Wind and weather, currents, tides and tidal streams in the East Indian Archipelago

WIND AND WEATHER, CURRENTS, TIDES AND TIDAL STREAMS

IN THE

EAST INDIAN ARCHIPELAGO.

PUBLISHED BY ORDER OF THE GOVERNMENT OF NETHERLAND'S INDIA

BY

J. P. VAN DER STOK, PH. D.
DIRECTOR OF THE METEOROLOGICAL AND MAGNETICAL OBSERVATORY.

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INTRODUCTION.

The issuing of this publication has in view a twofold aim: 1°. that it should be regarded as a scientific contribution to the *Physical Geography* of the *East Indian Archipelago*, and 2°. that it should also serve as a practical guide to all those who, in matters of wind, weather and streams, are in want of useful information concerning these phenomena.

In most branches of science such a combination of the essential conditions for scientific exactness on the one hand and for popular practicability on the other, would generally impair the usefulness in either respect; in those branches of science however, which at the present time are classified together under the generic name of *Physical Geography*, there is no such incongruity between science and practice, because the observations, if well made, and arranged in a judicious manner, find immediate application, and theory in these purely empirical and not experimental sciences plays, up to the present, a subordinate part.

A few words concerning the plan followed in the arrangement of the available matter and the methods used in working out the original data will suffice to add that information, which the reader may wish to receive and which has not been given in the text itself.

The work is divided into three chapters: the first treats exclusively of observations made on board ship, the second contains the results from observations of rainfall and wind made at coast-places and some inland stations, whilst the third chapter treats of tides and tidal streams.

The data which are made use of in the first chapter are extracted from many hundreds of log-books kept on board of the men of war which, during the 77 years 1814 to the end of 1890, have cruised in the Archipelagic seas. In these books — not to be confounded with special meteorological journals — are entered for each watch, i. e. six times per diem, the direction of the wind and its force in the usual marine-terms, the state of the weather, the condition of the sea and, once a day, the position of the ship according to the astronomical and dead reckonings.

These log-books belong to the archives of the Ministry of Marine in the *Hague* and were sent successively to the Observatory at *Batavia;* and, although the quantity of observations which it was possible to extract from them proved less than might have been expected, the data, especially those found in the books of the old sailing vessels are of great value for knowledge of the laws to which wind and weather are subject in these regions where monsoons and land- and seabreezes predominate, whilst cyclones and anticyclones seldom, if ever, occur.

As the strength of the wind is expressed in the usual sea-terms, and the condition of weather and sea in terms as shown in table D, the first operation was to copy all the observations in three corresponding registers irrespective of place and time and at the same time to substitute conventional numbers or symbols for the verbal descriptions according to the following scheme:

	Wind.	Weather.	Sea.
C.	Calm.	—	Calm.
1	Light air and light breeze.	Clear.	Swell.
2	Gentle breeze.	Overcast.	High swell.
3	Moderate and fresh breeze.	Showery.	Waves.
4	Strong breeze.	Rain.	Sea.
5	Moderate and fresh gale.	Squalls.	High sea.
6	Strong gale, storm.	Thunder.	—
7	—	Hazy.	—
8	—	Mist.	—
Circ.	Circulating winds.	—	—
Var.	Variable winds.	—	—

In the same registers the position of the ship at the time of observation was denoted by a number corresponding to the same figure inscribed in the degree squares, into which a map of the *Indian Archipelago* had been divided.

The second operation was to trace on the map 41 compartments (as shown in the monsoon-charts) and to insert all the observations into new registers, each relating to one compartment and to one month, so that, for wind, weather and sea together, $3 \times 41 \times 12 = 1476$ tables were obtained.

From these registers the sum and the percentage of occurrences of the different symbols were calculated, directly from the data concerning weather and sea; and for the wind-observations after having given to each direction the weight of the corresponding force, the symbol in this case representing a measure (though a somewhat unconventional one) of the wind's force.

This device has been followed because e. g. the direction of a wind of the force 3, corresponding to a moderate breeze, can be stated with a much greater accuracy than the direction of a feeble wind of the force 1, especially so when the observation is made on board of a steamship and, moreover, it may be assumed that, in regions where cyclones are extremely rare, a strong wind is a better characteristic of the prevailing monsoon than a feeble motion of the air, the direction of which is possibly local or accidental.

When, however, this device is applied in a consequent manner, there is no room for the circulating and variable winds, for which no force has been recorded, and the occurrences of calms — an important meteorological factor in these regions — disappears altogether from the results.

In order to evade this difficulty the occurrences of C, Circ., and Var. have been taken into account each with unity weight, a contrivance which certainly is neither strictly logical nor consequent, but which may be accepted where no method exists, which is both practical and consequent.

In tables D the results of this investigation are printed: the percentages for the condition of weather and sea corresponding to a period of 24 hours; those for the wind to night- and dayhours separately, because the tracks of the vessels in most cases were near the coast, so that the influence of land- and seabreezes is distinctly observable. To each table D (with the exception of compartment 41) corresponds a chart of wind-roses from which every practical seaman, many of whom object to figures, may easily get information concerning the direction of the wind which in a given month may be expected, and about the probability of his experiencing the prevailing wind; in these wind-roses a radius of 50 mm. (measured outwardly from the small inner circle) corresponds to a percentage of 100, or to absolute reliability.

The last operation was to concentrate the total result in tables A and B (which have been calculated from the percentages in table D) and in table C, which has been computed by taking together the components as given in Tables A and B.

The results given in table C may, therefore, be considered as free from the influence of land- and seabreezes, and to give a fair representation of the monsoons, which prevail in the different parts of the Archipelago.

The components, obtained by projecting the percentages corresponding to the 16 points of the compass, as given in tables D, on the four principal directions, have been given because they enable the reader to easily combine the results for different months and to evaluate the influence of land- and seabreezes in different months by forming the differences between the components of tables A and B.

It is evident that, these components being percentages, the root of the sum of the squares of these figures must be 100 whenever the wind has blown from one direction during the whole month, and that it will be equal to zero when it has blown with equal force from two or, in general, from an even number of opposite points of the compass; consequently these values form a measure of the steadiness of the monsoon or i. o. w. of the frequency of occurrence of the mean direction; they are to be regarded as quantities indicating the importance, which may be attached to the computed mean direction, which, of course, becomes an illusion when the probability of its occurrence approaches to zero.

The results exhibited by tables C are graphically figured in 13 monsoon-charts, which also show the amount of rainfall and the number of rainy days at different stations; no attempt has been made to elucidate the mechanism of the different air-currents by additional arrows: the charts are strict reproductions of the results given in tables C.

The 13th chart shows the surplus of transfer of air, taken over the whole year; it clearly exhibits the fact that there is a considerable displacement of air towards the equator in southern latitudes, but that it generally does not pass the equator.

In working out the results of the current-observations, computed from the astronomical and dead reckonings of the ship's position, all the observations showing velocities less than 10 miles in the 24 hours have been recorded as „no current" because the considerable errors, to which this method of computing the currents is liable, makes the results extremely doubtful when the velocity is feeble. The number of observations is not sufficient to give charts for every month, so that only two charts, exhibiting the currents in two seasons, have been projected, which, at the same time, show the rainfall in these periods of the year.

The observations of rainfall and wind, printed in Chapter II, have been compiled from the „Rainfall in the *East Indian Archipelago*, 17th year, 1895" and from the „Natuurkundig Tijdschrift voor *Nederlandsch-Indië*".

The data concerning the rainfall in the *Malakka Peninsula* and in *British North Borneo* have been taken respectively from the Meteorological Reports for the *Straits Settlements* and from Mr. Scott's paper on the Climate of *North Borneo* (Quarterly journal of the Royal Meteorological Society, Vol. XV, 1889).

The last chapter, forming a contribution to the knowledge of tides in the *Indian Archipelago*, may be regarded as a popular treatise on these phenomena and as an essay to forward a simple method of tidal prediction.

In drawing the charts of cotidal lines so many difficulties were encountered owing to the mixing together of different tide-waves at some crossways, that it seemed necessary and convenient to partially substitute arrows, exhibiting the directions in which the waves propagate, for the cotidal lines, which are to represent the wave-fronts; this method of representing the mechanism of tides does not essentially differ from the drawing of cotidal lines and is often more convenient.

In perusing the paragraphs of Chapter III the reader is requested to bear in mind, that these were written whilst many results were still unknown, and that the chart has been drawn after all the printing was finished.

It is due to this reason that in § 13 only examples have been given principally relating to the western parts of the Archipelago, and that f. i. no mention has been made of the fact shown in the cotidal charts, that the K_1 and M_2 waves propagate in opposite directions in the *Banda-* and *Molucca-seas.*

Batavia, November 1896.

VAN DER STOK.

SUMMARIZING TABLE

SHOWING THE CONDITION OF WIND, WEATHER AND SEA IN DIFFERENT PARTS OF THE ARCHIPELAGO.

