METEOROLOGICAL OBSERVATIONS AT FOSSIL BLUFF, ALEXANDER ISLAND

By C. J. Pearce

During February and March 1961 aircraft of the Falkland Islands Dependencies Survey were successful in establishing a new base at Fossil Bluff on Alexander Island. On 4 March three men were flown to the new base to spend the winter. They were the advance party in a programme primarily concerned with geological and survey work on the east and west coasts of George VI Sound. Although meteorological observations were not of prime importance in the programme, existing conditions enabled J. P. Smith and the writer, both Survey meteorologists, to carry out a continuous programme of observations from 9 March to 31 December 1961. Since meteorological observations have been temporarily discontinued at Fossil Bluff, the 1961 observations are the only record of weather in this part of Antarctica, and therefore represent a contribution to the general knowledge of Antarctic meteorology. These observations show a pattern of weather remarkable in its freedom from the blizzard conditions which are normally associated with Antarctica.

Location and Site

The Fossil Bluff base is located on the east coast of Alexander Island in lat. 71°21′S., long. 68°20′W. (Fig. 1). The base is situated at a point where the ice shelf of George VI Sound abuts on to the scree slopes of eastern Alexander Island, at an altitude of approximately 180 ft. (55 m.) above sea-level (Fig. 2).

The meteorological station is backed by the mountains of Alexander Island which rise very steeply to above 1,000 ft. (305 m.). These mountains trend almost due north and south, but immediately to the north-west there is a considerable break (extending over 5 miles (8 km.) inland and about 2–3 miles (3·2–4·8 km.) wide), and a small break immediately to the south-west of the base (extending some 800 yd. (732 m.) to a 2,500 ft. (762 m.) peak inland and about 150–200 yd. (137–183 m.) wide). To the east stretches 15 miles (24 km.) of uninterrupted ice shelf which separates Alexander Island from Graham Land. The mean level of the ice shelf in this area is about 50–100 ft. (15·2–30·5 m.) lower than at the base. To the north-east and south-east the ice terrain is uninterrupted for over 50 miles (80 km.).

Observations and Methods

Observations were made daily at 00.00, 12.00 and 18.00 hr. G.M.T. (corresponding to 21.00, 09.00 and 15.00 hr. local time), and transmitted once a day by radio to the Meteorological Office in Port Stanley, Falkland Islands. No meteorological programme had been anticipated so that a certain amount of improvisation was necessary. The weather observations recorded here are intended to do no more than give a general idea of the conditions experienced during 1961, but in order to define the limits of accuracy of the observations, the methods and instruments used are described briefly.

1. *Temperature*

(a) *The screen.* Since there was no Stevenson screen, a substitute was devised by using a box measuring 1 ft. 8 in.×1 ft. 2 in.×10 in. (50·8 cm.×35·6 cm.×25·4 cm.). The central board of the floor was removed and elevated about 0·75 in. (1·9 cm.). The end walls and the door were drilled with a number of holes, the door being hinged with lampwick and secured by a piece of wire to a catch. Two louvres were let into the back wall, each providing a space of about 0·75 in. (1·9 cm.) in width and inclined downwards. The "screen" was initially set up with its floor 4 ft. 3 in. (1·3 m.) above the snow surface; as a result of snow accumulation the floor was 4 ft. 0 in. (1·2 m.) above the surface by 1 August, and 2 ft. 8 in. (0·8 m.) by 23 August. The "screen" was anchored by a steel cable around it and secured to

