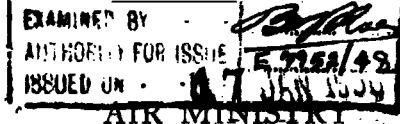


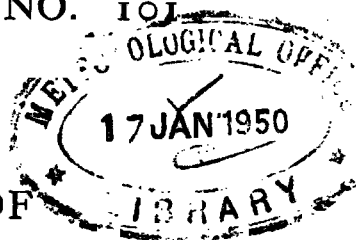
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THE CLIMATES OF
ADDU ATOLL, AGALEGA ISLANDS AND
TRISTAN DA CUNHA

By E. V. NEWNHAM, B.Sc.



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Grateful acknowledgment is due to the Director of the Naval Meteorological Service and to the Royal Air Force for the observations at Addu Atoll, to the Director of the East African Meteorological Service for the observations at Agalega, and to the Director of the South African Air Force Meteorological Service for supplying the meteorological data at Tristan da Cunha.

ADDU ATOLL

The naval record on the island of Gan covers the period September 1942 to March 12, 1945, and the Royal Air Force record the period March 13, 1945 to December 8, 1945.

Addu Atoll, the southernmost of the Maldivé Islands, is more than 500 nautical miles south-westward of Ceylon. All observations were made at a meteorological station a few feet above mean sea level on the north-west side of Gan ($0^{\circ} 41' \text{ S. } 73^{\circ} 10' \text{ E.}$), except from March 13 to May 13, 1945, when they were made at a station—also only a few feet above mean sea level—on Hitadu ($0^{\circ} 38' \text{ S. } 73^{\circ} 07' \text{ E.}$). Gan, the southernmost of the Atoll, is well wooded; it lies on a barrier reef which extends from south-east of Gan for $8\frac{1}{2}$ miles north-north-west to Hitadu. This reef is dry at low tide. The low islets of the atoll are so small that the weather experienced on them differs little from that of the surrounding Indian Ocean, but the heating of the land by day and its cooling by night cause an average diurnal variation of temperature of 10° F. Nocturnal

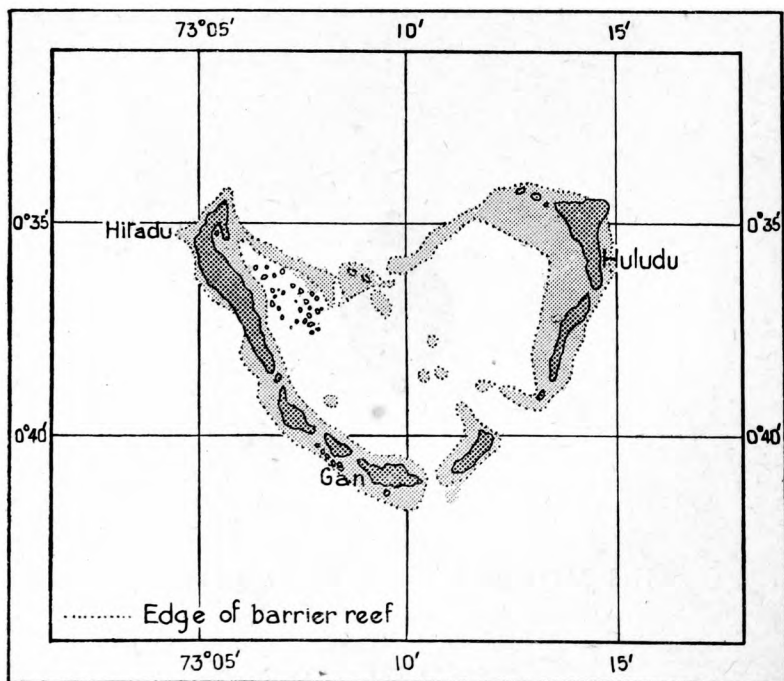


FIG. 1.—ADDU ATOLL

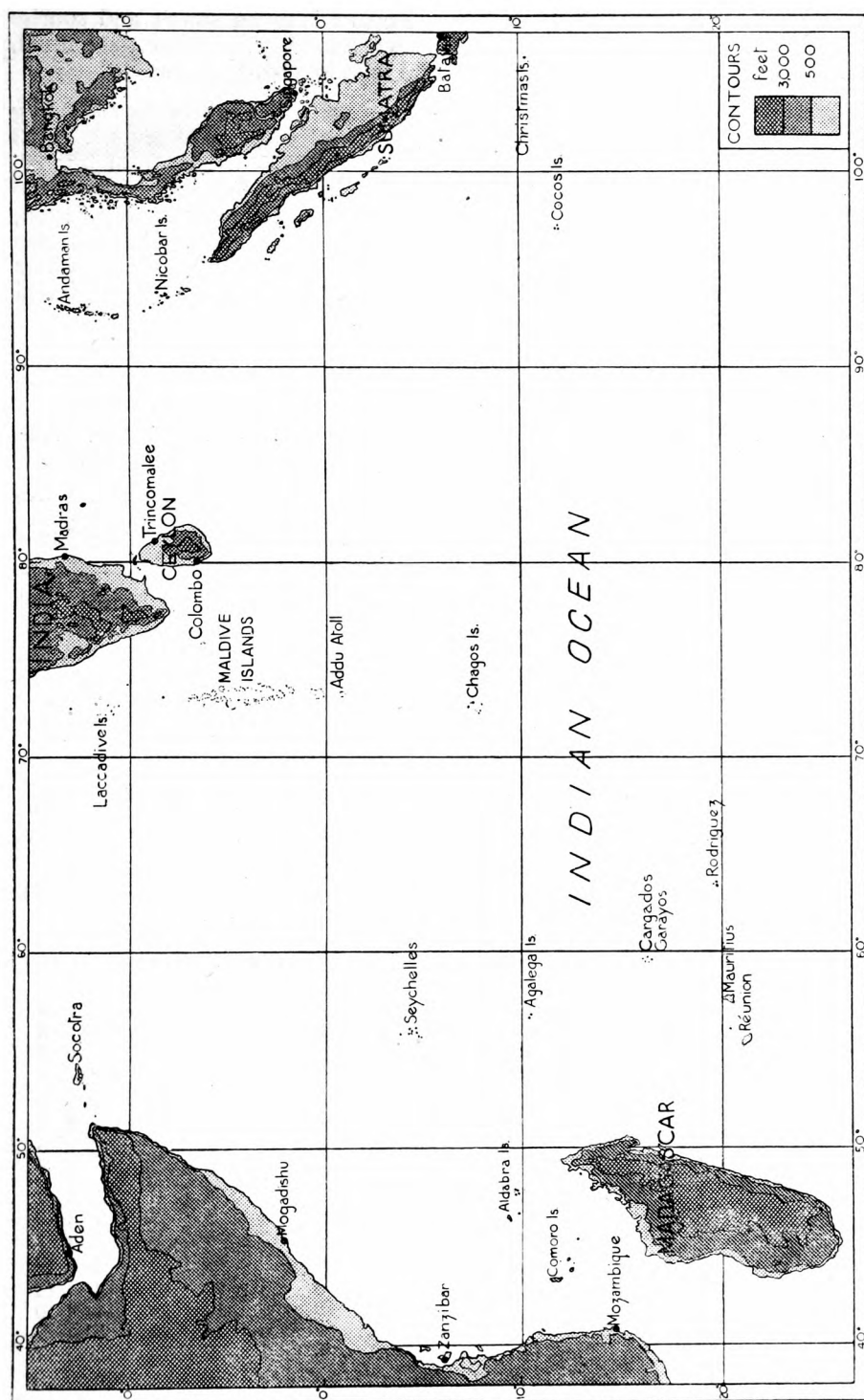


FIG. 2.—INDIAN OCEAN SHOWING THE POSITION OF ADDU ATOLL AND AGALEGA ISLANDS

cooling causes calms to be much more frequent between sunset and sunrise than during the day, and occasionally, when humidity is higher than usual, leads to the formation of a bank of ground mist at about sunrise.

Pressure.—In Table I are monthly means of pressure obtained by averaging the corrected readings of the barometer made at Gan at 2000 I.S.T. (1823 L.M.T.) from September 1, 1942 to July 25, 1944 and an hour later from July 26, 1944 to February 28, 1945. Since these hours fall about half way between the afternoon minimum and the night maximum of the regular diurnal variation, the means should differ little from means for the whole 24 hours. The table also shows means for the neighbourhood of Addu Atoll deduced from the isobars on the "Monthly meteorological charts of the Indian Ocean" which are based on ships' observations over the period 1921-43.