		Clear.	Overcast.	Showery.	Rain.	Squalls.	Thunder.	Hazy.	Mean force.	Land- and seabreeze.
I.	Malakka-strait	91.2	55.5	8.3	36.9	1.5	2.4	4.8	1.40	4 %
II.	Atjeh, East coast	104.1	53.1	4.3	33.1	0.7	1.1	3.7	1.30	37
III.	Atjeh, North-East coast . . .	107.6	58.9	**3.5**	26.3	0.3	1.1	3.0	1.26	**42**
IV.	Atjeh, North coast.	105.3	50.9	8.6	31.4	1.7	0.9	2.0	1.53	23
V.	Pulu Bras.	87.0	**36.8**	13.4	**57.1**	**4.8**	0.5	**0.8**	1.43	4
VI.	Atjeh, West coast 1.	98.1	46.7	6.3	46.2	0.7	1.4	1.5	1.27	21
VII.	Atjeh, West coast 2.	93.0	50.5	5.5	46.2	0.4	1.0	3.8	1.27	18
VIII.	Sumatra, West coast 1 . . .	57.9	85.2	13.0	38.0	0.9	2.8	2.6	1.48	23
IX.	Sumatra, West coast 2 . . .	**53.5**	78.1	15.1	42.2	1.1	4.2	6.4	1.57	18
X.	China-sea, North	59.8	**90.7**	11.2	30.4	0.7	1.6	5.0	1.67	14
XI.	China-sea, South	64.5	80.0	12.6	32.1	1.4	3.1	6.4	1.70	4
XII.	Riouw- and Lingga Arch. .	78.8	76.6	10.7	25.4	1.1	2.1	5.7	1.61	2
XIII.	Banka-strait.	74.4	77.8	12.9	24.3	0.9	2.8	6.7	1.53	7
XIV.	Karimata-strait	71.5	80.0	10.4	30.2	2.2	0.9	4.2	1.59	5
XV.	Sunda-strait.	66.8	77.4	14.1	28.7	1.3	**4.5**	7.9	1.65	15
XVI.	Indian Ocean, South of Java.	100.1	69.0	7.4	16.0	0.8	0.9	6.1	1.64	13
XVII.	Sumatra, South-Eeast coast.	80.7	71.3	11.9	26.2	1.6	2.7	6.2	1.63	14
XVIII.	Java-sea, West.	78.8	70.0	11.7	25.0	1.2	3.4	10.1	1.62	15
XIX.	Java-sea, Middle	90.5	59.7	10.8	26.8	1.6	1.8	7.8	1.61	8
XX.	Java-sea, East	99.9	58.5	11.2	19.0	1.5	1.4	8.8	1.69	8
XXI.	Madura-strait	102.3	56.5	9.3	19.4	0.5	1.6	10.8	1.61	23
XXII.	Spermonde Archipelago . . .	96.6	60.2	7.9	26.0	0.8	1.7	7.2	1.61	18
XXIII.	Makasser-strait, South	85.1	67.1	8.5	28.9	1.4	2.4	6.6	1.42	6
XXIV.	Makasser-strait, North	92.7	61.4	6.5	33.5	**0.2**	0.8	4.4	1.38	2
XXV.	Borneo, North-East coast . .	94.6	59.2	6.2	35.8	0.5	0.9	2.8	**1.25**	9
XXVI.	Celebes-sea	99.3	58.9	8.0	29.4	**0.2**	0.8	3.7	1.37	16
XXVII.	Pacific Ocean.	87.1	62.9	10.3	34.5	0.4	0.9	4.2	1.52	7
XXVIII.	Gulf of Tomini.	94.4	60.0	8.1	33.0	0.4	0.5	4.0	1.48	7
XXIX.	Molucca-sea	81.8	67.3	12.3	32.2	0.6	1.1	5.0	1.56	2
XXX.	Sunda-sea	98.0	60.2	11.3	19.3	1.0	1.5	9.1	1.66	**0**
XXXI.	West. Sunda Isles, North . .	109.1	54.6	8.9	14.7	1.9	1.3	9.8	1.60	16
XXXII.	West. Sunda Isles, South . .	108.3	57.3	8.8	**13.9**	1.9	1.6	8.4	1.57	15
XXXIII.	East. Sunda Isles, North . .	107.3	52.8	7.7	21.2	0.9	1.3	8.9	1.44	9
XXXIV.	East. Sunda Isles, South . .	110.1	49.8	7.6	19.8	1.0	1.4	9.5	1.43	6
XXXV.	Indian Ocean, S. of Sunda Isles	62.6	82.4	16.2	25.7	1.4	1.0	10.7	1.69	4
XXXVI.	Timor-sea	**117.4**	46.1	8.1	15.4	0.9	0.7	**11.9**	1.64	13
XXXVII.	Harafura-sea	95.8	60.3	7.6	31.1	1.3	**0.4**	3.4	1.57	4
XXXVIII.	Banda-sea, South.	106.7	44.2	**18.5**	24.8	1.9	0.9	3.2	**1.80**	2
XXXIX.	Banda-sea, North.	77.9	66.9	12.1	36.9	0.8	1.1	4.8	1.65	4
XL.	Ceram-sea.	87.0	63.0	12.1	30.6	**0.2**	1.1	6.2	1.53	5
XLI.	New-Guinea, North coast . .	102.6	48.2	8.4	35.0	0.5	2.7	2.8	1.52	7

		Swell.	High swell.	Sea.	High sea.	Calm.	Mean Direction of the Wind.		Steadiness of the monsoon.	
							January.	August.	January.	August.
I.	Malakka-strait	22.9	0.8	14.8	**0.0**	161.1	N E	S S E	35 %	24 %
II.	Atjeh, East coast	50.0	1.9	8.8	0.5	138.8	E	S	15	23
III.	Atjeh, North-East coast . . .	58.0	1.3	8.9	0.2	131.6	E S E	S	50	26
IV.	Atjeh, North coast.	41.1	0.9	20.4	0.3	137.5	E	S W	66	72
V.	Pulu Bras.	37.7	1.9	29.8	1.6	129.1	E	S W	83	72
VI.	Atjeh, West coast 1.	**104.1**	2.4	**6.9**	0.2	86.4	E N E	S S E	39	27
VII.	Atjeh, West coast 2.	75.6	1.6	**6.9**	0.8	114.7	E N E	N	22	**19**
VIII.	Sumatra, West coast 1 . . .	42.4	0.8	15.7	3.2	137.6	E S E	N W	**11**	30
IX.	Sumatra, West coast 2 . . .	76.0	13.5	16.0	1.7	90.0	W N W	E N E	22	16
X.	China-sea, North	33.8	4.0	15.0	**15.1**	131.7	N	S	78	46
XI.	China-sea, South	36.4	2.0	22.1	3.3	130.9	N N W	S S E	84	71
XII.	Riouw- and Lingga Arch. .	21.5	0.9	11.2	2.5	161.7	N	S S E	83	63
XIII.	Banka-strait.	**13.9**	0.3	15.3	0.2	**167.4**	N W	S E	74	63
XIV.	Karimata-strait	51.4	1.3	24.7	2.9	116.3	N W	S E	78	75
XV.	Sunda-strait.	36.0	6.5	32.2	2.0	122.0	W	S S E	53	46
XVI.	Indian Ocean, South of Java.	78.7	5.6	20.6	**0.0**	93.2	W N W	S	57	55
XVII.	Sumatra, South-East coast .	28.3	1.8	25.3	1.7	142.0	W N W	E S E	64	51
XVIII.	Java-sea, West.	36.8	2.0	35.1	4.1	119.2	W N W	E S E	79	62
XIX.	Java-sea, Middle	32.5	1.4	37.1	3.4	123.8	W	E S E	71	74
XX.	Java-sea, East	44.5	2.6	39.8	6.2	104.9	W N W	S E	63	77
XXI.	Madura-strait	27.2	1.5	21.6	2.1	144.3	W	S E	64	52
XXII.	Spermonde Archipelago . . .	30.5	0.9	27.8	1.9	138.2	N W	S E	37	65
XXIII.	Makasser-strait, South	41.9	1.1	18.6	0.1	136.6	N W	S E	46	44
XXIV.	Makasser-strait, North	22.8	1.2	15.1	0.2	160.3	N	S S W	36	53
XXV.	Borneo, North-East coast . .	26.9	**0.1**	13.9	**0.0**	158.6	N N E	S S E	43	24
XXVI.	Celebes-sea	31.4	0.3	12.5	8.1	145.4	N	S	40	34
XXVII.	Pacific Ocean.	50.8	0.7	27.1	1.2	118.1	N	S	55	71
XXVIII.	Gulf of Tomini.	28.0	0.6	16.8	0.2	151.6	N N W	S S W	50	23
XXIX.	Molucca-sea	28.6	2.1	24.5	4.3	139.5	N N W	S	67	65
XXX.	Sunda-sea	26.9	4.4	29.2	4.6	130.1	W	E S E	78	76
XXXI.	West. Sunda Isles, North . .	45.8	5.0	15.8	4.0	126.7	W N W	S E	68	58
XXXII.	West. Sunda Isles, South . .	56.3	5.0	12.1	2.7	122.1	W N W	S S E	56	55
XXXIII.	East. Sunda Isles, North . .	35.1	2.7	14.6	3.8	142.1	W	E S E	58	58
XXXIV.	East. Sunda Isles, South . .	35.0	0.6	12.7	2.0	147.8	W	S E	48	52
XXXV.	Indian Ocean, S. of Sunda Isles	81.4	**13.6**	**44.6**	**0.0**	**47.2**	S	S E	33	80
XXXVI.	Timor-sea	72.2	0.2	30.5	0.9	92.6	W N W	S E	66	55
XXXVII.	Harafura-sea	41.2	0.9	28.7	0.6	126.8	N W	S E	62	92
XXXVIII.	Banda-sea, South.	39.2	0.3	26.1	4.6	123.5	W N W	E S E	89	**96**
XXXIX.	Banda-sea, North.	48.7	5.1	23.8	4.2	115.4	N W	S E	65	85
XL.	Ceram-sea.	41.6	3.3	14.4	3.2	135.1	N W	S S E	59	68
XLI.	New-Guinea, North coast . .	103.7	5.3	13.8	12.5	63.3	N W	—	**93**	—

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ERRATA

Page 84, Table C, Mean Direction, May, for S S E, read S S W.
Page 176, right column, line 59, for 15°.943, read 13°.943.
Page 201, for Longitude of *Labuan* 105°.2, read 105°.8.
Page 203, left column, line 41, for *is* well marked, read *are* well marked.

CHAPTER I.

RESULTS OF OBSERVATIONS MADE ON BOARD OF MEN OF WAR FROM 1814–1890.

WIND, WEATHER AND CONDITION OF THE SEA, MONSOON-CHARTS FOR DIFFERENT PARTS OF THE ARCHIPELAGO.

CURRENT-OBSERVATIONS AND CURRENT-CHARTS FOR TWO SEASONS.

I. STRAIT MALAKKA, SOUTH OF DELI-RIVER.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	17	15	N 40° E	N E	23%	1.2	201
February	25	8	N 18° E	N N E	26	1.2	138
March	— 1	8	S 82° E	E	8	1.2	238
April	15	— 3	N 10° W	N	15	1.3	165
May	—31	24	S 37° E	S E	39	1.3	326
June	—34	27	S 38° E	S E	43	1.4	188
July	—38	3	S 4° E	S	38	1.3	153
August	—22	8	S 20° E	S S E	23	1.4	273
September	— 5	— 8	S 60° W	W S W	10	1.4	192
October	6	—20	N 74° W	W N W	21	1.4	170
November	27	—27	N 45° W	N W	38	1.4	157
December	47	—23	N 27° W	N N W	52	1.4	201
Year	1	1	N 56° E	N E	1	1.33	2402

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	35	32	N 42° E	N E	47%	1.4	191
February	30	20	N 34° E	N E	36	1.3	129
March	17	33	N 63° E	E N E	37	1.4	223
April	14	3	N 11° E	N	15	1.4	151
May	—23	19	S 39° E	S E	29	1.4	314
June	—30	17	S 30° E	S S E	34	1.5	175
July	—17	— 7	S 23° W	S S W	18	1.4	149
August	—22	12	S 28° E	S S E	25	1.4	251
September	— 8	— 7	S 42° W	S W	11	1.4	184
October	19	— 3	N 9° W	N	19	1.5	182
November	31	—16	N 27° W	N N E	35	1.6	139
December	42	— 8	N 10° W	N	43	1.4	190
Year	7	8	N 46° E	N E	11	1.43	2278

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	26	23	N 41° E	N E	35%	1.3	392
February	28	14	N 27° E	N N E	31	1.3	267
March	8	21	N 69° E	E N E	22	1.3	461
April	15	0	N	N	15	1.4	316
May	—27	21	S 38° E	S E	34	1.4	640
June	—32	22	S 29° E	S S E	39	1.5	363
July	—27	— 2	S 4° W	S	28	1.4	302
August	—22	10	S 24° E	S S E	24	1.4	524
September	— 6	— 8	S 51° W	S W	10	1.4	376
October	12	—12	N 45° W	N W	17	1.5	352
November	29	—22	N 37° W	N W	36	1.5	296
December	44	—16	N 20° W	N N W	47	1.4	391
May—September	—23	9	S 21° E	S S E	25	1.39	2475
October—April	23	1	N 1° E	N	23	1.42	2205
Year	4	4	N 45° E	N E	6	1.40	4680

Generally strait *Malakka* is considered to be situated within the region of the N E—S W monsoon, observed at the northern parts of *Sumatra*.