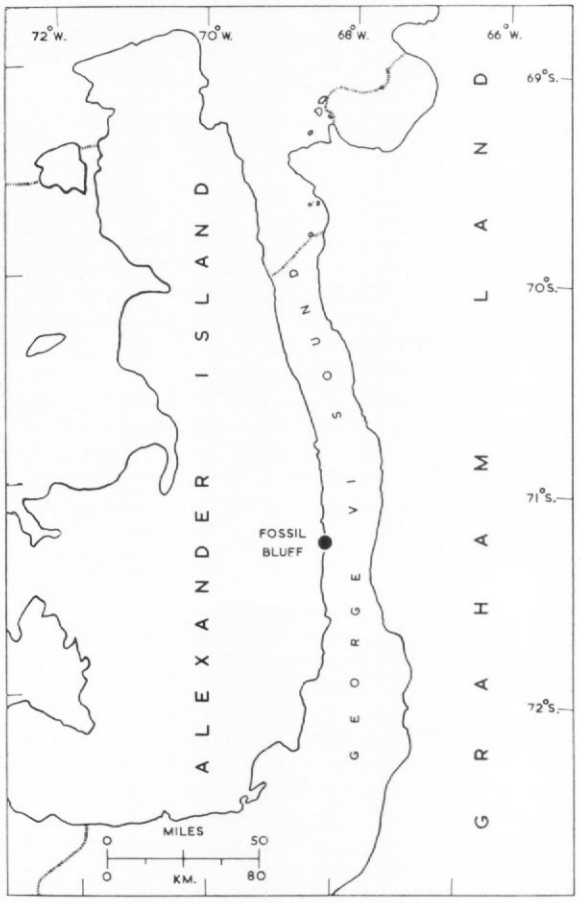

Fig. 1. Sketch map showing the position of Fossil Bluff on Alexander Island.

a boulder beneath. The "screen" was in a position about 25 yd. (22·9 m.) from the hut and at a level about 10 ft. (3 m.) below the floor of the hut.

(b) *Thermometers.* Two ordinary, one maximum and one minimum, thermometers were in use during this period. Because of the shortage of ordinary thermometers, no wet bulb readings were taken.

The fact that there was no proper Stevenson screen necessarily resulted in some inaccuracy in exposure. On checking against a whirling psychrometer, the error was generally $\pm 2°$ F ($\pm 1 \cdot 1°$ C), except during the last two months when an increasingly high sun heated the screen during the middle part of the day. For this reason only the 00.00 and 12.00 hr. G.M.T. observations were used for compilation of the temperature statistics.

2. *Pressure*

A marine barometer (Mark II) was in use during this period. A correction chart was compiled, assuming the station was 180 ft. (54·9 m.) above sea-level, an assumption based on the reading from an aircraft altimeter. It is now thought that the altitude of the base is slightly lower and therefore the pressure readings are fractionally low. A barograph was used for continuous pressure readings.

3. *Wind*

No instruments for recording wind speed and direction could be flown in to the base and

Fig. 2. An oblique aerial view of Fossil Bluff, which lies between Eros Glacier to the north and Uranus Glacier to the south. The highest peak is approximately 2,500 ft. (762 m.). The site of the hut is on a moraine at the north-eastern corner of the small glacier in the centre of the bluff. When the photograph was taken on 27 January 1962, much of the ice shelf surface of George VI Sound was covered by melt pools.

hence all wind statistics are based on estimates; both meteorologists had spent at least one year on properly equipped bases so that they had had some experience on which to base their estimates. Estimates were usually based on groups of 5 kt. (2·54 m./sec.). Obviously, there could be the possibility of considerable error in such estimates, but it is felt that the winds experienced at Fossil Bluff rarely exceeded gale force, and long periods of absolutely calm conditions helped to make the task of estimation very much easier. Wind direction was based on prismatic compass observations corrected for magnetic variation.

4. *Visibility*

Objects of suitable distance were taped, paced, measured by sledge wheel, or measured from published maps of George VI Sound.

5. *Present weather*

The weather at the time of observation was reported as closely as possible in accordance with the prescribed code.

6. *Optical phenomena*

Different kinds of optical phenomena added considerable interest to the work, and these were reported on all occasions.

Weather Synopsis

The synopsis of the weather at Fossil Bluff (Table I) has been abstracted from the meteorological log book which is now in the Meteorological Office of the British Antarctic

TABLE I. SUMMARY OF METEOROLOGICAL STATISTICS, MARCH–DECEMBER 1961

WIND. Speeds in selected groups are given as a percentage of observations for the month.

kt.	m./sec.	*March* *	*April* *	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.* *	*Dec.*
Calm	—	55	63	55	61	44	42	43	36	45	43
1–10	0·51–5·08	26	33	32	32	30	43	40	35	36	40
11–33	5·59–16·76	17	3	13	7	26	14	17	28	18	17
>33	>16·76	1	—	—	—	—	1	—	1	—	—

Percentage of winds from given directions.