TABLE I—MEAN PRESSURE REDUCED TO M.S.L.

Add 1000 mb. to the figures given

	Jan	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>millibars</i>												
Gan	10.6	09.8	09.6	10.5	08.9	09.3	10.1	10.6	11.0	10.6	10.4	10.6	10.2
Indian Ocean near Gan	10.8	11.0	10.3	09.5	09.2	09.8	10.4	10.9	10.9	11.1	10.6	10.6	10.4

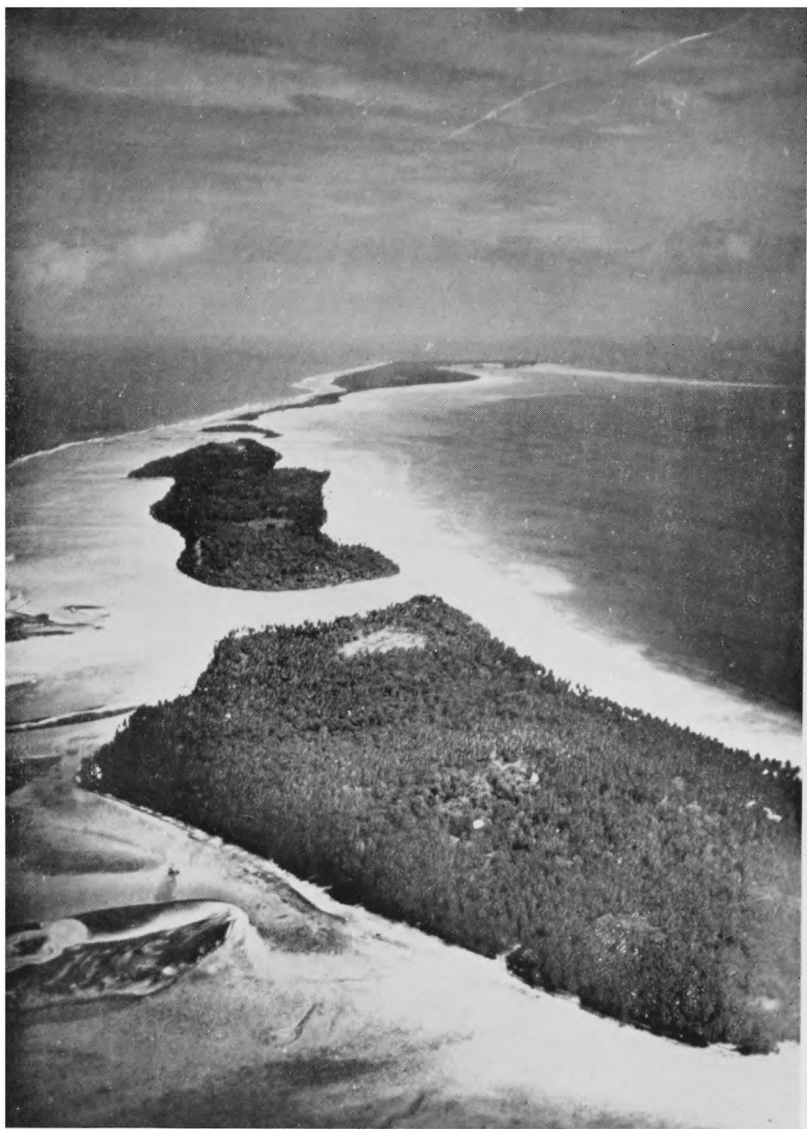
Surface wind.—Ships' observations over a long period of years are summarised in "Monthly meteorological charts of the Indian Ocean" for a 5-degree square north of Addu Atoll (0-5°N., 70-75°E.) and a similar square south of Addu Atoll (0-5°S., 70-75°E.). These summaries show that from December to February over the open ocean north-easterly winds are predominant north of Gan and north-westerlies to the south. Since this is the season when the NE. monsoon prevails around the Indian peninsula, it appears that on Gan the prevalent northerly winds of these months are drawn from the NE. monsoon not yet deviated into the north-westerly to westerly monsoon of the tropical zone between 0° and 10° S. The summaries show further that, after February,

TABLE II—PERCENTAGE FREQUENCY OF WIND DIRECTIONS AT ADDU ATOLL (GAN)

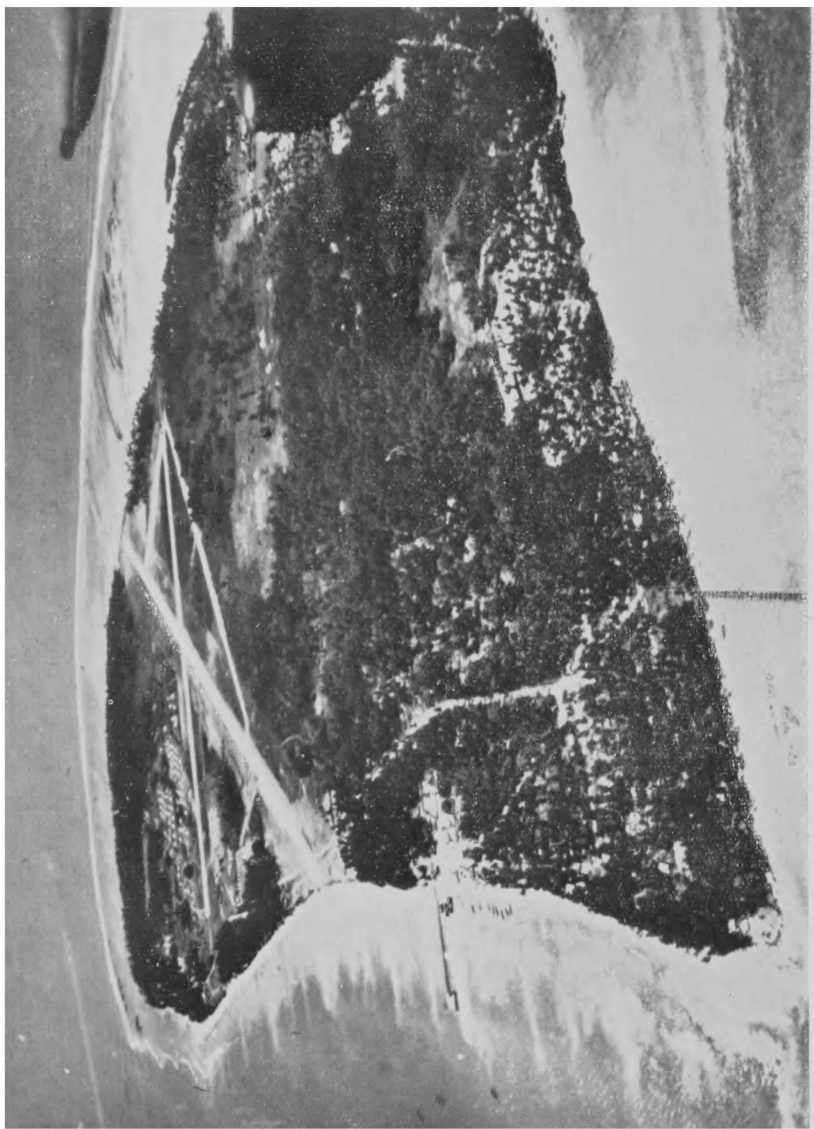
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>per cent.</i>												
N. . .	22	15	6	4	2	1	1	4	0	0	1	9	5
NNE. . .	14	9	4	0	0	0	1	2	0	0	0	5	3
NE. . .	7	6	3	1	1	0	3	2	0	0	0	2	2
ENE. . .	7	1	1	0	0	1	3	1	0	0	0	0	1
E. . .	4	1	3	0	0	1	5	4	0	0	0	1	2
ESE. . .	3	1	3	1	0	3	7	1	0	0	1	1	2
SE. . .	1	0	2	2	1	8	16	4	2	0	0	1	3
SSE. . .	1	1	3	2	5	22	20	7	6	0	0	1	6
S. . .	1	0	3	5	5	16	11	12	20	1	2	2	7
SSW. . .	1	1	3	6	8	10	6	7	16	8	3	2	6
SW. . .	1	1	4	9	11	7	7	4	12	18	9	3	7
WSW. . .	1	3	5	13	20	6	5	8	8	25	16	9	10
W. . .	4	7	10	18	16	6	2	8	14	24	21	18	12
WNW. . .	5	8	14	12	8	5	1	10	9	13	24	11	10
NW. . .	5	15	14	9	9	4	1	7	5	6	10	6	7
NNW. . .	13	17	14	7	6	1	1	3	1	2	4	10	7
Calm . .	10	14	8	11	8	9	10	16	7	3	9	19	10

Period.—September 1942-February 1945.