Tables A, B and C, exhibiting the results of the observations, and still more the inspection of the monsoon-charts, show distinctly that this notion, based upon the distribution of the rainfall throughout the year, is not exact if the direction of the wind is taken as a criterium. Neither can strait *Malakka* be regarded as a border-region between the two monsoons, the charts proving that this border-region should rather be sought in the more northern parts of the strait.

About the midst of May the S E monsoon sets in, but it never can be fairly depended on, the percentages of the steadiness being rather small during this as well as the other monsoons.

From May to August S E and S winds prevail, but winds from the W, N W, and occasionally from the northward, may be also expected. This monsoon, if monsoon it may be called, lasts till September, when the percentage of W and N W winds begins to increase.

From May to September the weather is very unsettled and showery, the sky is clouded, and heavy gusts of rain accompanied by thunderstorms blowing from varying directions are not infrequent.

On inspection of the wind-charts for the months May to September, this S E monsoon appears to be the effect of the draught caused by the well marked S W monsoon blowing at the northern opening of the strait on the one hand, and of the pressure excercised by the strong and very constant S E winds blowing in the *China-sea* and the *Riouw-Archipelago* on the other. These S E winds, in passing over the *Java-* and *China-seas*, have lost their original dryness and are therefore apt to promote showery weather and moderate rainfall.

From October to December W, N W and N winds occur: this N W monsoon, caused by the prevalence of northerly winds in the *China-sea* is an effect of suction also, the E winds blowing at the entrance of the strait not yet having attained a development sufficient to counteract this effect.

During these months the rainfall attains its maximum value and the N W winds are accompanied by showery weather and squalls exactly as the S W winds of August are.

The moist air originating in the *Indian Ocean* flowing into the strait along the western *Malakka*-coast, is compelled to rise where the strait grows narrower and thus causes a continuous rainfall. Occasionally however the gyrating movement of the air, that necessarily occurs at the entrance of the strait, where the S E monsoon blows, prevents the development of this normal state of affairs and is the cause of the unsettled weather which, in this as in the preceding season, forms one of the characteristics of the climate in these parts.

In January the monsoons at the north coast of *Sumatra* have attained to full development; now there is no occasion for the air to flow into the strait along the *Malakka*-coast; the east monsoon blowing over the peninsula and the whole entrance of the strait.

The prevailing direction of the wind in the southern parts of the strait is the resultant of these winds and of the northerly winds in the *China-sea*, as is clearly shown by the charts: N E winds will ensue which, in their passage over the *Malakka* mountains, have lost a great deal of their moistness; and then relatively settled and fine weather with a minimum of rainfall and free from heavy squalls and thunderstorms, may be expected.

Towards the end of March the monsoons in either part commence to abate with respect to both steadiness and strength and in April winds from all directions and very unsettled weather are experienced with occasional squalls and thunderstorms.

In the southern parts the narrowness of the strait and the vicinity of the coasts of *Malakka* and *Sumatra*, prevent the development of land- and seabreezes, but in the northern parts these local winds will be met with at a distance less than 10 miles out of the shore: under the *Sumatra*-coast the „Sumatranen" — heavy S W squalls characteristic of the East-coast and mentioned in the next chapter — begin to make sailing difficult for small crafts.

The general direction of the currents in every season being towards the N and N W, the sea will be roughest during the four last months of the year, when wind and currents flow in opposite directions; especially when the tidal streams set with the current, i. e. towards the N W.

These tidal streams being stronger than the permanent current, a rather high sea may however be experienced from whatever quarter the wind may blow.

As might be expected in these sheltered parts the recurrency of the swell reaches but a very small percentage.

The tides are semi-diurnal and therefore a port-establishment may be said to exist, rapidly increasing from $2^h\ 30^m$ at the mouth of *Deli-river* to $7^h\ 30^m$ near *Benkalis*.

The flood-streams set to the southward, the ebb to the northward: in consequence of this the direction of the tidal currents is sometimes found to be different in different parts of the strait, a circumstance which increases the intricacies of their course.

Tidal stations, where observations of tides and tidal streams are made daily at three fixed hours, have been recently established at *Benkalis*, *Bagan api-api*, *Tandjong Tiram* and *Belawan*.

For rainfall near the coast or farther inland the reader is referred to the stations: *Bekalla*, *Medan*, *Medan Poetri*, *Gedong Djehor*, *Timbang Langkat*, *Tandem*, *Tandem Hilir*, *Kisaran* and *Benkalis*.

TABLE D. STRAIT MALAKKA, SOUTH OF DELI-RIVER.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**13.9**	14.6	7.2	13.3	4.7	2.2	4.0	4.1	3.7	4.5	17.0	14.2	5.3	11.9
N N E	5.0	2.2	1.0	—	0.5	2.2	—	1.5	1.5	0.4	2.2	5.0	1.0	2.6
N E	11.2	**18.0**	11.5	8.0	4.1	5.1	2.0	5.4	5.9	7.0	4.0	11.0	5.1	10.6
E N E	5.0	2.8	0.3	1.3	0.7	1.5	3.0	1.0	0.4	1.7	1.3	1.4	1.3	2.1
E	11.6	9.0	13.4	7.6	8.8	5.5	3.4	7.7	5.6	2.5	2.2	2.8	6.4	6.9
E S E	2.7	0.6	2.3	0.4	3.4	5.1	2.0	3.6	3.0	2.5	3.6	0.4	2.9	2.0
S E	7.3	9.0	**13.4**	**16.9**	**33.6**	**34.9**	**20.5**	**21.0**	**19.6**	13.6	6.7	4.6	**24.3**	9.1
S S E	2.7	0.6	4.3	0.4	5.2	3.7	5.0	5.9	1.5	2.1	0.4	0.4	3.6	1.8
S	5.0	4.5	5.9	2.7	7.4	10.7	21.0	9.7	8.1	6.2	1.8	1.4	9.9	4.1
S S W	—	1.7	1.0	0.4	1.1	—	5.0	1.5	1.1	2.1	2.2	1.4	1.5	1.4
S W	6.6	5.0	6.2	5.8	11.3	8.8	8.5	10.3	5.6	6.6	7.2	1.4	8.3	5.5
W S W	1.5	—	3.3	0.4	—	1.1	1.0	1.5	3.0	0.8	—	1.1	1.2	1.1
W	4.6	7.9	9.5	7.6	2.9	2.6	6.0	7.4	12.2	13.2	15.2	10.3	6.3	10.1
W N W	3.9	2.8	3.0	7.1	0.2	2.2	2.5	2.3	3.7	3.7	4.9	6.4	3.0	4.1
N W	8.1	12.4	9.5	13.3	7.9	4.4	7.5	8.2	17.4	**26.7**	**22.4**	**28.7**	9.8	**18.0**
N N W	0.8	1.7	1.6	3.6	0.9	0.7	1.0	2.3	3.0	0.8	2.7	5.3	1.9	2.2
Circulating	3.9	1.7	3.6	8.0	2.3	4.8	1.0	3.6	0.4	2.9	2.2	1.4	3.4	2.6
Variable	1.5	2.2	0.3	—	0.5	2.2	4.0	1.3	1.5	0.8	0.9	1.1	1.6	1.1
Calm	4.6	3.4	2.6	3.1	4.7	2.2	3.0	1.5	3.0	2.1	2.7	1.8	2.9	2.9

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	14.5	15.1	13.5	8.8	4.0	7.3	4.6	3.7	2.3	9.5	14.6	16.0	5.1	13.9
N N E	9.8	6.2	2.5	3.3	0.5	1.5	1.4	2.0	4.9	2.5	3.7	6.0	2.3	5.1
N E	**19.2**	15.1	**20.6**	7.4	6.0	5.4	4.6	6.0	4.9	7.0	9.6	16.0	5.7	**14.6**
E N E	5.4	4.5	2.8	3.7	1.3	2.7	3.2	3.2	1.5	8.4	1.4	1.1	2.6	3.9
E	14.9	**16.2**	13.8	11.1	14.5	6.5	4.2	6.0	4.2	7.4	3.7	5.3	7.8	10.2
E S E	1.1	2.8	3.5	2.8	4.0	2.7	2.3	4.9	2.3	2.8	—	—	3.2	1.7
S E	4.7	4.5	14.0	12.0	**19.4**	**25.3**	**14.8**	**19.5**	**20.0**	6.7	7.3	3.9	**18.5**	6.9
S S E	1.8	1.7	3.8	1.4	4.9	3.4	1.9	4.3	2.6	1.1	2.3	—	3.1	1.8
S	2.9	3.4	5.3	1.9	10.0	16.5	14.4	11.8	6.8	4.6	3.7	2.5	10.2	3.7
S S W	0.4	—	1.3	0.5	1.3	1.1	0.5	1.7	0.8	1.1	0.9	1.4	1.0	0.9
S W	1.4	4.5	0.9	6.0	9.8	7.3	10.6	9.8	6.0	7.7	3.7	5.0	8.3	3.9
W S W	0.4	1.1	—	—	0.5	0.8	1.4	0.3	3.8	0.7	0.5	0.7	1.1	0.6
W	4.3	6.1	3.8	12.5	6.5	8.4	13.0	8.0	13.6	7.7	11.9	6.7	10.3	6.8
W N W	0.7	1.1	1.6	3.7	0.7	—	2.3	0.9	3.4	2.5	2.7	5.7	1.8	2.4
N W	4.7	11.2	7.8	10.7	8.0	4.2	9.7	7.2	14.7	**21.1**	**21.9**	**16.3**	9.1	13.8
N N W	2.9	1.7	1.6	4.6	0.3	0.4	0.9	1.4	0.4	1.1	4.6	6.0	1.3	3.0
Circulating	3.3	1.1	1.9	8.8	4.9	3.1	5.6	4.9	4.5	6.0	5.5	2.5	5.3	3.4
Variable	4.7	—	0.3	—	0.9	1.9	0.9	1.7	1.1	1.4	1.8	2.1	1.1	1.7
Calm	2.9	3.9	1.3	0.9	2.5	1.5	3.7	2.6	2.3	1.1	0.5	2.8	2.3	2.1

CONDITION OF THE SEA, PERCENTAGE.