Directions	*March*	*April*	*May* *	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.* *	*Dec.*
360–090°	0	3	7	11	4	4	2	0	0	2
090–180°	26	25	19	20	25	24	6	26	27	30
180–270°	3	0	2	0	8	13	6	5	1	0
270–360°	71	72	71	69	63	59	86	69	71	68

VISIBILITY. Percentages of visibility grouped in arbitrary ranges: Bad (0–1 mile; 0–1·6 km.), medium (1–49 miles; 1·6–78·8 km.), and excellent (>50 miles; >80 km.).

	March *	*April*	*May*	*June* *	*July*	*Aug.* *	*Sept.*	*Oct.* *	*Nov.*	*Dec.*
Bad	7	5	0	1	13	6	3	7	2	2
Medium	23	49	44	43	59	73	41	54	26	37
Excellent	69	46	56	55	28	20	55	38	72	61

TEMPERATURE. Mean temperatures, and extremes for each month, based on readings at 00.00 and 12.00 hr. G.M.T. All readings in ° F.

	March	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Mean	+13·6	+5·9	−0·7	−9·8	+4·2	+1·3	+6·3	+6·3	+22·3	+29·6
Minimum	−8·9	−26·2	−27·8	−37·9	−36·1	−35·4	−26·0	−30·8	−8·1	+11·1
Maximum	+36·3	+36·3	+27·6	+23·2	+31·0	+32·0	+27·0	+37·2	(>+40)	?

PRESSURE. Percentage of observations when pressure fell between given ranges, reduced to sea-level.

mb.	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.* *	*Nov.*	*Dec.*
940–960	0	0	4	4	0	2	0	17	0	2
960–980	62	15	54	29	19	23	31	68	61	39
980–1000	38	54	38	47	54	34	39	14	39	59
1000–1020	0	31	4	20	27	41	30	0	0	0

WEATHER. Percentage of observations on which the various kinds of "weather" were reported.

	March	*April*	*May* *	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.* *
No weather	71	75	74	74	54	45	67	57	75	77
Snow	16	20	19	17	36	40	11	23	20	19
Drift	13	3	6(3)	8	10(11)	14(5)	21	20	5	0
Fog	(4)	2	0	1	(6)	1	1	(5)	(1)	1
Drizzle	—	—	—	—	—	—	—	—	—	2

Figures in brackets indicate [illegible]entage of observations when drift or fog was present but ac[illegible] present weather code figure reported snow.

* 1 per cent anom[illegible]ies are due to percentages for each particular group being ta[illegible] to the nearest whole number.

Survey, Port Stanley. It is an attempt to indicate the salient features of the weather from 9 March to 31 December 1961.

Discussion

An examination of Table I indicates that the main features of the weather at Fossil Bluff in 1961 were its comparative mildness, lack of wind, lack of "weather" and the tendency towards low pressure during many of the months. Several of these features appear particularly surprising and worthy of comment.

First, the comparative mildness of conditions during most of the year was surprising. One would expect that its latitudinal position would ensure that the prime influence on temperature would be high pressure and polar air, and that Fossil Bluff would be well to the south of disturbances associated with depressions moving eastwards from the Bellingshausen Sea (Figs. 3 and 4). Furthermore, apart from the 12 weeks of twilight or darkness experienced at this latitude, it should be borne in mind that Fossil Bluff is at least 100 miles (160 km.) from open water at all times, and for 8 months of every year is probably 200 miles (320 km.) or more from open water. Yet, with exceptions in May and June, the winter temperatures showed monthly means above 0° F (−16·7° C), and during July and August the air temperature rose to extremes of +31° F (−0·6° C) and +32° F (0° C), respectively. Conditions during May and June followed the expected pattern of decreasing temperatures with high pressure, clear skies (Fig. 5) and little wind, so that the first week of June had an average temperature of −25° F (−31·7° C). Yet this proved to be the coldest period of the year, for the last two weeks of the month had an average temperature of −6·8° F (−21·6° C), continuing to rise during July to −1·3° F (−18·5° C) and +9·5° F (−12·5° C) for the two fortnightly periods of the month. Minimum temperatures were not as low as might be expected at a base in this situation, −37·9° F (−38·8° C) being the lowest. Such temperatures as this are reported almost every year from bases in Marguerite Bay, 200 miles (320 km.) to the north.