Times of observation.—0600, 0900, 1200, 1500, 1800, 2000 and 2400 I.S.T.



THE WESTERN SIDE OF ADDU ATOLL LOOKING TOWARDS HITADU



THE ISLAND OF GAN, ADDU ATOLL, LOOKING SOUTH-EASTWARDS

the direction of greatest frequency of wind backs increasingly, being westerly in April, south-westerly in May and southerly from June to September, and that a reversal of these changes then sets in until the northerlies are re-established. The observations of wind direction near ground level are summarised in Table II.

The figures are in general agreement with the ships' observations. Comparisons between the four years showed that there was considerable variation from year to year; the figures also suggest that the northerlies of January and February are steadier than the southerlies of June to September; the latter, especially in 1944, were scattered over a wide range of southerly directions. The southerlies appear, when examined in detail, to be the result of a struggle for mastery between two distinct wind systems—the SE. trades to the south and the SW.-W. winds further to the north.

Upper winds.—In Table III, upper winds measured with the aid of pilot balloons and a single theodolite are tabulated for various heights according to direction and speed. The year has been divided into three periods according to the surface winds; the first period, December to March, is the season when northerly winds occur most often, the second covers the transitional months April, May, October and November, and the third, June to September, is the season when southerlies are most frequent. Below 18,000 ft. there is considerable variation in wind direction, but at 18,000 ft. winds from the south-east and north-east quadrants are the most frequent, although from June to September westerly winds have not decreased in frequency at that level. On 40 per cent. of the 35 occasions when the wind was measured at 26,000 ft. it was from between 90° and 120°, while on 80 per cent. it had a component from east, in agreement with the observed high frequency of westward movement of cirrus clouds.

TABLE III—PERCENTAGE FREQUENCIES OF WIND DIRECTION AT VARIOUS HEIGHTS OVER ADDU ATOLL

When two pilot-balloon ascents were made on one day, only one set of observations was used when compiling this table

Height ft.	No. of obs.	Speed kt.	Direction												Speed 0-5kt.
			30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°	
<i>per cent.</i>															
December-March															
18,000	19	6-15	16	5	5	11	-	-	-	5	-	-	-	-	32
		16-25	-	5	11	-	-	-	-	-	-	-	-	5	
		26-35	-	-	5	-	-	-	-	-	-	-	-	-	
10,000	111	6-15	2	5	4	3	3	2	2	4	9	8	5	2	30
		16-25	1	1	-	-	-	-	-	2	3	6	5	-	
		26-35	-	-	-	-	-	-	-	1	1	1	-	-	
6,500	214	6-15	6	4	1	1	1	3	4	5	10	15	7	5	19
		16-25	2	-	-	-	1	-	-	-	7	5	1	1	
		25-35	-	-	-	-	-	-	-	-	1	1	-	-	
3,000	286	6-15	10	2	2	2	2	1	2	4	13	10	11	9	20
		16-25	1	-	-	-	-	-	-	-	3	3	2	3	
1,500	300	6-15	9	3	3	2	1	1	1	3	12	9	13	11	20
		16-25	3	-	-	-	-	-	-	1	2	1	2	3	

TABLE III—*continued*

Height ft.	No. of obs.	Speed	Direction												Speed -5 kt.
			30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°	
per cent.															
April, May, October, November															
18,000	42	6-15 16-25	2 2	7 2	10 —	10 —	5 —	2 —	— —	5 2	5 5	— —	— —	5 —	38
10,000	132	6-15 16-15 26-35	— — —	1 1 —	1 — —	1 — —	6 — —	3 — —	5 — —	8 1 —	11 2 —	12 10 2	8 4 1	2 — —	20
6,500	232	6-15 16-25 26-35	1 — —	— — —	— — —	1 — —	— — —	4 — —	5 — —	9 8 1	13 15 5	10 8 2	2 — —	— — —	16
3,000	303	6-15 16-25 26-35	— — —	— — —	— — —	— — —	2 — —	2 — —	8 2 —	12 7 1	17 6 4	6 6 2	2 1 —	— — —	12
1,500	314	6-15 16-25 26-35	— — —	— — —	— — —	— — —	2 — —	2 — —	12 1 —	15 6 1	17 10 2	6 6 —	3 2 —	— — —	15
June-September															
18,000	50	6-15 16-25 26-35	2 — —	4 — —	10 2 —	8 — —	6 — —	4 — —	4 2 —	12 2 —	2 10 2	6 2 —	— — —	4 2 —	16
10,000	187	6-15 16-25 26-35 36-45	2 — — —	1 — — —	1 — — —	1 — — —	2 1 — —	3 2 — —	7 1 — —	8 3 1 —	16 7 3 —	5 4 3 2	5 2 3 —	1 — — —	19
6,500	292	6-15 16-25 26-35	1 1 —	— — —	1 — —	1 — —	2 — —	3 — —	7 1 —	5 4 —	13 11 3	13 5 4	6 2 —	1 1 —	16
3,000	358	6-15 16-25	1 —	2 —	1 —	5 1	4 2	5 —	6 1	10 1	13 7	9 4	3 1	1 —	23
1,500	363	6-15 16-25	1 —	1 —	4 —	3 —	7 3	8 1	11 1	9 1	10 2	7 2	3 1	— —	25

Period.—September 1942–December 1945.

Temperature and humidity.—Addu Atoll is so far from any extensive land mass that temperature and humidity are controlled largely by the warm waters of the Indian Ocean and are both high. The means in Table IV are for 2 or 3 years, except maximum temperatures for March and May which are the means for 1944 only. The outstanding feature of this table is the small annual variation of all the elements. Relative humidity seldom approaches saturation or falls to 60 per cent.

TABLE IV—MEAN TEMPERATURES AND HUMIDITY AT ADDU ATOLL

Means	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<i>degrees Fahrenheit</i>													
Temperature													
Maximum	86	87	87	88	88	87	88	86	86	87	86	86	87
Minimum	77	77	77	78	78	77	77	76	76	76	76	75	77
‡ Max. + min.	81	82	82	83	83	82	82	81	81	81	81	81	82
Dry bulb*	79	80	81	81	82	81	81	80	80	80	80	80	80
Wet bulb*	75	76	75	76	77	77	76	76	76	75	75	76	76
<i>per cent.</i>													
Relative humidity*	83	80	77	78	80	81	80	82	82	81	83	83	81

* Mean of 0900 and 2100 i.s.t., subtract 1 hr. 37 min. to get L.M.T.

Cloud.—It is very unusual for the sky in this region to be either overcast or completely free from cloud for 24 hours or more at a time. The monthly and annual means of cloud amount (3–4 years' observations) and the mean numbers of clear and overcast days (3 years' observations) are shown in Table V. A clear day is taken as one with mean cloud amount at 0900, 1200 and 1800 I.S.T. less than 2 tenths and an overcast day as one with mean amount at these hours more than 8 tenths. The cloud amounts in the first row are the means for 0900 and 2100 I.S.T.

TABLE V—MEAN CLOUD CONDITIONS AT ADDU ATOLL

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean cloud amount ..	<i>tenths</i>												
	6.6	6.1	5.0	6.3	7.1	7.6	7.7	7.8	7.6	7.0	6.0	6.2	7.2
	<i>days</i>												
Clear ..	0	1	2	1	0	0	0	0	0	1	1	0	6
Overcast ..	12	9	7	8	13	19	17	17	17	13	9	9	150

These figures show an appreciable annual variation, the cloudiest season (mean 7.5) being May to October, and the least cloud November to April (mean 6.2). In the cloudiest season overcast days average 16 per month, in the least cloudy season 9. Monthly means of cloud amount ranged from 5.5 in May 1945 to 8.6 in September 1944. Much of the cloud is of a convectional type, varying from fair-weather cumulus to massive cumulonimbus, and generally undergoing frequent changes in the course of the day. During the rainier periods there is often a background of altostratus or cirrostratus.

Rainfall.—The occasions when rain fell practically continuously for eight hours or more were very infrequent, and a large proportion of the annual total is derived from heavy showers. These are often accompanied by thunder, and seldom last for more than an hour or two.