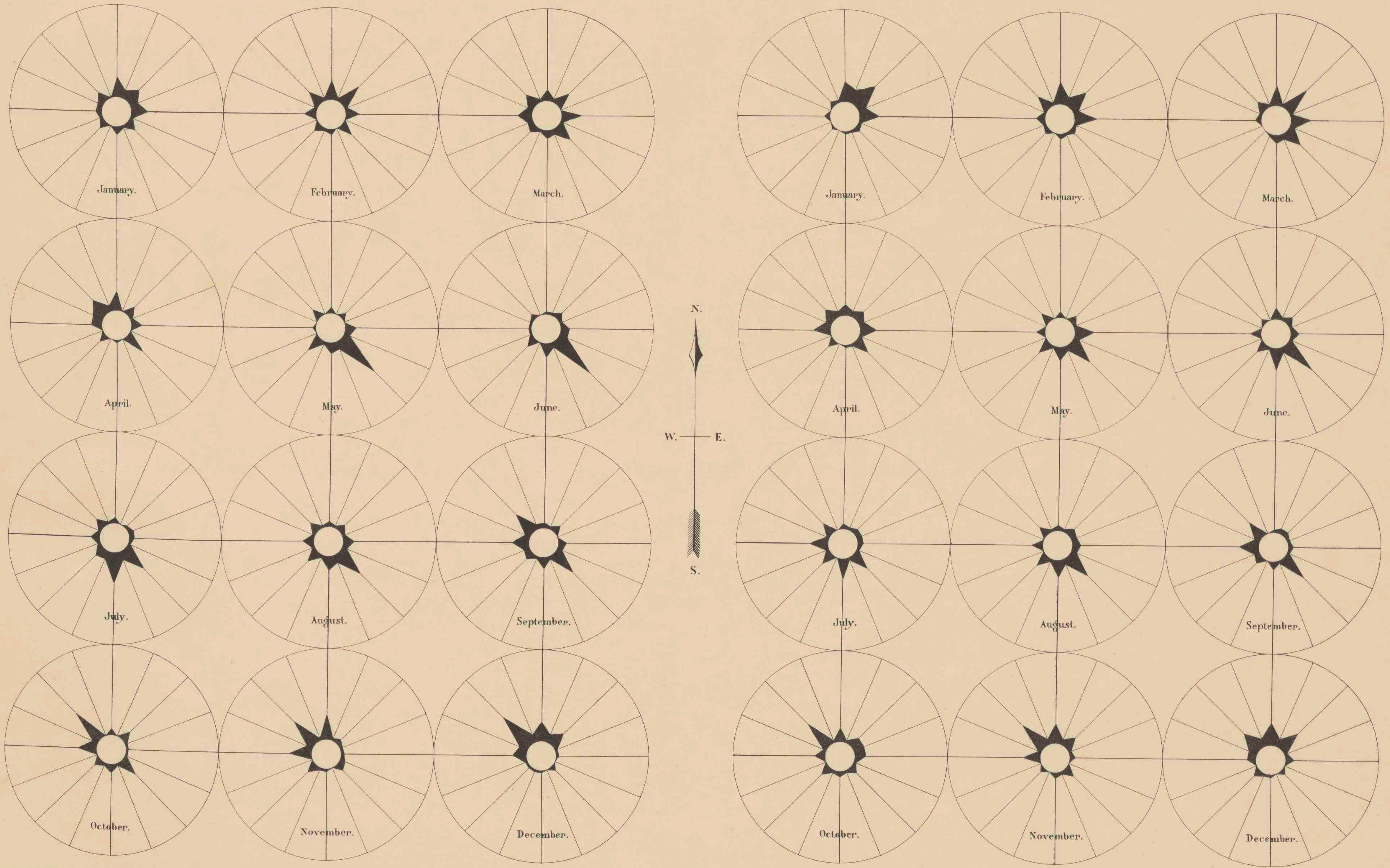
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	6.7	5.6	2.7	6.1	12.5	13.6	14.8	17.7	20.4	18.1	9.5	9.7	14.2	8.7
High Swell	0.3	—	—	—	—	—	3.4	—	0.6	0.3	—	—	0.7	0.1
Waves	—	0.8	0.2	0.4	0.9	—	—	0.2	0.3	0.9	0.4	0.3	0.3	0.4
Sea	4.9	3.0	4.0	5.1	7.9	6.5	5.5	10.2	9.1	11.8	11.4	9.2	7.4	7.4
High Sea	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Calm	88.3	90.7	93.2	88.6	78.8	79.9	76.4	72.0	69.6	68.8	78.8	81.0	77.6	83.5
Number of Observations	333	267	454	318	617	354	271	521	329	348	295	353	2410	2050

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	50.9	59.9	60.1	40.9	41.8	44.9	41.2	35.5	48.9	39.3	37.0	46.6	42.2	49.0
Overcast	25.8	21.8	24.2	31.2	29.5	27.1	34.0	34.2	26.4	29.2	25.0	24.6	30.4	25.1
Showery	2.6	3.1	0.9	1.6	4.1	4.9	5.5	3.7	4.8	6.1	6.7	5.8	4.1	4.2
Rain	19.0	12.3	11.8	19.7	19.7	18.9	13.9	20.4	14.7	21.6	27.8	21.2	17.9	19.0
Squalls	0.3	—	—	0.7	0.5	1.2	2.1	0.8	1.1	—	1.5	0.6	1.1	0.4
Thunder	0.3	—	0.4	2.9	3.1	1.5	1.1	1.6	1.6	—	1.1	0.3	2.0	0.4
Hazy	1.1	3.1	2.8	3.2	1.4	1.8	2.4	4.0	2.7	3.9	1.1	1.1	2.6	2.2
Mist	0.3	—	—	—	—	—	—	—	—	—	—	—	—	0.1
Number of Observations	382	262	459	320	638	355	296	516	376	361	292	378	2501	2134

I. STRAIT MALAKKA.

DAY. NIGHT.



II. ATJEH, EAST-COAST, FROM DELI-RIVER TO DIAMOND POINT.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	30	41	N 54° E	N E	51 %	1.3	360
February	34	26	N 37° E	N E	43	1.5	291
March	47	— 1	N 1° W	N	47	1.3	331
April	37	—15	N 22° W	N N W	40	1.4	318
May	9	21	N 67° E	E N E	23	1.3	308
June	—14	34	S 68° E	E S E	37	1.3	406
July	7	34	N 79° E	E N E	35	1.2	589
August	1	25	N 88° E	E	25	1.4	453
September	15	25	N 59° E	E N E	29	1.3	369
October	16	9	N 29° E	N N E	18	1.3	479
November	8	35	N 77° E	E N E	36	1.3	451
December	32	6	N 11° E	N	33	1.4	637
Year	19	20	N 46° E	N E	28	1.33	4992

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—29	—11	S 21° W	S S W	31 %	1.3	354
February	—25	—34	S 54° W	S W	42	1.3	299
March	—24	—30	S 51° W	S W	38	1.2	310
April	—37	—40	S 47° W	S W	54	1.3	311
May	—40	—22	S 29° W	S S W	46	1.3	304
June	—46	—29	S 32° W	S S W	54	1.2	377
July	—51	—27	S 28° W	S S W	58	1.2	569
August	—47	—26	S 28° W	S S W	54	1.2	416
September	—42	—21	S 27° W	S S W	47	1.1	352
October	—44	—34	S 38° W	S W	56	1.1	458
November	—38	— 7	S 11° W	S	39	1.3	440
December	—27	—25	S 25° W	S S W	37	1.4	603
Year	—38	—26	S 34° W	S S W	46	1.24	4793

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	1	15	N 86° E	E	15 %	1.3	714
February	5	— 4	N 39° W	N W	6	1.4	590
March	12	—16	N 53° W	N W	20	1.3	641
April	0	—28	W	W	28	1.4	629
May	—16	— 1	S 4° W	S	16	1.3	612
June	—30	3	S 6° E	S	30	1.3	783
July	—22	4	S 10° E	S	22	1.2	1158
August	—23	— 1	S 2° W	S	23	1.3	869
September	—14	2	S 8° E	S	14	1.2	721
October	—14	—13	S 43° W	S W	19	1.2	937
November	—15	14	S 43° E	S E	21	1.3	891
December	3	—10	N 73° W	W N W	10	1.4	1240
May—November	—19	1	S 3° E	S	19	1.26	5971
December—April	4	— 9	N 66° W	W N W	10	1.36	3814
Year	— 9	— 3	S 18° W	S S W	9	1.30	9785

On comparing the summarizing table, placed after the introduction, with the monsoon-charts and with Table D, it is evident that this part of *Strait Malakka* must be regarded as the border-region dividing the area of the S W—N E monsoon blowing at *Sumatra's* north-coast from that where the monsoon-winds, characteristic of the southern parts of *Strait Malakka*, prevail.

During all the months the percentages of the mean directions are very low: in fact it is hardly possible to discern two or more well marked seasons: however, we may state in a general way, that from May to November the prevailing winds are those from the two southern quarters, S, S E and S W, whereas from December to April the force and steadiness of the monsoon are reduced to a minimum.

This proves the view put forward in the description of the climate in *Strait Malakka*, viz. that the N E winds, which blow in the southern parts of the strait from January to March, cannot be considered as a continuation of the East-monsoon of *Atjeh's* north-coast, it being evident that, in that case, the easterly components of the wind would be found rather to increase on following the coast in a northerly direction, than to decrease and vanish, which as a fact they do.

The distribution of the rainfall however is, notwithstanding this difference as to monsoon-winds, about the same as in the southern parts of *Strait Malakka:* September, October, November and December are the wet, February and March the dry months, but, on the whole, the weather is better and the sky clearer than in the strait: at the same time there is less probability of rain, fewer showers and squalls or thunderstorms and haziness than there.

The mean force of the wind too is 1.30, whereas in the southern parts the average value, as computed from all the available data, is 1.40.

This fact, viz. that the weather is much more settled notwithstanding the comparative unsteadiness of the monsoons, is due to the unusual development of local influences, as evidenced by Tables A and B.

There it may be seen that, as a fact, the steadiness of the direction, if taken separately for night- and daytime, is much greater than in the southern parts of the strait.

Land- and seabreezes occur here and at the north-coast of *Atjeh* to such an extent, as to completely neutralize the effect of the feeble monsoons: during the night in all months S W and S S W winds prevail with large percentages; during daytime N E and N N E winds are experienced, though not so regularly as the S W winds at night-hours.

The reason of this difference is obvious: by subtracting the average components for the night from those for the day and dividing by 2, we find for the seabreeze the direction N 39° E with a percentage of 37 % and for the landbreeze the direction S 39° W: during daytime the N E landbreeze is counteracted by the southerly monsoon-winds, which blow from May to November; at night-hours the landbreeze and the prevailing monsoon-winds on the other hand strengthen each other and thus the considerable differences between the percentages during these months are readily explained.

From December to April, on the other hand, the percentages of the steadiness for the same reason will be rather higher during the hours of the day than at nighttime.

Within a distance of 10 miles from the coast, therefore, Tables A and B are to be consulted as to the wind to be expected; for a larger distance from the shore the requisite information will be found in Table C.

This extraordinary development of land- and seabreezes attains its maximum — as found by subtracting the components of Table A for April from those of Table B — when the rays of the sun are vertical: it is due to the slowly sloping mountainrange which extends from *Langsar Bay* onward along the coastline as far as *Oleh-leh* and occasionally gives rise to those sudden squalls accompanied by rain and thunderstorms, which are known and feared under the generic name of „Sumatranen".