Although the statistics have not been given in Table I, it is of some interest that temperatures rarely fell below +30° F (−1·1° C) during January 1962, when the surface of the ice shelf of George VI Sound became a complicated system of interconnected surface lakes.

Secondly, the absence of strong winds was a noticeable feature at Fossil Bluff. Apart from personal memories of long periods of absolutely calm weather, the statistics each month gave remarkable averages: 5, 2, 3, 6, 4 kt. (2·54, 1·02, 1·52, 3·05, 2·03 m./sec.), etc., the highest being 7 kt. (3·56 m./sec.) in October. Winds estimated to be in excess of 33 kt. (16·76 m./sec.) were only observed on three days. Obviously, the fact that observations were non-instrumental leaves room for error in judgement, but even so the greatest possible margin of error would still result in a quite astonishing lack of strong winds. A partial explanation of this is the site of the base which is well sheltered from westerly winds by the coastal heights of Alexander Island. This effect is well reflected in the wind direction table. Most of the winds came from the north-west sector, blowing through the break in the mountains mentioned earlier. Though this topographic configuration undoubtedly sheltered the base from the influence of the westerlies, the north-south "corridor" between Alexander Island and Graham Land could equally be expected to canalize the northerly and southerly elements in the wind and give a proportionally high level of strong winds from those sectors. But this did not happen. Even in the middle of George VI Sound, where the influence of surface configuration is minimal, evidence of strong winds (in the form of drifting snow) was rare and it is believed that the lack of wind at Fossil Bluff is generally representative of the area. Nevertheless, instrumental observations from various parts of George VI Sound would be of great interest.

Thirdly, apart from the high proportion of excellent visibility which can be seen in Table I, the incidence of "weather" is of interest. During the first four months at Fossil Bluff, the amount of "weather" was astonishingly small. Snowfalls were few and far between, and generally very light. The following was noted in the monthly report for May:

> " . . . Snow fell on 11 days of the month, though with few exceptions, snowfall was light. The snow was dry and loose, and the accumulation on the slopes behind the hut blew away on 4 May, leaving the slopes virtually clear . . .";

