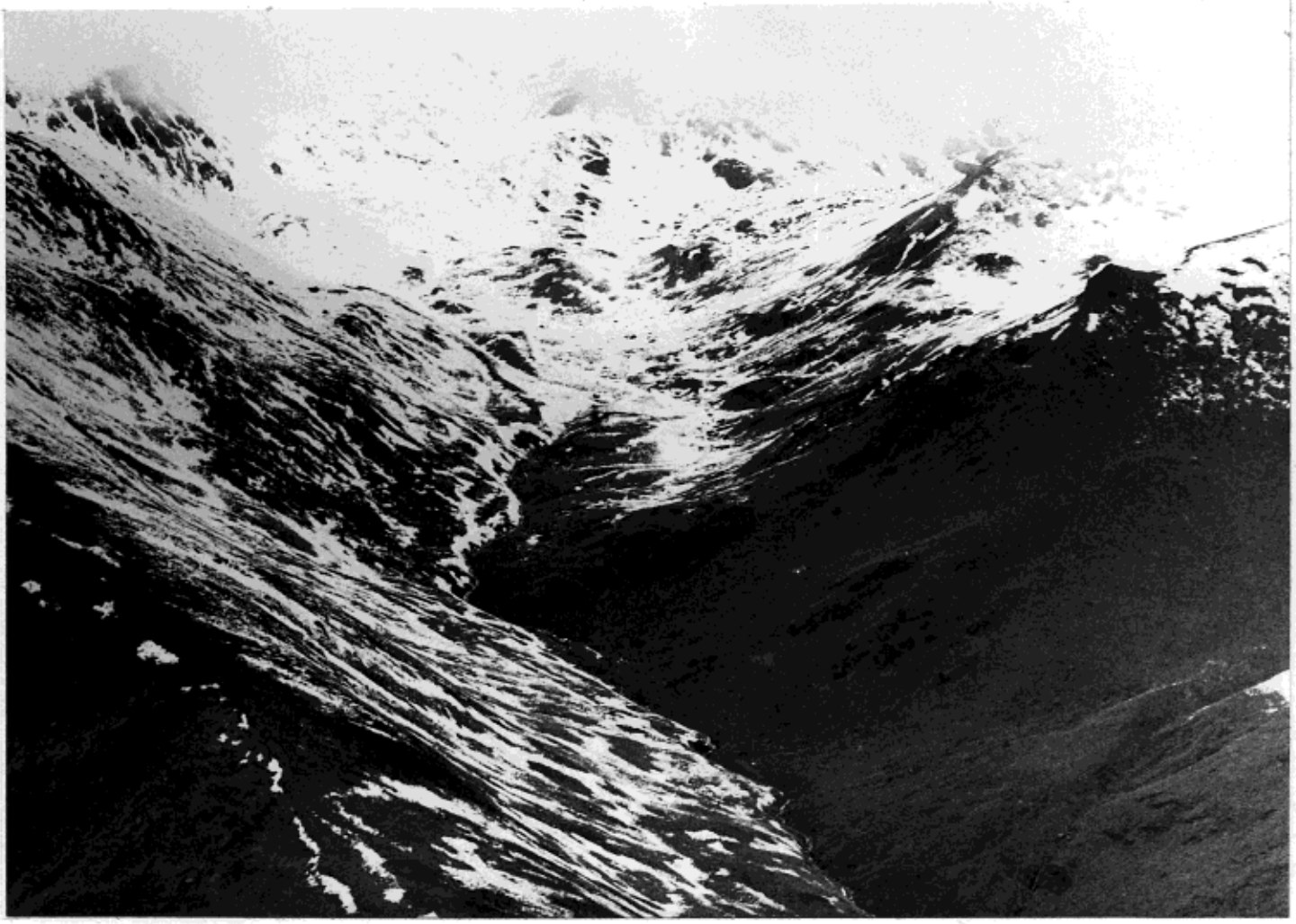
(b) Beginners' Slope below Lake Alta Moraine:
This is an 11% slope at 1750 m confined by the Lake Alta Moraine and the Wye Saddle Face. The Rastus Burn bisects the area, leaving approx 0.4 ha as a contiguous slope. Being in the valley floor and relatively closer at hand to base facilities than the Shadow Basin beginners' slope, this would be more attractive than area (a) as a development option.

(c) Sugar Bowl:
From Plan 2 it can be seen that there are four potential beginners' areas, distributed from the head of the Bowl to the lip above the main valley floor. For all these to be utilised would require connecting ski trails suitable for beginners (i.e. 1:10 or 10%). The exit from the lip of the Bowl, and back into the main valley, presents the largest obstacle to utilisation of these slopes. A 1:10 ski trail would have to be constructed across a side slope of 26-28° and then traverse north-west facing slopes which are relatively snow free. This would lead onto gentler novice slopes and so to the mid-field terminal. A total of approx 600 m of trail would be required. Similar logistic problems to those of the Shadow Basin would be involved.

Table 8 RASTUS BURN : MAXIMUM SKI FIELD SLOPE CAPACITY: BEGINNER SKIERS

Location	Area (ha)	Density/ha	Slope Capacity
a. Shadow Basin	1.0	125	125
b. Lake Alta Moraine	0.4	125	50
c. Sugar Bowl	2.5	190	475
			650

PHOTOGRAPH 9



RASTUS BURN VALLEY
13 October 1979 B J Mason

Thirteen days after the closure of the Coronet Peak skifield, the lower slopes of the Shadow Basin and the valley floor above the proposed lower lift terminals are unskiable. The south-west Sugar Bowl (not shown) probably has a continuous snow cover except in the boulder field areas.

On this date Coronet Peak above the halfway station had a discontinuous but skiable snow cover with the Back Basin having a continuous cover.

The effect of slope aspect on snow retention is illustrated by this photograph. On the left of the Rastus Burn is a south-west face, with north-east slopes on the right.