These sudden S W winds are experienced near the shore when the landbreeze comes off in sharp gusts, dangerous to small sailing-vessels; they occur from sunset to midnight and may be signalled by the presence of a sharply defined cloud which, by its slight elevation above the horizon, gives the false impression of being still at a long distance: within a few minutes of its appearance however the squall comes on with sudden violence.

This view of their origin justifies the conclusion that those squalls will be experienced especially by vessels riding at anchor near the shore in roads or in bays, but not at some distance from the shore: their frequency depends much upon the configuration of the coast and they will mostly occur where the effect of the heated or cooled slopes all around is concentrated upon a comparatively small area.

The haziness of the sky which, as appears by the results of the observations, is densest during the period March to August, causes some difficulty in making land in the morning hours and is frequently increased by the forest-fires kindled in the process of clearing the ground for the tobacco-culture.

Owing to the vicinity of the *Indian Ocean* the swell of the sea is much heavier and more frequent in these regions than in the strait, but, in consequence of the strong tidal streams and the ruggedness of the bottom, the sea soon becomes smooth again.

As the main current follows the coast-line N N W ward during all the year, strong N, N N W and N E winds will occasion heavy seas, especially when tidal streams set with the current.

Consequently this will occur principally during the months from September to March, when N W winds prevail, and oftener in day- than in night-hours; a force of the wind stronger than 3 has, however, very seldom been registered.

The tides bear a semi-diurnal character and the port-establishment varies from 10^h 52^m near *Diamond Point* to 2^h 30^m at the mouth of *Deli-river*.

Rainfall has been observed at *Edi* and *Seroeway*.

A tidal station has been established at *Edi*.

TABLE D. ATJEH, EAST-COAST, FROM DELI-RIVER TO DIAMOND POINT.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	3.1	8.5	11.4	14.5	5.4	4.5	9.9	6.0	11.5	7.4	6.8	16.4	8.6	8.9
NNE	5.5	4.2	2.0	4.3	1.1	1.5	1.0	4.7	1.8	0.8	3.5	2.7	2.4	3.1
NE	**34.4**	**24.4**	**24.4**	11.2	**19.5**	9.0	**17.7**	15.2	**19.8**	16.0	18.4	13.4	**15.4**	**21.8**
ENE	5.8	4.7	2.5	0.7	2.0	0.9	3.2	2.1	4.6	1.3	2.0	4.2	2.3	3.4
E	20.0	14.4	7.0	3.1	14.0	**23.8**	15.4	10.3	10.5	10.5	**23.4**	11.9	12.9	14.5
ESE	1.2	1.5	0.6	0.7	4.8	3.7	3.5	6.0	1.6	1.2	1.0	1.2	3.4	1.1
SE	2.7	9.1	3.6	7.1	12.0	20.5	16.5	**15.3**	16.9	15.1	10.4	5.8	14.7	7.8
SSE	0.5	0.1	0.2	0.1	0.9	2.2	1.1	1.1	0.9	1.1	—	0.4	1.1	0.4
S	2.5	0.7	1.9	3.6	4.9	7.8	7.0	9.6	3.7	3.2	10.8	3.8	6.1	3.8
SSW	0.1	1.0	—	0.1	0.7	0.3	0.3	0.2	0.6	0.3	0.2	0.7	0.4	0.4
SW	4.1	2.3	3.1	7.8	7.2	8.0	5.1	6.9	5.3	7.1	5.1	5.4	6.7	4.5
WSW	—	0.1	0.5	0.3	0.2	0.3	0.1	1.0	0.4	0.2	0.3	1.8	0.4	0.5
W	6.3	4.4	1.6	5.6	5.7	3.6	3.7	3.7	3.7	6.2	2.3	5.3	4.3	4.4
WNW	—	2.0	5.3	3.7	2.8	0.9	0.4	0.4	0.5	0.8	0.7	1.2	1.5	1.7
NW	5.5	15.1	24.0	**23.0**	11.4	8.8	8.2	7.9	10.0	**17.3**	7.0	**18.0**	11.6	14.5
NNW	0.2	4.4	5.1	8.1	0.6	0.1	0.7	3.3	1.3	2.6	1.8	2.6	2.4	2.8
Circulating	3.8	0.1	2.7	4.5	2.0	2.3	1.4	3.3	1.3	3.4	2.0	2.8	2.5	2.5
Variable	2.0	0.9	1.8	1.5	1.7	0.9	3.4	1.6	2.5	0.5	0.4	0.4	1.9	1.0
Calm	2.5	2.2	2.3	0.4	2.7	1.1	1.5	1.3	3.3	5.0	3.7	2.0	1.7	3.0

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	0.6	3.4	3.4	2.8	—	1.5	2.3	3.0	1.8	1.2	3.4	0.9	1.9	2.2
NNE	—	1.5	—	—	—	—	0.1	0.2	0.4	3.3	—	0.8	0.1	0.9
NE	7.9	0.9	3.5	0.3	1.3	2.6	2.4	2.1	5.1	0.2	3.8	5.7	2.3	3.7
ENE	0.9	0.4	0.6	—	0.2	0.2	0.3	0.3	0.1	0.1	—	0.7	0.2	0.5
E	12.4	2.1	5.6	0.9	5.0	4.4	3.1	1.4	3.4	2.2	8.9	4.1	3.0	5.9
ESE	0.9	2.0	1.4	0.5	2.7	1.2	0.7	1.0	2.7	0.2	0.8	0.5	1.5	1.0
SE	9.2	9.1	7.7	8.3	13.6	11.0	6.7	7.2	3.2	10.3	18.8	10.1	8.3	10.9
SSE	1.2	0.4	0.8	3.6	3.1	1.4	1.3	3.5	2.3	1.4	4.0	1.1	2.5	1.5
S	6.6	10.9	8.8	10.5	13.7	14.4	24.1	22.2	**25.8**	17.4	9.5	13.6	18.5	11.1
SSW	5.1	1.3	4.4	6.1	3.1	4.7	4.9	6.0	8.0	3.7	4.4	3.6	5.5	3.8
SW	**29.0**	**34.1**	**27.4**	**29.8**	**28.4**	**36.7**	**33.1**	**27.6**	21.8	**32.0**	**21.4**	**25.5**	**29.6**	**28.2**
WSW	2.4	0.4	1.0	5.3	3.6	0.6	0.9	1.1	0.7	2.8	1.8	2.4	2.0	1.8
W	9.2	9.0	13.5	10.9	13.1	12.4	8.9	9.4	8.3	14.4	12.4	10.7	10.5	11.5
WNW	1.4	1.1	2.3	3.2	1.1	0.7	0.4	0.5	0.4	1.1	1.4	1.3	1.1	1.4
NW	5.9	15.4	11.2	7.7	4.2	3.4	3.9	5.6	9.1	4.5	2.3	11.5	5.7	8.5
NNW	0.3	2.2	—	1.8	0.6	—	—	—	—	0.1	0.5	2.6	0.4	1.0
Circulating	4.2	2.7	1.1	5.1	2.1	2.8	4.0	1.4	1.7	1.2	1.3	3.4	2.9	2.3
Variable	0.1	—	5.2	1.6	2.5	1.2	1.2	3.2	3.0	0.5	0.7	—	2.1	1.1
Calm	3.0	3.1	2.1	1.6	1.7	0.6	1.7	4.6	2.3	3.3	4.6	1.3	2.1	2.9

CONDITION OF THE SEA, PERCENTAGE.

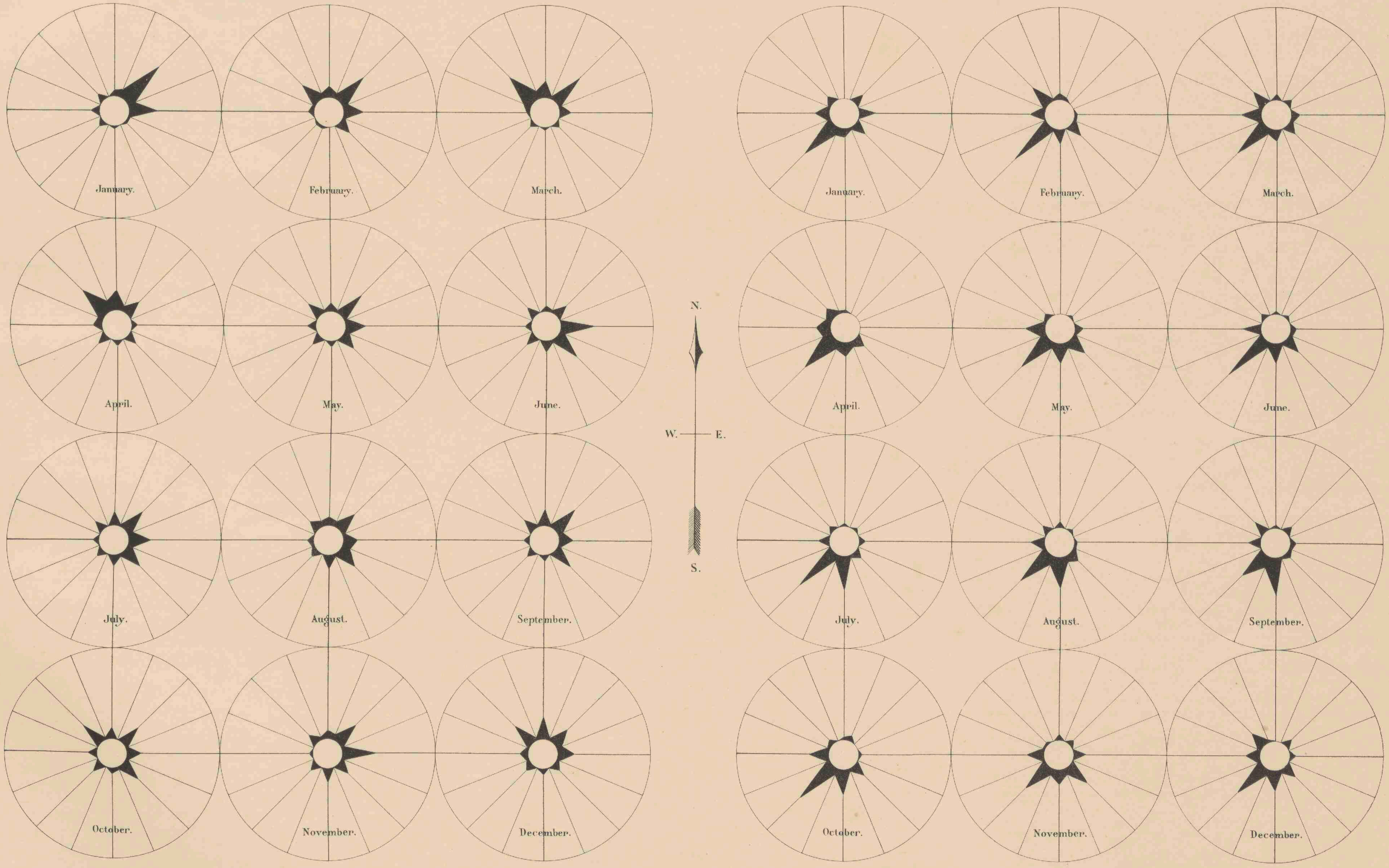
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	36.4	18.4	13.2	10.7	19.0	27.8	32.4	29.0	36.0	18.5	24.4	34.5	25.8	24.2
High Swell	0.8	0.2	0.1	0.5	0.3	0.8	2.2	1.4	0.1	0.9	1.3	2.8	0.9	1.0
Waves	0.1	0.4	0.1	—	—	0.4	0.1	—	0.1	0.2	0.1	0.1	0.1	0.2
Sea	6.3	5.4	5.2	4.5	6.1	2.4	1.6	6.5	5.3	3.3	2.9	3.5	4.4	4.4
High Sea	0.8	0.2	—	—	—	0.1	0.3	—	0.6	0.1	0.4	0.1	0.2	0.3
Calm	55.8	75.5	81.5	84.4	74.8	68.7	63.6	63.2	58.2	77.1	71.1	59.0	68.8	70.0
Number of Observations	708	578	605	543	463	740	1074	911	640	866	844	1228	4371	4829