Analysis of rainfall during the period March 1944 to February 1945 showed that with westerly winds the average daily fall was 0.28 in., with northerly winds 0.22 in., and with south-easterly winds only 0.11 in. Rainfall of 0.04 in. or more was recorded on about 1 day in 2 with the westerly winds, but only on 1 day in 4 with the south-easterlies.

Monthly totals for the 13 months beginning with February 1944 are given in Table VI.

TABLE VI—MONTHLY RAINFALL AT ADDU ATOLL

	1944												1945	
	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		Jan.	Feb.
Total rainfall	<i>inches</i>													
	2.3	12.8	3.9	6.5	10.9	4.8	6.5	8.4	13.0	8.4	6.8		11.5	0.2
Days with 0.4 in. or more ..	<i>days</i>													
	7	14	12	15	14	10	18	14	20	14	13		8	3

There is nothing in these figures to suggest the occurrence of a well defined rainy season analagous to that of the SW. monsoon of India.

Visibility.—Reference has already been made to the occasional formation of a bank of mist over Gan in the early morning after a calm and cloudless night. Apart from this, visibility is nearly always good, very good or excellent, except when rain is falling. Rain often reduces visibility to about a mile, and occasionally, as on May 9, 1943, to 100 yd. There is a slight difference in average visibility with different wind directions, as can be seen in Table VII, which is based on observations made at 1500 I.S.T. during 1944.

TABLE VII—VARIATION OF VISIBILITY WITH WIND DIRECTION
AT ADDU ATOLL

Wind direction	Range of Visibility				
	Poor ($1\frac{1}{2}$ – $2\frac{1}{2}$ mi.)	Moderate ($2\frac{1}{2}$ – $6\frac{1}{2}$ mi.)	Good ($6\frac{1}{2}$ – $12\frac{1}{2}$ mi.)	Very good ($12\frac{1}{2}$ –31 mi.)	Excellent (over 31 mi.)
	<i>per cent.</i>				
NW.–NE.	4.5	4.5	14.6	43.8	32.6
E.–S.	0	0	23.6	36.4	40.0
SW.–NW.	3.0	9.7	34.8	35.4	17.1

The greatest contrast, which is that between the figures for south-easterly and westerly winds, is clearly due to the greater frequency of rain with westerly winds.

Squalls.—At Addu Atoll strong winds or gales appear to be rare and to affect only a small area at a given moment, since they are generally part of convectional disturbances such as thunderstorms, although westerly winds during a wet spell sometimes blow rather strongly for a day or two and may be accompanied by squalls that are not unlike the line-squalls of temperate latitudes. The rare phenomenon of a sustained gale was observed on July 18, 1944. On the previous day there had been easterly winds, which freshened in the afternoon but died down towards midnight. At about 0230 I.S.T. a strong gale sprang up from NW., with heavy rain, and blew with an average speed of about 45 kt, reaching about 60 kt. in gusts. The gale continued for more than an hour, but then died down, and it was calm by 0530 I.S.T. These changes do not appear to have been accompanied by any disturbance of the normal daily changes of pressure.

On October 8, 1943, an exceptionally violent wind occurred at Hitadu, several miles away to the north-west, which removed the roof of the signal station there. A large cumulonimbus cloud could be seen in that direction from Gan, and it seems likely that the wind was associated with a thunderstorm.

There were a good many wet spells, with fairly frequent thunderstorms, these storms coming generally from some westerly point, and during such spells the wind speed sometimes rose to 20 or even 30 kt. in squalls.

Waterspouts.—Waterspouts and dust devils are by no means uncommon at Gan. They were observed repeatedly between February 10 and April 20, 1943, generally depending from the side of a cumulonimbus cloud. The most common time for their development was in the late afternoon, when convectional clouds were reaching their greatest development, especially when the wind was light and variable. The circulation in all these whirls was counter-clockwise.

AGALEGA ISLANDS

These two small islands (about $10^{\circ} 30' S.$ $56^{\circ} 40' E.$) are low-lying and well wooded. They are more than 400 miles east-north-east of the northern end of Madagascar, the nearest land (see Fig. 2), and their climate differs little from that of the surrounding Indian Ocean except that there is a small diurnal variation of temperature, humidity and wind.

Surface wind.—Ships' observations over a long period of years, which are summarised in "Monthly meteorological charts of the Indian Ocean" are not very numerous in this part of the Indian Ocean. They show that the SE. trade wind prevails over the open ocean around the Agalega Islands from April to December, while from January to March wind direction is more variable, the resultant wind in January being north-westerly and in February and March northerly. Percentage frequencies of wind directions for the islands for the two years 1945-46 are given in Table VIII. The figures are in fair agreement with the ships' observations except that during March in these two years there were nearly twice as many winds from between S. and E. as from between N. and W. from which it may be concluded that in one or both years the SE. trade wind was established earlier than usual. It will be seen that 97 per cent. or more of the winds in every month from June to October were from some point between S. and E.

TABLE VIII—PERCENTAGE FREQUENCIES OF WIND DIRECTION AT AGALEGA

			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
			<i>per cent.</i>											
Calm	..	..	10	11	6	7	2	3	0	3	0	0	6	16
N.	..	..	16	16	2	5	2	0	3	0	0	0	2	8
NE.	..	..	11	2	7	5	0	0	0	0	0	0	3	5
E.	..	..	8	0	24	10	22	5	11	10	0	11	17	19
SE.	..	..	13	2	19	38	45	57	60	73	72	76	53	31
S.	..	..	6	2	11	18	27	35	26	14	28	11	13	6
SW.	..	..	2	16	5	5	2	0	0	0	0	2	2	7
W.	..	..	10	32	7	5	0	0	0	0	0	0	2	5
NW.	..	..	24	19	19	7	0	0	0	0	0	0	2	3

Period.—1945-46.

Time of observation.—0530 G.M.T. (0917 L.M.T.).

The frequency of winds of different strengths on the Beaufort scale are shown in Table IX for the period January to March (3 years' observations) and April to December (2 years' observations).

TABLE IX—PERCENTAGE FREQUENCIES OF WIND FORCE AT AGALEGA

	Beaufort force										
	0	1	2	3	4	5	6	7	8	Period	
	<i>per cent.</i>										
January-March	18.7	19.5	21.4	26.4	10.2	3.7	0.1	—	—	1945-47	
April-December	6.5	9.7	15.2	35.0	21.8	10.1	1.3	0.2	0.2	1945-46	

Times of observations.—0230, 0530, 1130 G.M.T. (0617, 0917, 1517 L.M.T.).

The figures show that the trade winds are decidedly stronger than the variable winds of January to March, which reached force 6 on only one day (February 27, 1946) the wind at the time being NW. During the trade-wind season force 8

was reached on two days (November 23, 1945 and December 10, 1945) and force 7 on four days (May 18, 1946, September 18 and 19, 1946, and December 30, 1946). Force 6 was recorded on 18 days, the earliest date being May 18 and the latest, December 10. The direction was easterly or south-easterly on all these occasions of force 6 or over except on December 10, 1945, when it was north-westerly. The division of the year into two seasons adopted in Table IX gives a misleading impression of the seasonal variation of calms. Although December falls within the season of low frequency of calms, the percentage for the three hours of observation was as high as 24 in that month. In March the percentage of calms (21) was slightly higher than in January or February. December and March, with only slightly more trade winds than other winds, may be regarded as transitional months, and it is interesting that at Christmas Island, in the same latitude but on the far side of the Indian Ocean, a high frequency of calms is also characteristic of both the early and late stages of the SE. trade wind. At Christmas Island also, the frequency of calms then differs little from what it is during the NW. monsoon, while it is much greater than the frequency at the height of the trade-wind season.

Temperature and humidity.—These islands are so far from any considerable land mass that temperature and relative humidity must of necessity be controlled by the warm waters of the Indian Ocean, and therefore always be high. This is clearly shown in Table X.

TABLE X—MEAN TEMPERATURES AND HUMIDITY AT AGALEGA

Means	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>degrees Fahrenheit</i>												
Temperature													
Maximum	86	87	87	87	85	84	83	83	83	84	86	87	85.1
Minimum	77	77	77	77	77	75	75	73	73	75	76	76	75.6
Dry bulb	83	83	84	84	83	80	79	79	79	81	82	83	81.7
Wet bulb	78	78	79	79	78	75	75	74	73	75	77	78	76.6
Relative humidity	<i>per cent.</i>												
	83	84	81	82	81	81	81	79	75	77	79	80	80.3

Period.—January 1945–March 1947.

Time of observation.—0530 G.M.T. (0917 L.M.T.).

