Surface temperature and sea-level pressure at Norway Station and Sanae

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Monthly and annual mean surface temperatures and sea-level pressures for Sanae for the period January 1969 to December 1975 are presented. The main features of the results, considered in conjunction with those obtained at Norway Station and Sanae from 1960 to 1968, are discussed.

Maandelikse en jaarlikse gemiddelde oppervlakte temperature en seevlakdrukke vir Sanae vir die tydperk Januarie 1969 tot Desember 1975 word verstrek. Die belangrikste eienskappe wat blyk uit hierdie data in samehang met die data vir Norway Station en Sanae vanaf 1960 tot 1968 word bespreek.

Data

Monthly mean temperatures and sea-level pressures for Norway Station/Sanae for the period January 1960 to December 1968 have already been published (South African Weather Bureau, 1971). It was pointed out that, owing to the close proximity of the two stations, their data could be treated together. A comprehensive discussion of the climate of Norway Station and Sanae for the 11-year period 1957-1967 was published by Burdecki (1969). However, the temperature and pressure data obtained since 1968 reveal some new features and also support previous conclusions. The monthly and annual means of temperature and pressure for the period 1969-1975 are presented in Tables 1 and 2. Provisional means for January to August 1976 are mentioned in the discussion.

Discussion

Figures 1–4 are based on the observations of the 16-year period January 1960 to December 1975. Figure 1 shows the annual course of the monthly mean temperature. December and January are the mid-summer months with mean temperature about –4 °C, whereas July and August are the mid-winter months with mean temperatures about –28 °C. From January to April, the temperature drops sharply by about 16 °C but then the downward trend decelerates for 2 months before dropping again by 5 °C to the winter minimum.

This anomalous reduction in the downward trend of the temperature during May and June is not peculiar to Sanae alone, but is found at all Antarctic stations, though the further appreciable drop to the July/August minimum might not be as pronounced elsewhere as at Sanae. The relatively small change in mean temperature over Antarctica from April to September has come to be known as the 'coreless winter'.

In individual years the most common event is an appreciable rise of temperature in either May or June. This happened in 9 of the 17 years since 1960 (including 1976). In 6 of the remaining years the temperature remained practically constant for two or three months in succession and then dropped in July, but it was only in 1966, 1971 and 1973 that the phenomenon did not occur.

The deceleration or reversal of the downward temperature trend in May/June requires an explanation in terms of a considerable change in the atmospheric circulation over the Antarctic and southern middle latitudes at this time. It might be due to more frequent incursions of relatively warm subantarctic air masses into Antarctica during May and June, or it might simply be due to the onset of stronger winds which stir the surface layers and destroy the characteristic strong surface-temperature inversion over the ice. Although tentative explanations have been offered for the existence of the Antarctic 'coreless winter', a fully satisfactory answer for the behaviour of the temperature in May and June has not yet been forthcoming.

Figure 2 indicates the annual mean temperatures since 1960. Fluctuations were less than about 2 °C until 1971 when a steady rise from –18,7° to –13,9 °C in 1975 set in. This total rise of 4,8 °C for an annual mean is considerable. Further investigation of this phenomenon should include comparison with the events at other Antarctic stations, as well as with the sea temperature and pack-ice distributions around the continent. The impression is that ice conditions experienced during the voyages of the *RSA* from Cape Town to Sanae during the last several summers were less severe (less ice was encountered) than during the 1960s.

The marked increase of mean temperature since 1971 should be reflected in the trends of the temperatures of corresponding months in successive years. The 12 straight lines fitted through the monthly mean temperatures recorded for each month for the period from January 1971 to August 1976, all show a rising trend, except for April, during which the mean temperature remained roughly constant. It would seem, however, from the provisional mean temperatures reported by radio from Sanae for January to August 1976, that the upward trend will be sharply reversed during this year.*

Figure 3 shows the annual march of monthly mean sea-level pressure. The double oscillation, with highest pressures in January and June and lowest pressures in March and October, is striking. This indicates that the second harmonic of the series is much stronger than the first harmonic. This pattern of behaviour of the pressure in the Antarctic has been known for the past 30 years. The pressure oscillation is concurrent with a northward-southward shift of the circumpolar low-pressure trough, the position of which is at about 65 °S on average. When the pressure rises over Antarctica the trough shifts northward, and vice versa. This double 'breathing' process, which is clearly marked poleward of about 50 °S, also requires an explanation. Part of this unresolved problem is how it is possible for the surface pressure, which is proportional to the total mass above the surface, to be highest in midsummer when temperatures are highest and densities lowest in the troposphere and lower stratosphere. A plausible explanation is that considerable addition of air mass occurs to the upper stratosphere, mesosphere and higher layers over the polar region. In summer the circulation is anticyclonic at these levels, whereas during winter the mass is removed from the core of the strong cyclonic vortex which then comes into existence. This, however, cannot be the entire explanation, because the oscillation is semi-annual.