CONDITION OF THE WEATER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	55.9	62.3	66.4	51.7	59.2	50.3	54.5	51.3	50.5	42.2	38.3	42.2	52.9	51.2
Overcast	26.2	26.2	19.8	27.7	22.9	26.9	27.8	26.8	23.9	33.8	31.4	25.4	26.0	27.1
Showery	2.6	2.3	0.4	2.2	2.6	1.2	2.4	1.7	3.6	1.2	2.1	3.5	2.3	2.0
Rain	14.3	8.9	9.4	14.2	12.4	14.7	11.2	15.7	21.1	22.4	27.4	27.0	14.9	18.2
Squalls	0.2	—	—	0.2	0.6	0.5	0.9	0.8	0.4	0.1	0.2	0.1	0.6	0.1
Thunder	—	—	1.1	2.4	0.3	0.1	0.5	0.6	0.4	0.1	0.4	0.8	0.7	0.4
Hazy	0.8	0.3	3.1	1.8	2.3	6.6	2.9	3.1	0.3	0.1	0.4	0.8	2.8	0.9
Mist	—	—	—	0.1	—	—	—	—	—	—	—	—	0.0	—
Number of Observations	709	723	638	618	580	765	1132	856	697	930	882	1227	4648	5109

II. ATJEH, EASTERN COAST FROM DELI RIVER TO DIAMOND POINT.

DAY. NIGHT.



III. ATJEH, NORTH-EAST-COAST, FROM DIAMOND POINT TO BATOE-PEDIR.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	23	67	N 71° E	E N E	71 %	1.4	755
February	36	50	N 54° E	N E	62	1.3	723
March	32	43	N 53° E	N E	54	1.3	758
April	40	— 3	N 4° W	N	40	1.3	622
May	23	5	N 12° E	N N E	24	1.3	713
June	14	9	N 33° E	N N E	17	1.3	685
July	17	9	N 28° E	N N E	19	1.4	645
August	7	11	N 58° E	E N E	13	1.3	917
September	15	2	N 8° E	N	15	1.4	890
October	19	3	N 9° E	N	19	1.2	765
November	19	34	N 61° E	E N E	39	1.2	570
December	21	56	N 69° E	E N E	60	1.4	683
Year	22	24	N 47° E	N E	33	1.32	8726

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—50	29	S 30° E	S S E	58 %	1.1	729
February	—56	8	S 8° E	S	57	1.1	698
March	—59	— 8	S 8° W	S	60	1.1	710
April	—69	—27	S 21° W	S S W	74	1.1	564
May	—54	—17	S 17° W	S S W	57	1.2	667
June	—64	—13	S 11° W	S	65	1.2	597
July	—58	—10	S 10° W	S	59	1.1	620
August	—58	—13	S 13° W	S S W	59	1.2	934
September	—59	—12	S 12° W	S S W	60	1.2	868
October	—45	— 9	S 11° W	S	46	1.1	717
November	—55	10	S 10° E	S	56	1.1	556
December	—51	19	S 20° W	S S E	54	1.2	672
Year	—57	— 4	S 4° W	S	57	1.14	8332

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—14	48	S 74° E	E S E	50 %	1.3	1484
February	—10	29	S 71° E	E S E	31	1.2	1421
March	—14	18	S 52° E	S E	23	1.2	1468
April	—15	—15	S 45° W	S W	21	1.2	1186
May	—16	— 6	S 21° W	S S W	17	1.3	1380
June	—25	— 2	S 5° W	S	25	1.3	1282
July	—21	— 1	S 3° W	S	21	1.3	1265
August	—26	— 1	S 2° W	S	26	1.3	1851
September	—22	— 5	S 13° W	S S W	23	1.3	1758
October	—13	— 3	S 13° W	S S W	13	1.2	1482
November	—18	22	S 51° E	S E	28	1.2	1126
December	—15	38	S 69° E	E S E	41	1.3	1355
May—September	—20	— 5	S 14° W	S S W	21	1.27	10204
October—April	—14	31	S 66° E	E S E	34	1.24	6854
Year	—17	10	S 30° E	S S E	20	1.26	17058

The inspection of the summarizing table, given in the introduction, and of Table C, shows at once that this part of *Sumatra's* coast is situated within the limits of the north-east and south-west monsoon of the *Indian Ocean.*

The percentages of the mean direction are still very low; from April to October, when the S and S W monsoon blows regularly, they never surpass 30 %.

In December and January however the E S E monsoon, which at the east-coast is hardly perceptible, is well marked with percentages amounting to 41 % and 50 %.

Here again the vicinity of the mountainrange to the coast is favourable to the full development of land- and seabreezes.

By subtracting the average components for the night-hours from those for day-time and dividing by 2, we find the direction of the seabreeze to be N 19° E with a percentage of 42 % and the direction of the landbreeze S 19° W; this being the maximum height of land- and seabreezes throughout the Archipelago.

The differences between the mean directions of the wind for the night- and for the day-time are, therefore, even more strongly marked here than at the east-coast.

From April to October S and S S W winds prevail during night-, and N and N N E winds during day-hours.

During these months the S W monsoon-winds counteract to a great extent the N N E seabreeze, which is the reason why the percentages of the steadiness are low in Table B, winds of varying directions being experienced at day-time.

During the night-hours, on the contrary, the S W monsoon-winds and the landbreeze set in the same direction and steady S and S W winds will ensue with large percentages.

From December to March the E S E monsoon blows *along* the coast in a direction almost at right angles to that of the land- and seabreezes, thus giving rise to a S S E resultant in night- and a N E resultant in day-time, both with increased percentages of steadiness.

The force of the wind, however, does not increase at the same rate as the steadiness: on the contrary, the force in day-time not inconsiderably exceeds that during night-hours, the proportion being 1.32 to 1.14.

Fine weather with a bright sky is mostly experienced during the three first months of the year; heavy squalls never occur during this season.

February and March are the dry months; in April, when the S W monsoon sets in, the weather becomes more unsettled, and from June to August a force of the wind greater than 4 has at times, though not often, been registered: heavy squalls are seldom met with.

October to December are the wet months which proves that it is not the E S E monsoon as such that brings rain or drought because the periods of maximum as well as those of minimum rainfall fall within the limits of the same E S E monsoon.

Charts have been drawn up with a view of showing at the same time the distribution of the monsoons during two periods of the year — generally April to September and October to March — and that of the rainfall.

In some parts, e. g. the *Java-sea*, this method may answer the purpose well enough, but in many regions it is impossible to discern two distinct monsoons and in other parts the two seasons, as defined by the prevailing directions of the wind, do not coincide with the two seasons as marked by the distribution of the rainfall.

The north-east-coast of *Atjeh* being more freely exposed to the influence of the *Indian Ocean* than the east-coast, the swell of the sea is more considerable than eastward from *Batoe-Pedir.*

March and April are, in this respect, the best months with percentages of „calm sea" amounting to 81 % and 85 %; February, October and November follow with percentages resp. of 76 %, 74 % and 70 %.

As the main current sets to the W N W ward during every season, strong currents may be met with, especially in this west-north-westerly direction, when the ebb sets in, which, for the same reason, runs longer and stronger than the flood.

Rainfall is observed at *Telok Semawé* and tidal stations have been established at *Telok Semawé* and *Segli.*

TABLE D. ATJEH, NORTH-EAST-COAST, FROM DIAMOND POINT TO BATOE-PEDIR.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	3.9	9.6	8.8	**20.8**	12.0	10.2	12.7	7.9	11.8	7.8	9.0	6.6	12.6	7.6
N N E	3.5	5.6	3.7	4.5	3.7	3.5	3.5	3.7	1.9	1.7	2.8	1.2	3.3	3.1
N E	26.2	**28.6**	**29.6**	13.1	12.9	9.9	**18.5**	**14.8**	**17.1**	**14.7**	**20.0**	24.3	**14.4**	**23.9**
E N E	14.4	11.9	8.3	3.1	2.8	2.5	3.4	3.9	2.4	3.3	4.3	10.3	3.0	8.8
E	**29.6**	19.7	17.9	8.0	11.2	11.9	7.1	11.0	7.7	9.6	18.4	**28.1**	9.5	20.6
E S E	2.9	2.1	1.5	0.6	1.6	0.5	1.7	3.0	1.2	1.9	3.3	3.0	1.4	2.5
S E	7.8	4.5	6.9	3.3	7.8	**13.8**	7.4	8.3	6.5	6.6	10.6	9.1	7.8	7.6
S S E	0.3	0.1	0.1	0.1	0.4	1.0	0.8	0.8	0.8	0.2	0.5	1.4	0.7	0.4
S	2.3	1.5	2.6	4.3	4.4	6.8	4.8	6.0	7.3	5.4	4.2	2.2	5.6	3.0
S S W	0.1	0.1	0.5	0.3	1.0	1.4	1.9	2.1	1.3	0.7	0.2	0.3	1.3	0.3
S W	1.0	1.5	2.2	4.5	4.5	9.1	9.5	11.6	10.6	7.8	4.1	1.0	8.3	2.9
W S W	—	0.2	0.4	1.4	0.6	0.7	2.1	1.6	1.5	0.7	0.6	0.3	1.3	0.4
W	1.7	3.5	2.6	7.8	10.3	8.2	5.9	6.9	7.5	8.0	3.5	3.7	7.8	3.8
W N W	—	1.4	0.9	1.4	1.1	0.5	1.9	1.1	1.0	4.9	0.4	0.1	1.2	1.3
N W	1.4	2.4	6.4	18.4	**15.1**	9.4	7.0	8.8	12.3	14.5	8.9	4.5	11.8	6.4
N N W	0.5	1.7	1.3	2.0	1.8	3.2	1.3	1.3	2.5	2.2	1.7	0.7	2.0	1.4
Circulating	2.0	3.1	3.2	4.2	5.9	5.4	7.1	4.6	4.9	5.3	4.8	1.9	5.4	3.4
Variable	0.2	0.4	0.7	0.3	0.9	1.2	0.9	1.2	1.3	1.0	0.1	—	1.0	0.4
Calm	2.4	2.6	3.0	2.6	2.6	1.4	3.1	1.9	1.4	4.3	3.0	1.7	2.2	2.8