The small annual variation of temperature and relative humidity, with its minimum in September, is the counterpart of the annual variation of mean sea temperature; the mean temperatures of 82° F. in March and 78° F. in September agree with the average sea temperatures for those months derived from ships' observations.

Cloud.—In Table XI the mean monthly and annual cloud amounts derived from observations at 0230, 0530 and 1130 G.M.T. (0617, 0917 and 1517 L.M.T.) are given together with the percentage number of clear and overcast days. A clear day is defined as one with mean cloud amount at these three times less than 2 tenths and an overcast day as one with more than 8 tenths.

TABLE XI—MEAN CLOUD CONDITIONS AT AGALEGA

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>tenths</i>												
Mean cloud amount ..	7.7	7.7	6.8	7.0	5.9	6.7	7.6	6.9	6.6	6.7	7.0	7.3	7.0
	<i>per cent.</i>												
Clear days ..	2	—	1	—	—	—	—	—	—	—	1	1	0.6
Overcast days	54	49	30	32	11	25	47	26	32	27	33	36	35

Period.—January 1945–March 1947.

The mean cloud amount for the period January to March was 7·4 tenths and for the trade-wind period, April to December, 6·8 tenths. It is a curious fact that no clear days occurred during the months when the trade wind was most persistent, *i.e.* May to October, although the mean cloud amount was then 6·7 tenths, and therefore below the yearly average, but only during the period November to March when the mean cloud amount was 7·3 tenths, and therefore above the annual average. There were five clear days and these were either calm or days of light southerly to westerly breezes.

The percentage frequencies of different cloud amounts are shown in Table XII.

TABLE XII—PERCENTAGE FREQUENCIES OF DIFFERENT CLOUD AMOUNTS AT AGALEGA

	Cloud amount (tenths)									
	0	1	2	3	4	5	6	7	8	9 10
January–March	0	1	2	6	5	7	13	10	12	24 20
April–December	0	2	2	7	10	10	13	9	11	20 16

It will be seen that, although amounts less than 6 tenths are more frequent in the trade-wind season than during the NW. monsoon, in both seasons the most frequent amount is 9 tenths, and a cloudless sky is very unusual (two instances only out of the 2,460 observations on which the percentages are based).

Rainfall.—Monthly totals of rainfall, rain days (0·01 in. or more) and days of considerable rainfall (0·4 in. or more) are shown in Table XIII.

TABLE XIII—MONTHLY RAINFALL AT AGALEGA

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Rainfall totals (inches)													
1945	4·86	5·51	5·96	6·42	15·29	4·45	7·96	3·98	2·28	6·29	7·57	11·23	81·89
1946	6·01	15·85	5·01	7·31	11·07	13·30	9·36	2·44	1·35	2·12	6·41	8·82	89·05
1947	6·76	8·97	3·53	—	—	—	—	—	—	—	—	—	—
Days with 0·01 in. or more													
1945	22	21	20	27	20	23	27	19	16	21	24	22	262
1946	19	21	13	20	23	26	27	25	18	18	17	20	247
1947	27	22	13	—	—	—	—	—	—	—	—	—	—
Days with 0·4 in. or more													
1945	2	6	3	6	6	3	7	3	2	6	7	8	59
1946	6	12	3	5	7	8	5	0	1	0	6	8	61
1947	4	5	2	—	—	—	—	—	—	—	—	—	—

Although the period covered is too short to give reliable monthly averages, it will be seen that the rainfall totals for August, September and October are all below the general monthly average of about 7 in., and it appears very probable that these months form a relatively dry season, which corresponds roughly with the season of lowest temperature and humidity. It may be noted that at Christmas Island, in the same latitude but on the far side of the Indian Ocean, these months are also the driest, although on that island there is a far bigger seasonal variation of rainfall. It is the exception on the Agalega Islands for a month not to contain at least one day with a fall of more than 1 in., and

there were several days both in 1945 and 1946 with considerably more than 2 in. The largest daily falls were 6·75 in. on May 20, 1945, 4·85 in. on July 3, 1946, and 3·50 in. on May 13, 1945. On May 18, 1946 the total was 2·90 in., and during the three days, May 18–20, 1946, 5·55 in. fell altogether.

Ships' observations show that an area of rather high frequency of thunderstorms is centred between Madagascar and the African coast from December to April, and that the Agalega Islands are on the eastern edge of this area. This is consistent with the fact that thunderstorms were fairly frequent on the islands from November to April, being observed on 7 days in February, while none were recorded from May to October.

There was not much difference between the average daily rainfalls with different wind directions. South-easterly winds were slightly the driest, with 0·23 in. per day, and 75 per cent. rain days (0·01 in. or more). For northerly winds the corresponding figures were 0·26 in. per day and 69 per cent. rain days; and for westerly winds 0·29 in. per day and 73 per cent. rain days.

Visibility.—Visibility is remarkably good on the whole, the percentage of occasions with different visibilities being as follows:—

TABLE XIV—PERCENTAGE FREQUENCIES OF DIFFERENT VISIBILITIES
AT AGALEGA

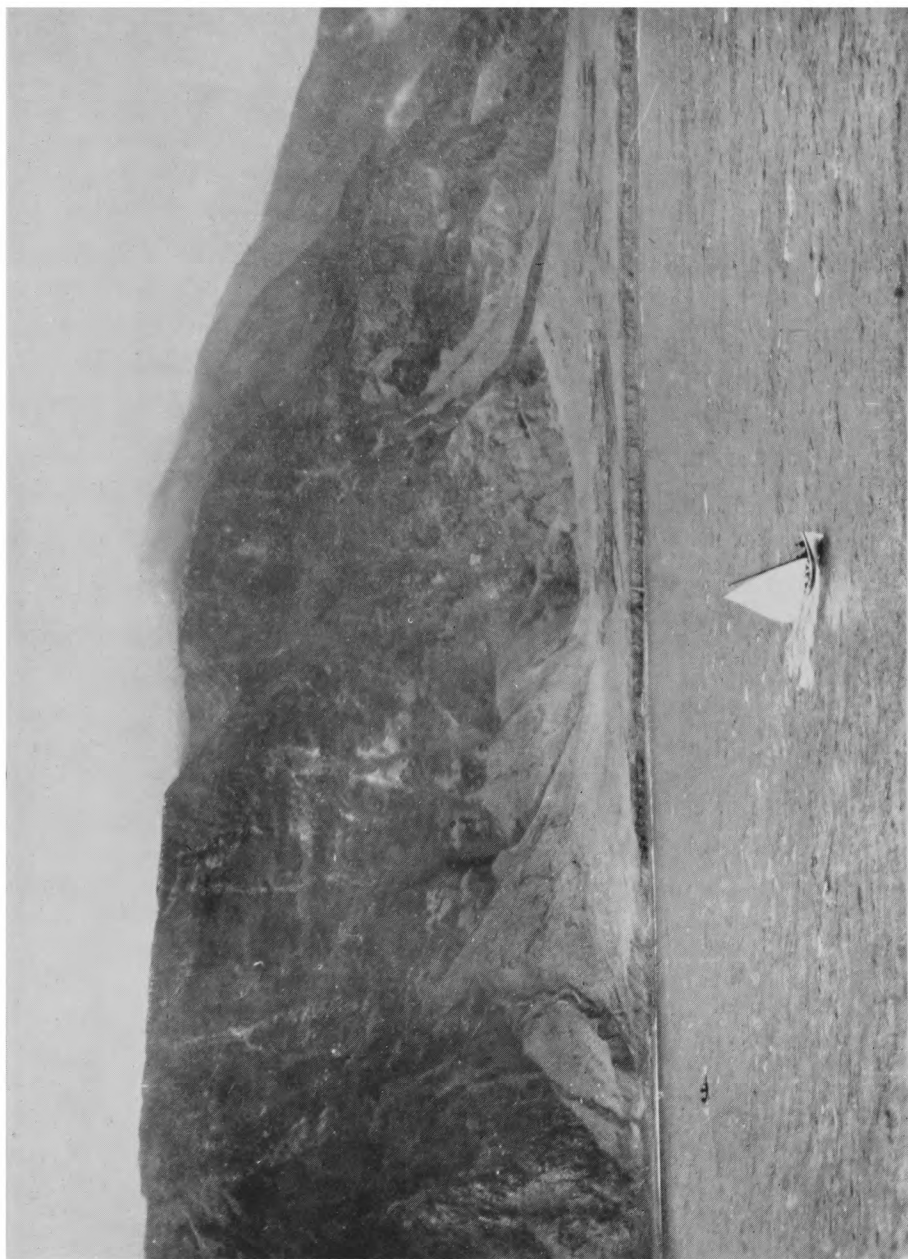
Range and Visibility					
1,100 yd.–1¼ mi.	1¼–2½ mi.	2½–6¼ mi.	6¼–12½ mi.	12½–31 mi.	over 31 mi.
<i>per cent.</i>					
0·5	0·3	2·6	10·6	36·8	49·2

Time of observation.—0530 G.M.T. (0917 L.M.T.).