Figure 4 shows the fluctuation of annual mean pressure from 1960 to 1975. Curve fitting shows a rising trend from 1960 to 1968 and then a gradual falling trend till 1975, the total rise being about 4 mb and the subsequent fall about 2 mb. However, no great significance should be attached to these tendencies reflected from data collected over only a 16-year period.

*The annual mean temperature for 1976 dropped 3,0 °C to –16,9 °C

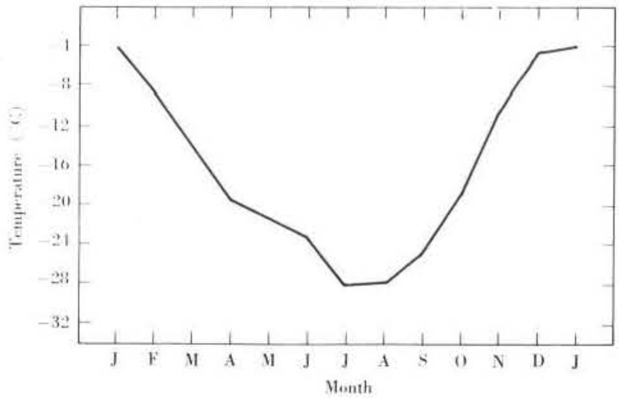

Fig. 1. Monthly mean temperature (°C) at Norway Station/Sanae, 1960–1975.

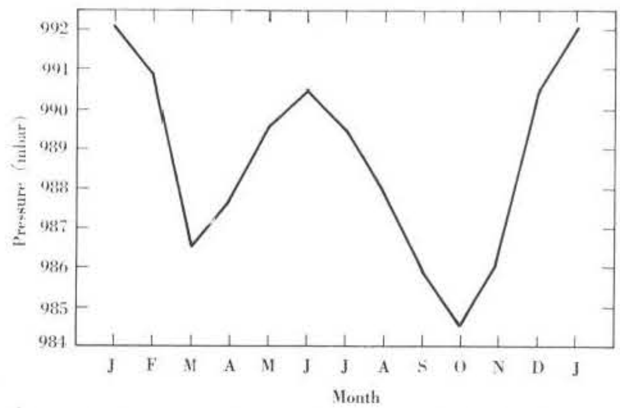

Fig. 3. Monthly mean sea-level pressure (millibars) at Norway Station/Sanae, 1960–1975.

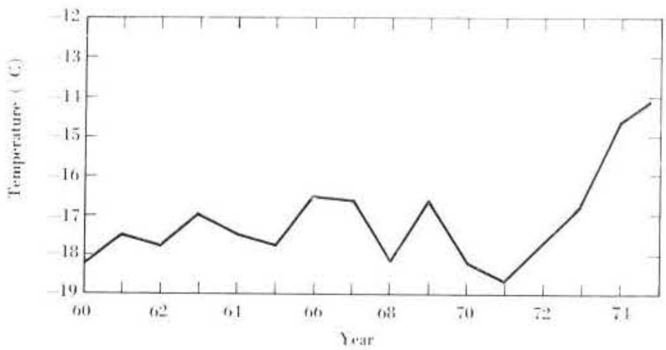

Fig. 2. Annual mean temperature (°C) at Norway Station/Sanae, 1960–1975.

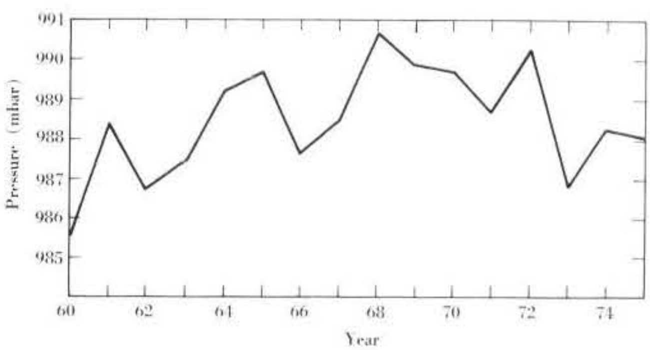

Fig. 4. Annual mean sea-level pressure (millibars) at Norway Station/Sanae, 1960–1975.