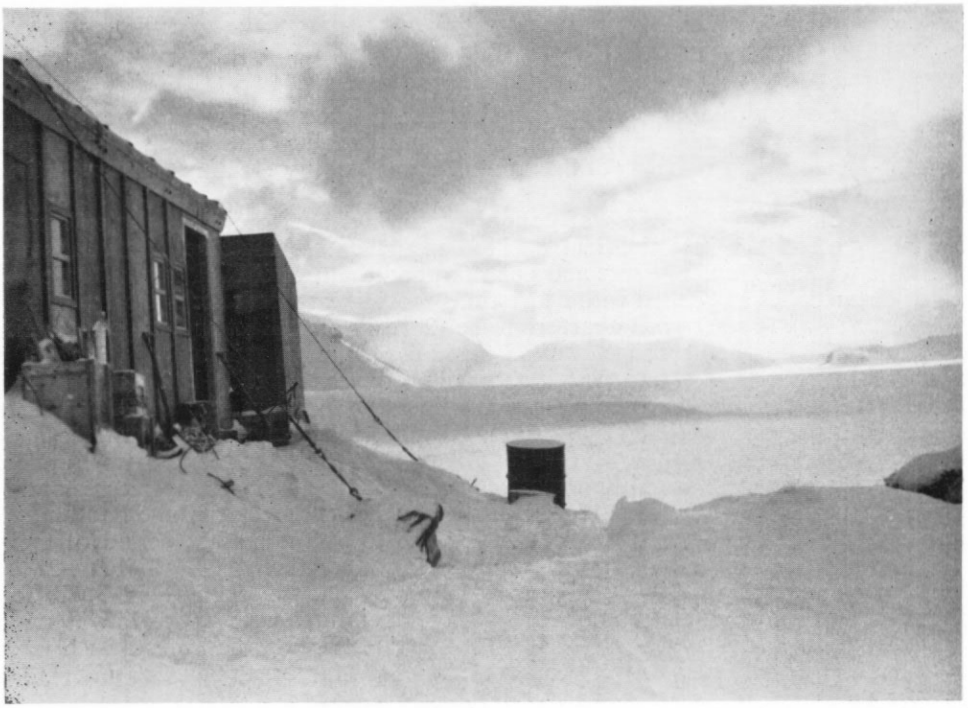

Fig. 3. A temporary clearance during the passage of an eastward-moving depression in September 1961.

Fig. 4. A temporary clearance during the passage of an eastward-moving depression in January 1962.

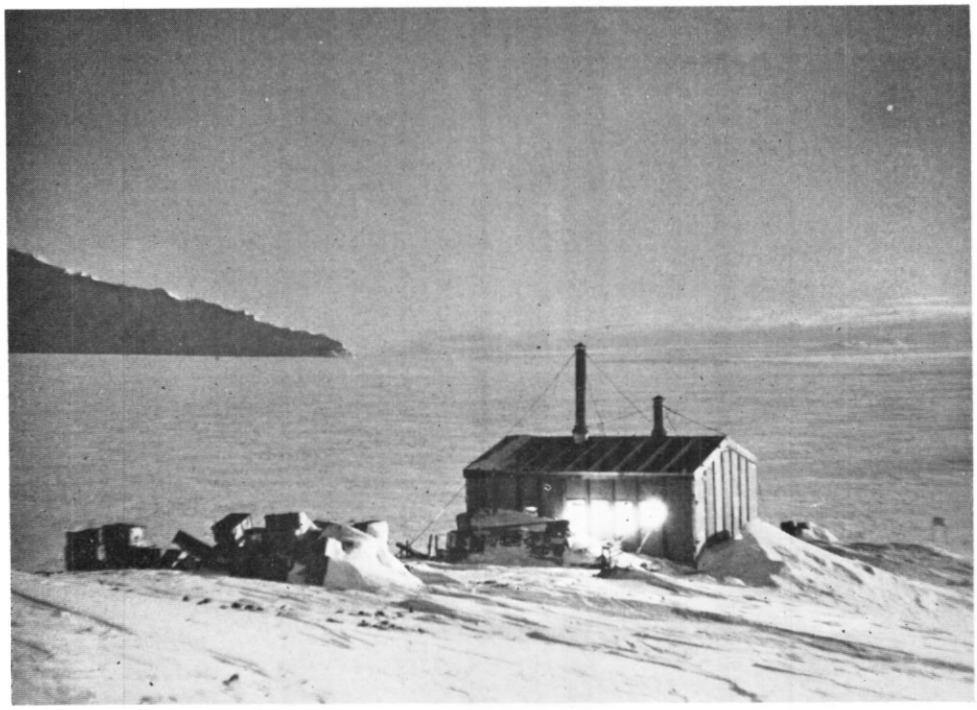

Fig. 5. The hut at Fossil Bluff in the winter of 1961. The meteorological screen is to the right of the hut. Excellent visibility and cloudless skies were a feature of high pressure conditions during the winter. This photograph was taken by moonlight.