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	0.5	1.1	0.9	0.1	1.4	0.9	1.0	0.1	1.2	0.9	1.3	1.3	0.8	1.0
N N E	0.5	0.4	0.1	—	0.2	—	—	0.3	0.3	0.2	0.3	0.3	0.1	0.3
N E	3.4	2.2	1.1	0.3	1.3	0.9	2.0	1.3	1.7	2.1	1.8	3.3	1.3	2.3
E N E	3.4	1.0	1.0	0.2	0.6	0.4	0.1	0.2	—	1.0	0.5	1.6	0.3	1.4
E	12.4	7.8	7.0	2.1	2.6	1.1	3.9	3.6	2.8	3.9	6.0	10.0	2.7	7.9
E S E	6.0	2.3	1.3	0.4	0.5	3.1	1.2	1.2	3.4	2.2	1.8	3.5	1.6	2.9
S E	22.2	16.5	12.2	7.2	11.8	13.1	12.6	15.9	18.6	14.1	**24.7**	**23.1**	13.2	18.8
S S E	4.6	6.5	4.4	0.8	3.6	3.2	3.9	4.4	2.8	3.4	4.7	5.9	3.1	4.9
S	**23.0**	**29.5**	**27.3**	**35.1**	**26.5**	**33.0**	**28.7**	23.4	23.9	**22.3**	24.1	21.8	**28.4**	**24.7**
S S W	2.6	3.8	6.6	8.2	5.3	5.4	4.9	5.9	5.8	2.9	3.7	3.4	5.9	3.8
S W	10.9	12.7	23.1	24.5	23.6	22.7	20.8	**24.9**	**24.1**	17.6	14.3	13.8	23.4	15.4
W S W	1.1	1.3	1.1	1.0	2.2	1.5	2.6	2.2	1.3	2.4	1.1	0.4	1.8	1.2
W	1.3	4.8	4.4	11.1	7.7	5.6	6.4	6.0	6.6	8.6	4.4	3.3	7.2	4.5
W N W	0.3	1.0	1.0	—	0.3	2.2	0.7	0.1	0.7	3.2	0.4	0.4	0.7	1.1
N W	1.3	2.0	3.1	2.3	5.9	1.1	1.6	4.8	2.6	4.2	2.7	3.0	3.1	2.7
N N W	0.1	0.4	0.2	0.7	0.1	0.8	—	0.3	—	0.2	0.1	0.3	0.3	0.2
Circulating	1.9	2.9	0.7	2.4	3.7	1.1	2.1	1.5	1.1	3.0	3.9	2.6	2.0	2.5
Variable	0.6	0.4	0.5	1.1	0.2	0.2	0.7	1.1	0.2	0.2	0.1	—	0.6	0.3
Calm	4.7	3.9	4.8	3.1	3.0	4.2	7.3	3.5	3.3	7.4	4.2	2.5	4.1	4.6

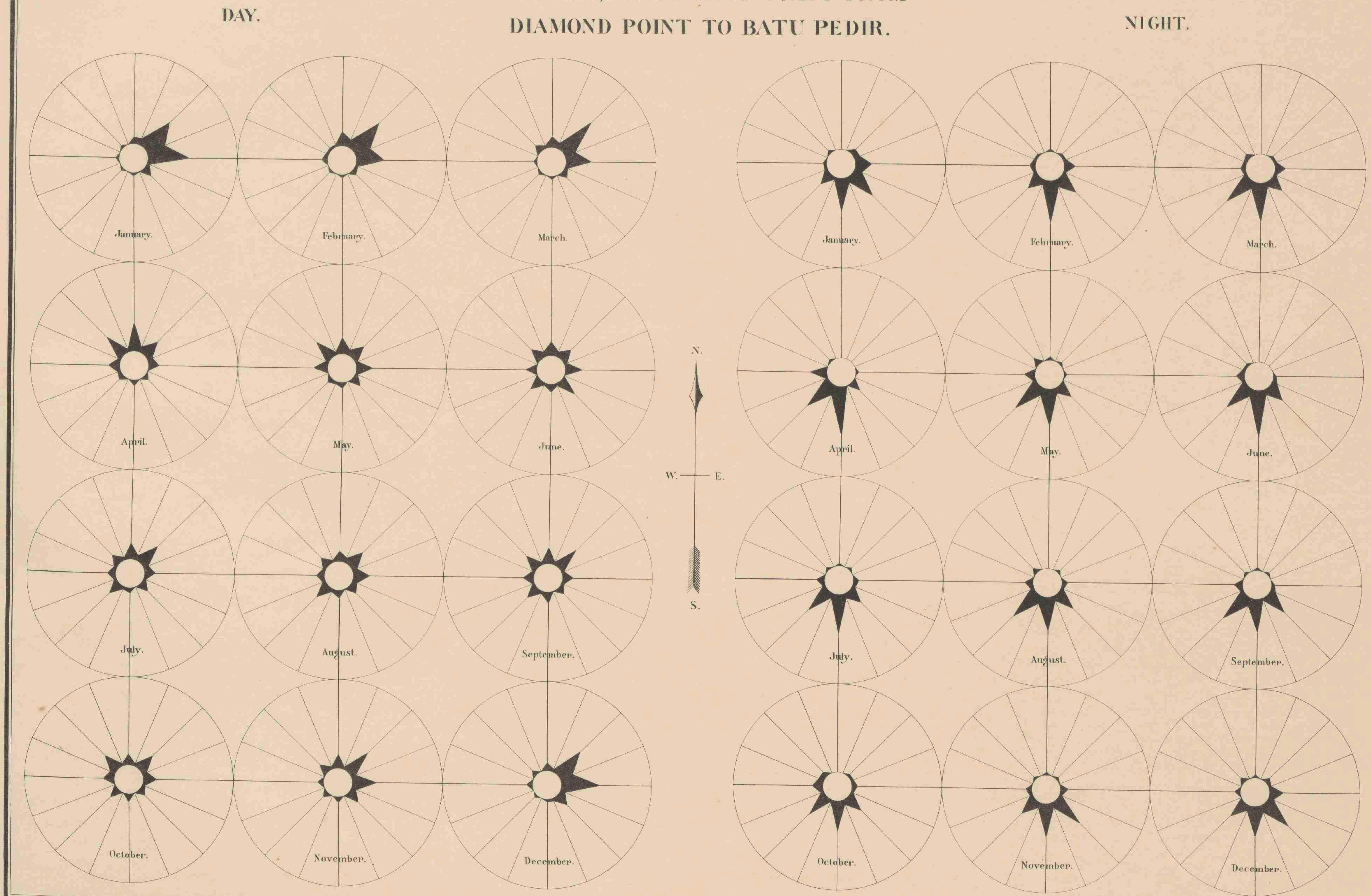
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	27.6	18.9	15.6	11.1	39.4	35.3	32.5	38.5	33.7	22.3	27.0	46.0	31.8	26.2
High Swell	0.4	0.1	—	—	1.0	0.5	0.9	1.9	1.7	0.5	0.1	0.7	1.0	0.3
Waves	0.1	0.5	0.1	0.5	0.1	0.3	0.3	0.7	—	0.3	—	0.3	0.3	0.2
Sea	7.6	4.5	3.5	3.7	6.0	4.1	4.6	2.5	3.5	3.6	2.9	6.9	4.1	4.8
High Sea	0.2	—	0.1	—	—	0.1	0.1	0.2	0.2	0.1	—	—	0.1	0.1
Calm	64.4	76.2	80.9	84.9	53.9	59.9	61.9	56.4	61.1	73.5	70.2	46.2	63.0	68.6
Number of Observations	1406	1339	1423	1093	1327	1255	1159	1674	1614	1310	994	1182	8122	7654

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	60.2	66.5	65.5	56.1	52.4	58.7	51.0	47.4	54.3	43.8	42.9	46.7	53.3	54.3
Overcast	24.1	23.1	23.9	29.0	28.2	27.3	34.0	37.1	29.2	31.6	34.0	31.6	30.8	28.1
Showery	1.8	0.7	1.5	1.2	2.4	1.4	1.6	1.6	2.1	2.2	2.2	2.1	1.7	1.8
Rain	13.0	8.0	6.7	9.8	14.0	10.7	8.8	12.1	13.2	21.7	20.2	19.6	11.4	14.9
Squalls	—	—	—	0.3	0.1	0.4	0.3	0.3	0.3	0.1	—	—	0.3	0.0
Thunder	0.2	0.3	0.9	0.7	1.3	0.1	1.1	0.5	0.4	0.3	0.7	0.1	0.7	0.4
Hazy	1.0	1.8	1.9	3.0	1.8	1.7	3.5	1.4	0.8	0.6	0.3	0.1	2.0	1.0
Mist	—	—	—	—	0.1	0.2	0.1	—	—	—	—	—	0.1	—
Number of Observations	1487	1382	1462	1189	1345	1282	1297	1858	1714	1449	1120	1315	8685	8215

III. ATJEH, NORTH EAST COAST FROM DIAMOND POINT TO BATU PEDIR.



IV. ATJEH, NORTH-COAST, FROM BATOE-PEDIR TO OLEH-LEH.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	22	73	N 74° E	E N E	76 %	1.7	540
February	29	63	N 65° E	E N E	69	1.5	589
March	27	44	N 59° E	E N E	52	1.4	793
April	12	— 5	N 23° W	N N W	13	1.3	441
May	— 2	—17	S 83° W	W	17	1.4	383
June	—22	—36	S 59° W	W S W	42	1.7	752
July	—32	—42	S 52° W	S W	53	1.7	860
August	—41	—51	S 51° W	S W	65	1.8	669
September	—30	—43	S 54° W	S W	52	1.7	559
October	—14	—27	S 62° W	W S W	30	1.4	613
November	1	23	N 89° E	E	23	1.3	906
December	6	60	N 84° E	E	60	1.5	945
Year	— 4	4	S 45° E	S E	6	1.53	8050

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—29	58	S 64° E	E S E	65 %	1.6	542
February	—44	35	S 38° E	S E	56	1.4	552
March	—59	29	S 27° E	S S E	66	1.3	777
April	—43	—10	S 13° W	S S W	44	1.2	394
May	—54	—28	S 27° W	S S W	61	1.4	358
June	—59	—33	S 30° W	S S W	68	1.6	711
July	—58	—42	S 36° W	S W	72	1.6	840
August	—62	—48	S 39° W	S W	78	1.7	647
September	—55	—40	S 36° W	S W	68	1.6	532
October	—56	—25	S 24° W	S S W	61	1.3	628
November	—43	19	S 23° E	S S E	47	1.3	907
December	—41	53	S 52° E	S E	67	1.5	936
Year	—50	— 3	S 4° W	S	50	1.46	7824

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	— 4	66	S 87° E	E	66 %	1.7	1082
February	— 8	49	S 81° E	E	50	1.5	1141
March	—16	37	S 67° E	E S E	40	1.4	1570
April	—16	— 8	S 27° W	S S W	18	1.3	835
May	—28	—23	S 39° W	S W	36	1.4	741
June	—41	—35	S 41° W	S W	54	1.7	1463
July	—45	—42	S 43° W	S W	62	1.7	1700
August	—52	—50	S 44° W	S W	72	1.8	1316
September	—43	—42	S 45° W	S W	60	1.7	1091
October	—35	—26	S 37° W	S W	44	1.4	1241
November	—21	21	S 45° E	S E	30	1.3	1813
December	—18	57	S 73° E	E S E	60	1.5	1881
April—October	—37	—32	S 41° W	S W	49	1.57	8387
November—March	—13	46	S 74° E	E S E	48	1.48	7487
Year	—27	0	S	S	27	1.53	15874

Whereas at the east-coast only very feeble traces of monsoons are to be found and at the north-east-coast the monsoons begin to blow, but with rather small percentages of steadiness, we find at the north-coast two well defined seasons.