Table 1

Monthly mean temperature (°C) at Sanae

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1969	–2,3	–7,9	–13,6	–15,3	–21,9	–16,5	–31,5	–33,3	–27,3	–15,7	–9,0	–4,9	–16,6
1970	–4,9	–10,4	–13,1	–19,0	–25,1	–26,0	–31,7	–31,7	–23,0	–19,4	–10,2	–3,8	–18,2
1971	–2,2	–8,4	–14,5	–20,2	–22,4	–32,6	–30,5	–29,0	–26,3	–18,6	–13,7	–5,7	–18,7
1972	–5,2	–9,8	–16,6	–17,8	–20,4	–22,1	–36,0	–22,4	–25,9	–22,4	–10,4	–4,3	–17,8
1973	–3,2	–9,9	–13,9	–15,9	–18,4	–22,4	–24,7	–33,1	–24,7	–19,7	–9,1	–5,9	–16,7
1974	–4,3	–9,2	–13,3	–18,5	–12,5	–23,5	–22,1	–23,3	–18,7	–18,8	–9,0	–1,6	–14,6
1975	–0,8	–3,6	–6,9	–16,7	–10,5	–23,1	–27,7	–25,1	–21,8	–19,0	–9,5	–2,7	–13,9
Averages													
1969–1975	–3,3	–8,5	–13,1	–17,6	–18,7	–23,7	–29,2	–28,3	–24,0	–19,1	–10,1	–4,1	–16,6
1960–1975	–4,0	–8,7	–14,0	–19,6	–21,1	–23,2	–28,2	–27,8	–24,9	–18,9	–10,3	–4,5	–17,1

Table 2

Monthly mean sea-level pressure (mb) at Sanae.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1969	999,5	993,9	986,9	990,7	990,2	989,9	983,9	987,4	990,4	988,0	985,8	992,2	989,9
1970	987,6	990,6	986,2	989,2	989,4	988,4	989,9	983,5	988,5	990,0	988,9	994,6	989,7
1971	994,4	988,5	983,5	991,3	995,9	988,7	990,3	990,7	983,3	981,2	984,6	991,8	988,7
1972	995,9	991,4	993,5	993,4	988,6	990,8	997,7	989,0	986,1	982,5	983,1	991,4	990,3
1973	994,3	988,5	981,4	983,5	988,7	991,6	980,5	985,3	986,7	988,5	986,9	986,2	986,8
1974	994,4	979,7	982,4	991,1	978,1	992,6	985,5	1002,1	977,0	987,4	993,3	995,7	988,3
1975	991,4	989,3	985,7	983,7	993,6	988,0	998,2	984,0	9828	984,4	986,0	989,6	988,1
Averages													
1969–1975	993,9	988,8	985,7	989,0	989,2	990,0	989,4	988,9	985,0	986,0	986,9	991,6	988,9
1960–1975	992,1	990,9	986,5	987,7	989,6	990,5	989,5	987,9	985,9	984,5	986,2	990,5	988,5

Conclusions

A study of temperature and pressure at Norway Station/Sanae shows several features which are not unique to this part of Antarctica and for which the explanations are not apparent. These are: 1) the deceleration or reversal of the summer to winter rate of drop in temperature during May and/or June; 2) the pronounced semi-annual oscillation of the atmospheric pressure over Antarctica, and 3) the pronounced, sustained rise in annual mean temperature from 1971 to 1975.

These phenomena ought to be studied for the whole of Antarctica and surrounding oceans in order to arrive at a complete description of the events and perhaps to find their explanations as well as the implications for middle and low-latitude weather.

References

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Report on South African participation in cruise MD08 of MS Marion Dufresne, March—April 1976

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Introduction

The Administration of Le Terretoire des Terres Australes et Antarctiques Françaises (TAAF), through SASCAR, invited our participation in their scientific programme during cruise MD08 of the *Marion Dufresne*. The total complement of scientists and technicians was 23, 15 from France, 3 each from South Africa and the United States, and one each from Portugal and Canada. Cruise MD08 lasted from 8 March to 26 April 1976. Details of the course, station locations and local noon positions of the *Marion Dufresne* during the cruise are given in Fig. 1. This report summarises the nature and extent of the South African contribution to the joint research programme, which was an investigation of the fauna around the Crozet Archipelago and the Prince Edward islands, and observations on the distribution and abundance of seabirds in the south-western sector of the Indian Ocean.

Studies of zooplankton and the marine benthos

(J. R. Grindley and T. H. Wooldridge)

Zooplankton samples were collected at 23 stations during MD08, with a 50-cm diameter WP II net hauled vertically from 300 m to the surface at a speed of about one metre per second. At depths of less than 300 m, the hauls were made from about 10 m above the bottom to the surface. Nine samples were taken at stations 1–8 in the southern Indian Ocean between Reunion and the Subtropical Convergence at about 40 °S. These samples are being studied at the Plankton Sorting Centre, Washington, D.C. One sample was collected at station 9, off Possession Island, Crozets, and 13 samples were collected at different stations in the vicinity of the Prince Edward islands. These latter samples, including the Crozet sample for comparison, are being sorted and studied at the University of Cape Town.

In a preliminary examination of the samples taken around Marion and Prince Edward, the following groups were observed: Copepoda (including the Antarctic species *Calanus propinquus*, *Calanoides acutus*, *Rhincalanus gigas* and *Oithona frigida*), copepod nauplius larvae, Ostracoda, Euphausacea (including juvenile stages), polychaete larvae, gasteropod larvae, lamellibranch larvae, diatoms, Radiolaria, Foraminifera, Dinoflagellata, Oikopleura, Chaetognatha, medusae, eggs and algal detritus. Some samples included large amounts of phytoplankton including *Chaetoceros flexuosus*, *C. neg-*