When visibility is less than 6¼ miles, this is nearly always due to rain, fog being virtually unknown. In general there is practically no connexion between visibility and wind direction. The frequency of visibility 31 miles was, however, about 5 per cent. greater and that of visibility 6¼ miles about 5 per cent. less than in the above table with winds from between SW. and NW. The seven occasions of visibility less than 2½ miles were all with winds from between S. and E.



AGALEGA ISLANDS



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TRISTAN DA CUNHA SHOWING THE SETTLEMENT FROM THE NORTH

TRISTAN DA CUNHA

This lonely island, which has an area of about 45 square miles, lies in the South Atlantic in $37^{\circ} 03' \text{ S. } 12^{\circ} 19' \text{ W.}$ It is about 1,600 nautical miles west-south-west of Cape Town. The island is of volcanic origin and has the form of a truncated cone, the sides rising at about an angle of 45° to a central peak nearly 7,000 ft. high. Except near the summit, where there is bare rock, often snow covered, the land is clothed with brushwood intermixed with ferns and tall tussock grass. The coast mostly consists of nearly vertical cliffs, 1,000–2,000 ft. high, which rise directly from the sea, but in the north-west there is a grassy plateau 100–200 ft. high and about half-a-mile wide. The meteorological station, which has been in operation since May 1942, is situated near the seaward edge of this plateau. Three quarters of a mile away to the south-east there are cliffs, 2,000 ft. high.

The following climatic summary covers the period from May 1942 to August 1944. The observations show that the climate is mild, cloudy, damp and very equable, with an annual rainfall of about 60 in. Ships' observations show a high frequency of westerly and north-westerly winds over the neighbouring ocean, with frequent gales, especially in winter, but the exposure of the meteorological station causes local distortion of these winds to such an extent that SW. winds were more frequent than NW. winds during the period under review. Comparing the climate of Tristan da Cunha with that of south-east England, Tristan da Cunha has twice as much rain and many more gales, a winter no colder than early autumn in England, and about the same average summer temperature as England but with no very hot days.

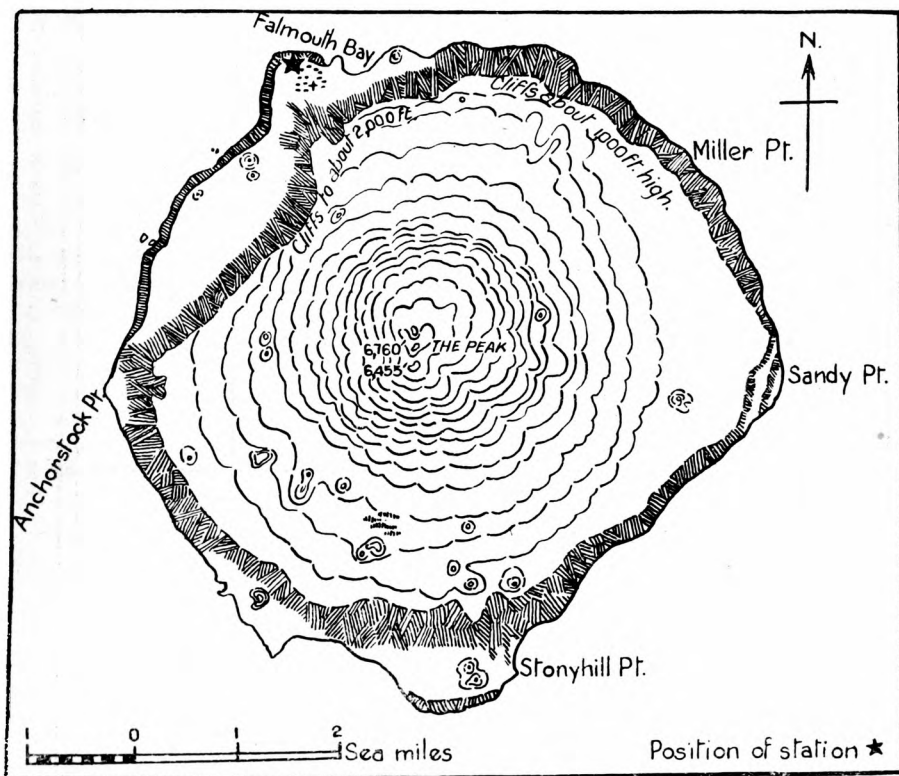


FIG. 3.—TRISTAN DA CUNHA

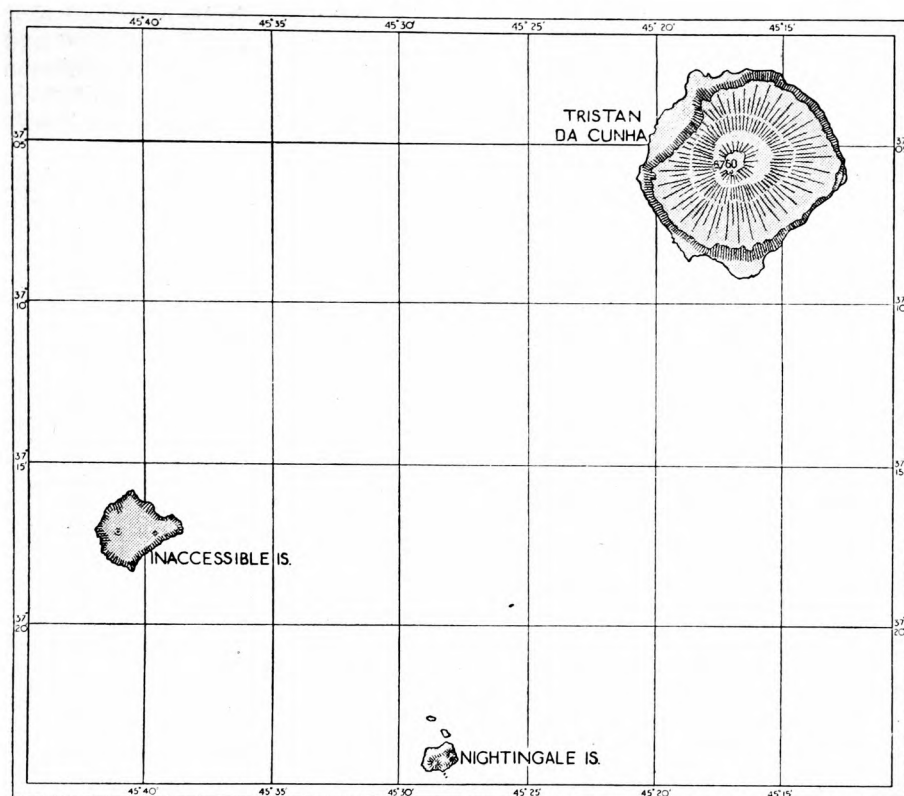


FIG. 5.—ISLANDS OF THE TRISTAN DA CUNHA GROUP

Pressure.—Tristan da Cunha lies to the south of the high-pressure belt of the South Atlantic; the axis of this belt is in about latitude 26° S. in July, and swings southwards with the sun to about 30° S. in January, but although this movement brings it to within 7° of the island it does not result in a maximum of pressure on the island in January because the belt is then less well developed (highest readings about 1021 mb. compared with about 1026 mb. in July). For the period May 1942 to August 1944, the month with highest monthly mean pressure was August (1021.5 mb.) and the month with lowest mean pressure May (1016.2 mb.). For the very much longer period covered by ships' observations the month with lowest mean pressure in this part of the Atlantic was also May (mean 1013.5 mb.) while in each of the four winter and spring months, July to October, the mean was about 1019 mb.

Day-to-day variations are greatest in winter, when a change of 10–20 mb. in 24 hours is not uncommon. The mean range of variation in each month is given in Table XV.

TABLE XV—MEAN MONTHLY RANGE OF PRESSURE AT TRISTAN DA CUNHA

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<i>millibars</i>											
25	24	30	32	31	36	41	44	37	35	34	26

The highest pressure for the whole period was 1042.2 mb. at 2100 on August 2, 1942, and the lowest 986.3 mb. at 1700 on July 15, 1943.