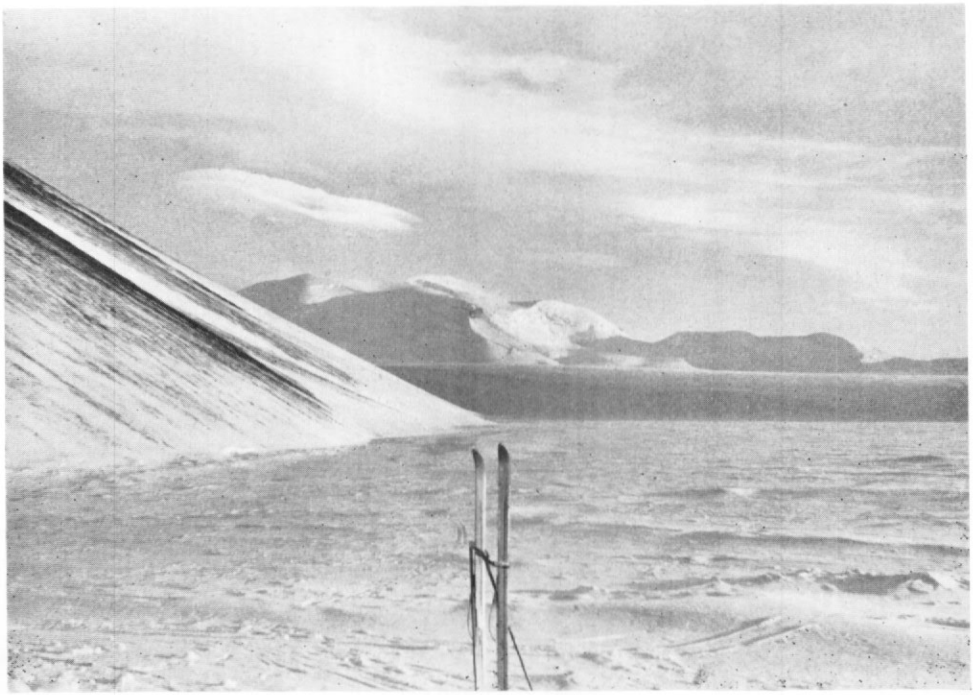

Fig. 6. Orographic cloud over the mountains west of the Eros Glacier in October 1961. The comparative lack of snow can be seen on the scree slopes to the left of the photograph.

and in June:

> " . . . Snowfalls were reported on 11 days, but were generally light. The depth of snow increased considerably, yet on the hillslopes the light nature of the snow caused it to be blown away on 16 June, exposing the upper screes. The depth of snow on exposed parts of the Sound was over 12 in. [30·5 cm.] . . . Drift was reported on six days, but was invariably low and short-lasting. Drums of fuel had drifts and 'wind-scoops' only one-third of their height after standing for four months in the same position."

During the latter months of the winter there was a much greater incidence of snow, some idea of the accumulation being derived from the screen whose accumulation rose from 3 in. (7·6 cm.) for the period from March to 1 August, to 1 ft. 2 in. (35·6 cm.) for the next 23 days up to 23 August. The comparatively low incidence of "drift" was a function of the low winds.

During the spring and summer snow on the hillsides disappeared fairly quickly, many areas of rock being free of snow by mid-October (Fig. 6), and most areas normally free of snow in summer clearing by early December. It would appear that during 1961 the main agent of snow clearance was melting, after an initial period of "sublimation". By the early days of December the melt streams were flowing from the land down on to George VI Sound where a pattern of lakes and streams made travel extremely difficult at the end of the month.

Conclusion

Any account of this kind, based on such a limited period of observations, is liable to considerable errors in interpretation. Another 29 years of observations are required before anything firm about the climate of Fossil Bluff can be stated. However, it seems that the statistics for 1961 suggest that the weather during that year, at least, was considerably more equable than theoretical considerations might indicate. The more pleasant aspects of a base are the ones always remembered, but the statistics seem to back up memories of long periods of gloriously clear, calm and, in the summer, sunny weather which enabled base personnel to sunbathe on occasions at lat. 71°S.

The fact that there was a delay of 27 days in January 1962 for a day on which flying between Fossil Bluff and Marguerite Bay was possible indeed emphasizes the fact that generalizations may be very misleading.

MS. received 11 November 1962