The diurnal variation is well shown in every month by the figures in Table XVI. For the whole year the maxima are at 0900–1000 and 2200 and the minima at 0400–0500 and 1500, but the time of the afternoon minimum shifts gradually in the course of the year from 1400 in May and June to 1700 in January and back again. The difference between the highest and lowest hourly means averages 1·4 mb.

TABLE XVI—HOURLY AVERAGES OF PRESSURE, REDUCED TO M.S.L. AND CORRECTED FOR NON-CYCLICAL CHANGE AT TRISTAN DA CUNHA

Add 1000 mb to the figures given

Time	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<i>Z + 1*</i>	<i>millibars</i>												
0000	17·6	17·8	18·4	17·2	16·7	17·3	18·1	21·7	19·8	18·4	18·2	18·9	18·3
0100	17·1	17·5	18·2	17·2	16·4	17·1	17·8	21·4	19·6	18·2	17·6	19·0	18·1
0200	16·7	17·7	18·1	17·0	16·2	17·0	17·6	21·2	19·2	17·8	17·4	18·7	17·9
0300	16·4	16·9	17·8	16·6	16·1	16·8	17·4	20·9	19·0	17·6	17·0	18·3	17·6
0400	16·4	16·9	17·7	16·3	15·7	16·6	17·3	20·8	18·9	17·3	16·8	18·3	17·4
0500	16·6	16·9	17·6	16·3	15·7	16·5	17·2	20·8	19·0	17·3	17·0	18·5	17·5
0600	16·7	17·1	17·5	16·4	15·8	16·6	17·3	21·0	19·2	17·5	17·3	18·6	17·6
0700	17·0	17·3	17·9	16·5	16·0	16·8	17·4	21·4	19·5	17·9	17·6	18·9	17·9
0800	17·3	17·5	18·2	16·9	16·4	17·1	17·7	21·9	19·9	18·0	17·8	19·0	18·1
0900	17·3	17·5	18·3	17·2	16·6	17·4	17·9	22·1	20·0	18·1	17·7	18·9	18·3
1000	17·4	17·6	18·5	17·2	16·7	17·7	18·1	22·2	20·0	18·1	17·7	18·9	18·3
1100	17·5	17·6	18·3	17·1	16·6	17·5	18·1	22·1	19·7	17·9	17·6	18·9	18·2
1200	17·4	17·4	18·1	16·9	16·2	17·0	17·6	21·6	19·3	17·8	17·5	18·8	18·0
1300	17·3	17·3	17·9	16·3	15·8	16·6	17·2	21·1	18·9	17·7	17·3	18·5	17·7
1400	17·2	17·1	17·7	16·2	15·7	16·4	16·9	21·0	18·7	17·5	17·3	18·3	17·5
1500	17·1	16·9	17·5	16·3	15·8	16·5	16·9	20·9	18·6	17·4	17·3	18·3	17·5
1600	16·9	16·9	17·5	16·3	15·9	16·6	17·0	21·0	18·7	17·4	17·1	18·2	17·5
1700	16·9	16·9	17·5	16·4	16·0	16·8	17·2	21·2	18·9	17·7	17·2	18·2	17·6
1800	16·9	17·0	17·7	16·5	16·3	17·0	17·4	21·4	19·0	17·9	17·2	18·3	17·7
1900	17·0	17·4	18·0	16·9	16·6	17·2	17·7	21·5	19·3	18·2	17·2	18·7	18·0
2000	17·2	17·7	18·4	17·1	16·7	17·3	17·8	21·6	19·6	18·7	18·2	18·9	18·3
2100	17·6	18·1	18·6	17·3	16·8	17·4	18·0	21·8	19·8	18·8	18·4	19·3	18·5
2200	17·7	18·0	18·6	17·4	16·9	17·4	18·2	21·8	19·8	18·8	18·6	19·4	18·5
2300	17·8	17·9	18·6	17·3	16·9	17·4	18·2	21·8	19·8	18·6	18·6	19·3	18·5
Mean	17·1	17·3	18·0	16·8	16·2	17·0	17·6	21·5	19·3	18·0	17·6	18·7	17·9

* To obtain local time add 11 min.

Surface wind.—Ships' observations for the square 35–40° S. 10–15° W. show that over the open ocean around Tristan da Cunha gales are frequent from April to October; from June to August wind force 7 or over has been observed at one observation out of every four, and even in summer at one observation out of twelve. It is clear therefore that the winds around the island more nearly resemble those that prevail in the zone of stormy westerlies, between 40° S. and 60° S., than those of the anticyclonic belt. The ships' observations show, further, that in every month of the year NW. winds are the most frequent, and winds from E. and SE. very uncommon.

Temperature and humidity.—Table XVII shows the hourly averages of temperature for each month, and the annual and monthly means. The equable character of the climate is clearly shown by these last, the difference between the coldest and warmest months (September and February) being barely 13° F. Over the whole period of two years and four months temperature never rose above 74° F. or fell below 40° F. Monthly mean differences between the daily maxima and minima varied from 6° F. to 8° F. The fact that the highest and

lowest of the hourly means differ by much less than this is due largely to the disturbance of the normal diurnal rise and fall of temperature caused by sudden changes of temperature due to the passage of cold and warm fronts across Tristan da Cunha, which often leads to the occurrence of maxima and minima at unusual hours. A factor that favours the occurrence of such frontal temperature changes, due to changes of air mass, is the rapidity with which sea temperature decreases from north to south in this part of the South Atlantic. This is due partly to the fact that the ocean to the south of Tristan da Cunha is covered by the cold east-going Southern Ocean current, while the ocean immediately to the north is affected to a considerable degree by the relatively warm Brazil current. Frontal disturbances, of which there are generally several in a month, travel away in an easterly or east-south-easterly direction. Thus observations from Tristan da Cunha are of great importance to forecasters in South Africa.

TABLE XVII—HOURLY AVERAGES OF TEMPERATURE AT TRISTAN DA CUNHA

Time	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Z+1*	<i>degrees Fahrenheit</i>												
0000	61	63	60	61	56	54	52	52	51	53	56	60	56.6
0100	61	63	60	61	56	53	53	52	51	53	56	60	56.6
0200	61	63	60	61	56	53	53	51	51	53	56	60	56.5
0300	61	63	60	61	56	54	53	51	51	53	56	60	56.6
0400	61	63	60	61	56	54	53	51	51	53	56	60	56.6
0500	61	63	60	61	56	53	53	51	51	53	56	60	56.5
0600	61	63	60	61	56	53	53	51	51	53	57	60	56.6
0700	62	64	61	61	56	53	53	51	51	53	57	61	56.9
0800	63	64	62	62	56	54	53	52	52	54	58	61	57.6
0900	64	65	63	63	57	54	53	53	52	55	59	62	58.3
1000	64	65	63	63	57	55	54	53	53	55	59	62	58.6
1100	64	66	64	63	58	55	54	54	53	56	59	63	59.1
1200	65	66	64	63	58	55	55	54	54	56	59	63	59.3
1300	65	67	64	63	58	55	54	54	54	56	60	63	59.4
1400	65	67	64	63	58	55	54	54	53	56	60	63	59.3
1500	65	67	63	63	57	55	54	54	53	55	59	63	59.0
1600	64	66	63	63	57	54	54	53	53	55	59	63	58.7
1700	64	65	62	62	56	54	53	53	52	55	59	62	58.1
1800	63	65	62	62	56	54	53	52	52	54	58	61	57.7
1900	63	65	61	61	56	53	53	52	51	53	57	61	57.2
2000	62	64	61	61	56	53	53	52	51	53	57	61	57.0
2100	62	64	61	61	56	53	53	52	51	53	57	61	57.0
2200	62	64	61	61	56	53	53	52	51	53	57	60	56.9
2300	62	63	61	61	56	54	53	52	51	53	57	60	56.9
Mean	62.8	64.6	61.6	61.9	56.5	54.0	53.1	52.4	51.8	54.0	57.7	61.1	57.6

* To obtain local time add 11 min.

Table XVIII gives hourly means of relative humidity for each month, monthly means of the hourly readings and annual means for each hour. The low mean for March is due to the very exceptional March of 1944 for which the mean was 76.9 per cent. (in March 1943 the mean was 82 per cent.) and it seems unlikely that the mean for March for a long period would be appreciably lower than in the neighbouring months. If that is a correct assumption the figures suggest that there is no appreciable annual variation at Tristan da Cunha, a peculiarity shared with Funchal (Madeira) but very unusual, since islands in temperate latitudes in both hemispheres generally have a well defined maximum in winter. The diurnal variation is small in all months, the mean daily range

averaging about 4 per cent. from October to March and 2 per cent. from April to September, with the minimum generally in the early afternoon. Mean wet-bulb temperatures (means of hourly readings) are given in Table XVIII.

TABLE XVIII—HOURLY MEANS OF RELATIVE HUMIDITY AND MONTHLY MEANS OF WET-BULB TEMPERATURE AT TRISTAN DA CUNHA

Time	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Z+1*	<i>per cent.</i>												
0000	84	86	82	83	84	85	83	82	81	83	85	85	84
0100	84	87	81	83	84	86	82	82	82	83	84	85	84
0200	84	87	80	83	84	85	83	83	81	84	85	84	84
0300	84	87	80	83	84	84	83	83	83	84	85	85	84
0400	84	87	80	83	83	85	83	83	83	85	84	85	84
0500	84	87	80	83	84	85	83	83	83	85	85	84	84
0600	84	87	80	83	83	85	84	82	83	84	84	83	83
0700	85	86	80	83	84	84	83	82	81	84	83	83	83
0800	83	85	78	82	83	83	85	81	81	83	84	82	82
0900	82	85	77	82	82	83	83	80	82	83	84	82	82
1000	82	84	77	82	82	83	83	81	82	83	84	82	82
1100	82	84	77	82	82	83	82	80	82	82	84	82	82
1200	81	84	78	82	81	83	82	80	80	81	83	82	81
1300	81	83	78	82	82	83	83	80	81	81	82	82	81
1400	81	83	78	82	82	83	83	80	82	80	81	82	81
1500	81	83	77	82	82	83	82	80	82	80	81	82	81
1600	81	83	79	82	83	83	82	80	82	81	81	82	82
1700	81	83	80	83	82	83	82	81	83	81	82	83	82
1800	82	85	80	83	84	83	83	82	83	83	83	83	83
1900	83	85	80	83	84	84	84	82	83	81	84	84	83
2000	83	86	81	83	84	84	83	81	83	82	85	85	83
2100	83	86	82	83	83	84	83	81	82	83	85	85	83
2200	83	86	81	83	83	85	83	82	82	83	84	85	83
2300	84	86	82	83	84	85	84	82	83	84	85	84	84
Mean	83	85	79	83	83	84	83	81	82	83	84	83	83
Mean wet-bulb temperature	<i>degrees Fahrenheit</i>												
	59.7	61.8	58.1	58.8	53.8	51.6	50.6	49.7	49.2	51.4	55.0	58.3	54.8

* To obtain local time add 11 min.

Cloud.—Table XIX shows the monthly mean amounts of cloud at 0600 (0611 L.M.T.) and 1500 (1511 L.M.T.) and the mean number of clear and overcast days per month in the two years August 1942–July 1944, based on observations at 0600, 1200 and 1700.

TABLE XIX—MEAN CLOUD CONDITIONS AT TRISTAN DA CUNHA

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Z+1*	<i>tenths</i>												
Mean cloud amount	7	8	7	7	7	8	8	7	8	8	8	8	7.6
	7	7	7	7	8	8	8	8	8	7	7	7	7.4
	<i>days</i>												
Clear ..	2	0.5	0.5	0	0	0	0	0	0	0.5	0	1	5
Overcast ..	12	11	8	7	8	12	10	9	11	13	9	15	125

* To obtain local time add 11 min.

These figures show that the summer is slightly less cloudy than the winter and that nearly all the few clear days come in summer.

Rainfall.—The monthly totals of rainfall and number of rain days (days with 0.01 in. or more) in Table XX point to the period May–October as being the wettest time of the year; during these months there were eight spells of ten or more consecutive rain days, but no such spells occurred from November to April. The largest fall in 24 hours was 2.74 in. on May 6, 1944; and the most notable prolonged downpour lasted from 0900 on that day until 0200 on the 8th, and yielded 4.59 in. It was accompanied for part of the time by a southerly gale, but pressure did not fall below 1006 mb. The total for the whole month, 11.40 in., was the largest of this record, but August 1943 with 8.71 in. was also very wet. The driest month was January 1943 with 2.11 in. Out of the 564 rain days 122 had 0.4 in. or more.

TABLE XX—MONTHLY RAINFALL AT TRISTAN DA CUNHA

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Rainfall totals (inches)													
1942	—	—	—	—	7.44	5.02	6.73	3.32	5.12	7.08	5.11	6.78	—
1943	2.11	3.73	3.71	3.98	4.51	5.37	5.57	8.71	3.91	7.77	2.87	3.62	55.86
1944	3.35	3.63	3.12	5.63	11.40	4.98	6.03	5.73	—	—	—	—	—
Days with 0.01 in. or more													
1942	—	—	—	—	22	24	25	24	23	23	18	19	—
1943	16	13	14	17	20	26	26	25	22	19	12	17	227
1944	18	21	13	16	24	23	23	21	—	—	—	—	—

Sunshine.—The annual and monthly averages of sunshine in hours and tenths for each hour of the day, and the average monthly totals are shown in Table XXI.

TABLE XXI—MEAN MONTHLY TOTALS OF SUNSHINE DURING EACH HOUR AT TRISTAN DA CUNHA

Hour ending (Z + 1)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
hours													
0700	6.7	3.0	4.1	0.3	—	—	—	0.2	1.5	2.3	3.9	5.1	26.9
0800	11.2	6.9	11.9	6.1	3.7	1.6	1.6	6.6	6.1	8.1	6.7	8.3	78.1
0900	12.3	6.9	12.5	10.0	10.2	6.8	6.8	11.8	8.4	9.8	8.5	8.3	112.0
1000	12.9	7.1	11.8	12.5	10.6	9.8	9.8	12.0	9.7	9.7	9.3	10.3	125.4
1100	14.7	8.7	12.9	10.9	9.6	12.1	12.1	12.9	11.1	10.7	8.5	9.5	131.5
1200	13.9	8.9	14.1	10.7	9.2	13.0	13.0	13.0	10.1	11.6	11.1	9.3	135.2
1300	12.9	9.5	13.2	11.5	9.0	11.3	11.3	13.5	10.5	11.4	11.7	10.5	136.5
1400	12.9	8.5	12.7	12.4	9.0	10.2	10.2	12.3	10.1	13.6	10.5	9.3	132.0
1500	13.1	9.9	13.5	9.6	8.8	9.3	9.3	11.5	8.7	10.9	11.0	9.1	124.4
1600	12.9	9.9	13.8	9.1	6.2	6.5	6.5	9.8	7.1	10.3	11.1	8.5	112.2
1700	12.5	10.1	11.6	3.8	2.8	1.6	1.6	6.0	5.0	8.9	9.7	7.9	81.4
1800	8.5	7.1	3.5	0.1	—	—	—	0.5	1.5	5.3	8.9	5.4	40.8
1900	1.9	0.7	—	—	—	—	—	—	—	0.1	2.3	1.1	6.1
Total	146	97	136	97	79	82	82	110	90	113	113	103	1,243

Period.—May 1942–August 1944.

Obstruction by the central mountain affects the means for 0700, 0800 and 0900 for at least part of the year.

Visibility.—Percentage frequencies of various degrees of visibility at 0600 (0611 L.M.T.) and 1500 (1511 L.M.T.) are given in Table XXII. They show no significant difference between the four seasons, but visibility is on an average slightly better at 1500 and 0600.

TABLE XXII—PERCENTAGE FREQUENCIES OF DIFFERENT VISIBILITIES
AT TRISTAN DA CUNHA

	Range of visibility															
	220-550 yd.		550-1,100 yd.		1,100-2,200 yd.		1½-2½ mi.		2½-3½ mi.		3½-12½ mi.		12½-31 mi.		31 mi.	
	0600	1500	0600	1500	0600	1500	0600	1500	0600	1500	0600	1500	0600	1500	0600	1500
	<i>per cent.</i>															
Dec.-Feb.	-	-	1	-	3	1	6	3	8	9	18	18	41	37	23	32
Mar.-May	-	-	-	-	2	1	5	3	3	11	21	18	42	38	27	29
June-Aug.	1	-	1	1	1	-	3	3	5	8	27	23	38	29	24	36
Sept.-Nov.	-	-	1	-	3	3	4	3	5	5	14	17	45	37	27	35

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