The S W monsoon sets in in April — when however land- and seabreezes still play a dominant part — comes to full development in July, August and September, and lasts till October.

The E monsoon blows from November to March: in November and December however S E and E S E winds prevail and the true E monsoon does not set in with full force before January: it would therefore, from a climatological point of view, be more correct to discern *three* seasons viz. a S W monsoon from April to October, an E monsoon in January and February, and a S E—E S E monsoon in November, December and March. Near the coast however the influences of the monsoons are not strong enough to neutralize those of the land- and seabreezes: on subtracting the components given in Table A from those of Table B, we find that these local winds blow with large percentages during the eight months from October to May and with much lower percentages from June to September when the S W monsoon has attained its full development: in February and March land- and seabreezes appear to come off strongest.

The average direction and percentage of steadiness are N 9° E for the seabreeze, S 9° W for the landbreeze and 23 % for the steadiness: but in February this percentage amounts to 44 %.

During the S W monsoon the landbreeze is strengthened by the prevailing winds and we find in Table B for the night-hours a steady direction with large percentages: during day-time however the monsoonwind tends to diminish the effect of the seabreeze and lower percentages are found and more winds from varying directions.

For January and February, on the other hand, Table C does not exhibit southerly or northerly components to any appreciable extent due to monsoon influences. Land- and seabreezes therefore are neither counteracted nor strengthened by the prevailing monsoonwinds, but both influences unite in forming resulting directions viz. E N E at day-time and E S E at night-hours.

The weather in these parts is characterized by rather strong winds, with an average force of 1.53 — to 1.26 at the north-east-coast — a clear sky and moderate rainfall.

A force greater than 3 has been registered 111 times, 60 of which fell on night- and 51 on day-hours, almost exclusively during the months June to September and from the S W, W S W and W ward.

Fine weather with bright skies and absence of showers and heavy squalls is experienced during the dry months February and March: during and after April, when S W winds begin to blow, showery weather and occasional heavy squalls, at times accompanied by rain, are experienced: these squalls are not, as at the east-coast, due to the sudden coming off of the landbreeze, but they originate in the western ocean and, therefore, are of longer duration than the „Sumatranen" and occur as well at day-time as at night-hours.

The rainy season lasts from April to November and thus sets in and ends earlier than it does at the north-east- and east-coast.

The swell of the sea, owing to the protection afforded by the isles *Poeloe Weh* and *Poeloe Bras*, is somewhat less here than at the north-east-coast, but the sea is considerably rougher than at the eastern shores, especially from June to September, when the strong S W winds, blowing in opposite direction to the main current and the ebb current, cause a rather high sea.

The best months in this respect are March and April, February, November and October. At *Oleh-leh* the port-establishment is $9^h\ 45^m$.

The extraordinary intensity of land- and seabreezes at *Atjeh's* east-, north-east- and north-coast gives rise to the following remarks.

The ancient belief of an immediate influence of the moon upon the weather has been proved erroneous by many investigations and a consequence of the lack of discernment between impression and observation.

At places however where, as at *Sumatra's* east-coast, a strong tendency exists to a development of land- and seabreezes, and where, at the same time, the height of the water is liable to considerable oscillations owing to tidal influences, a causal connection between the force of the wind and the moon's age might be proved to exist.

When, for instance, the fall of the water at a certain date is strongest at 8 a. m. and at 8 p. m., it is evident that, by this influence, the seabreeze in the morning will be hindered in its development, whilst, for the same reason, the coming off of the landbreeze after sunset will be promoted.

Consequently, in classifijing data concerning the velocity of the wind for a certain hour of the day according to the period of the moon's age, two maxima and two minima will be found in the computed average values, whilst the position of the maxima and minima will be inversed when the hours of observation made use of differ 12 hours.

These maxima and minima will come out strongest when components of the wind at right angles to the direction of the coast-line are arranged and when observations are used made at hours when the land- and seabreezes usually begin to blow.

Their determination might be proved useful in foretelling, by means of the known port-etablishment, the probability of occurrence of the above-mentioned „Sumatranen".

Near the mouth of the *Deli-river* e. g. according to these views the landbreeze will be feeble and the seabreeze stronger than usual on the 4^{th} day after the date of full and change, and, inversely, the landbreeze strong and the seabreeze weak on the 11^{th} day after new and full moon.

A causal connection of this kind has been stated to exist at other parts of the world and it would be of some importance if wind-observations were made on *Atjeh's* east-coast with a view of stating the exact relation which, in these parts, must exist between the wind to be expected and the moon's age or hour-angle.

Rainfall is observed at *Kotta Radja* and tidal stations have been established at *Oleh-leh* and *Poeloe Weh*.

TABLE D. ATJEH, NORTH-COAST, FROM BATOE-PEDIR TO OLEH-LEH.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	2.7	7.4	7.8	9.5	5.0	5.8	4.8	5.0	4.6	8.4	8.6	3.3	5.8	6.4
N N E	0.5	2.1	2.9	1.3	0.6	1.2	1.5	0.4	2.1	0.3	1.1	1.0	1.2	1.3
N E.	**36.4**	**30.4**	**32.9**	**15.6**	13.1	8.1	5.2	1.0	3.1	8.6	14.9	25.5	7.7	**24.8**
E N E.	7.7	13.0	5.9	1.8	0.4	0.8	1.2	—	0.8	1.5	3.3	5.4	0.8	6.1
E	32.1	27.8	18.4	8.9	8.4	4.0	3.2	2.5	2.8	5.8	**17.7**	**31.2**	5.0	22.2
E S E.	4.0	3.2	3.0	0.8	1.2	0.3	0.5	0.3	0.1	0.3	1.7	2.4	0.5	2.4
S E	10.1	4.8	7.1	6.5	6.9	2.0	2.1	2.7	4.7	5.4	15.5	13.9	4.2	9.5
S S E.	0.6	0.4	1.0	0.5	0.1	0.4	0.2	0.3	0.7	1.1	0.9	0.7	0.4	0.8
S	1.3	1.7	2.8	4.2	5.2	5.3	10.2	7.9	8.2	5.7	5.2	4.9	6.8	3.6
S S W	—	0.3	0.4	0.3	2.9	5.8	4.0	4.0	3.4	1.7	1.1	0.9	3.4	0.7
S W	0.7	1.5	3.5	14.6	**17.1**	**36.7**	**41.5**	**50.8**	**37.3**	**25.0**	9.6	3.4	**33.0**	7.3
W S W.	—	0.7	0.5	2.3	5.1	7.7	5.3	3.5	8.2	2.0	1.0	0.2	5.4	0.7
W	1.2	1.4	4.7	9.2	13.3	6.7	11.8	12.6	13.2	14.9	8.0	1.9	11.1	5.4
W N W	0.3	0.2	0.8	0.3	2.1	0.8	1.7	0.7	1.0	1.4	0.7	0.3	1.1	0.6
N W	1.0	1.7	4.1	14.5	10.7	8.5	5.1	3.3	4.6	11.4	5.5	1.5	7.8	4.2
N N W.	0.2	0.4	1.0	0.9	2.1	0.4	—	1.5	1.7	0.7	0.7	0.3	1.1	0.6
Circulating	0.3	1.9	1.4	2.5	2.3	3.0	1.1	1.5	2.1	2.3	1.4	0.9	2.1	1.4
Variable	1.4	0.2	0.7	1.1	0.8	1.4	0.6	1.7	1.1	1.5	0.9	1.2	1.1	1.0
Calm	—	1.5	1.6	5.5	2.9	1.5	0.5	0.7	0.8	2.2	3.0	1.6	2.0	1.7

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	1.2	1.2	0.3	2.4	0.2	0.1	1.1	0.1	0.6	1.2	1.5	0.7	0.8	1.0
N N E	—	0.6	0.2	—	—	0.1	—	—	0.2	0.1	0.2	0.1	0.1	0.2
N E.	15.1	4.6	3.3	4.1	0.9	1.4	0.4	0.4	0.9	1.1	4.7	5.2	1.4	5.7
E N E.	1.5	1.4	1.4	0.8	—	0.4	0.2	—	—	0.3	0.7	0.5	0.2	1.0
E	20.7	16.3	9.2	5.3	2.5	2.0	2.2	1.2	1.8	3.3	10.9	24.8	2.5	14.2
E S E.	6.7	4.9	3.0	1.2	1.2	0.9	0.7	0.3	0.4	1.1	4.0	4.1	0.8	4.0
S E	**34.1**	**26.9**	**30.5**	11.5	14.2	6.2	6.4	5.5	7.1	8.3	**27.0**	**36.8**	8.5	**27.3**
S S E.	2.1	2.7	5.3	2.9	2.2	1.7	0.7	1.6	3.6	4.2	3.9	2.6	2.1	3.5
S	10.0	22.2	28.8	**28.4**	20.4	21.4	19.1	15.1	15.0	27.7	14.3	11.8	19.9	19.1
S S W	1.2	1.3	1.1	2.2	3.0	10.2	6.0	7.8	3.7	2.6	1.2	2.0	5.5	1.6
S W	2.6	6.5	8.5	14.8	**28.5**	**35.5**	**43.3**	**48.3**	**43.6**	**27.8**	14.2	4.4	**35.7**	10.7
W S W.	0.4	0.9	0.2	1.3	4.2	5.7	3.7	5.9	4.2	2.8	1.6	0.2	4.2	1.0
W	0.9	3.2	2.1	12.3	15.1	6.0	11.5	9.8	10.2	12.5	6.1	1.5	10.8	4.4
W N W	0.4	0.6	0.1	0.7	0.9	0.5	0.8	0.3	1.4	0.9	0.4	0.2	0.8	0.4
N W	0.4	1.5	1.1	5.5	3.4	4.1	2.0	1.9	2.6	2.4	2.5	1.3	3.3	1.5
N N W.	—	0.3	0.3	0.2	—	0.1	0.1	0.3	—	—	0.1	0.2	0.1	0.2
Circulating	1.0	1.6	1.8	0.8	0.9	1.1	0.5	0.6	1.4	1.1	1.8	1.0	0.9	1.4
Variable	1.2	1.6	1.3	1.0	1.0	0.2	1.0	1.1	1.6	—	1.0	1.4	1.0	1.1
Calm	0.9	2.7	2.2	4.9	1.2	2.9	0.9	0.8	2.1	3.1	4.3	1.6	2.1	2.5

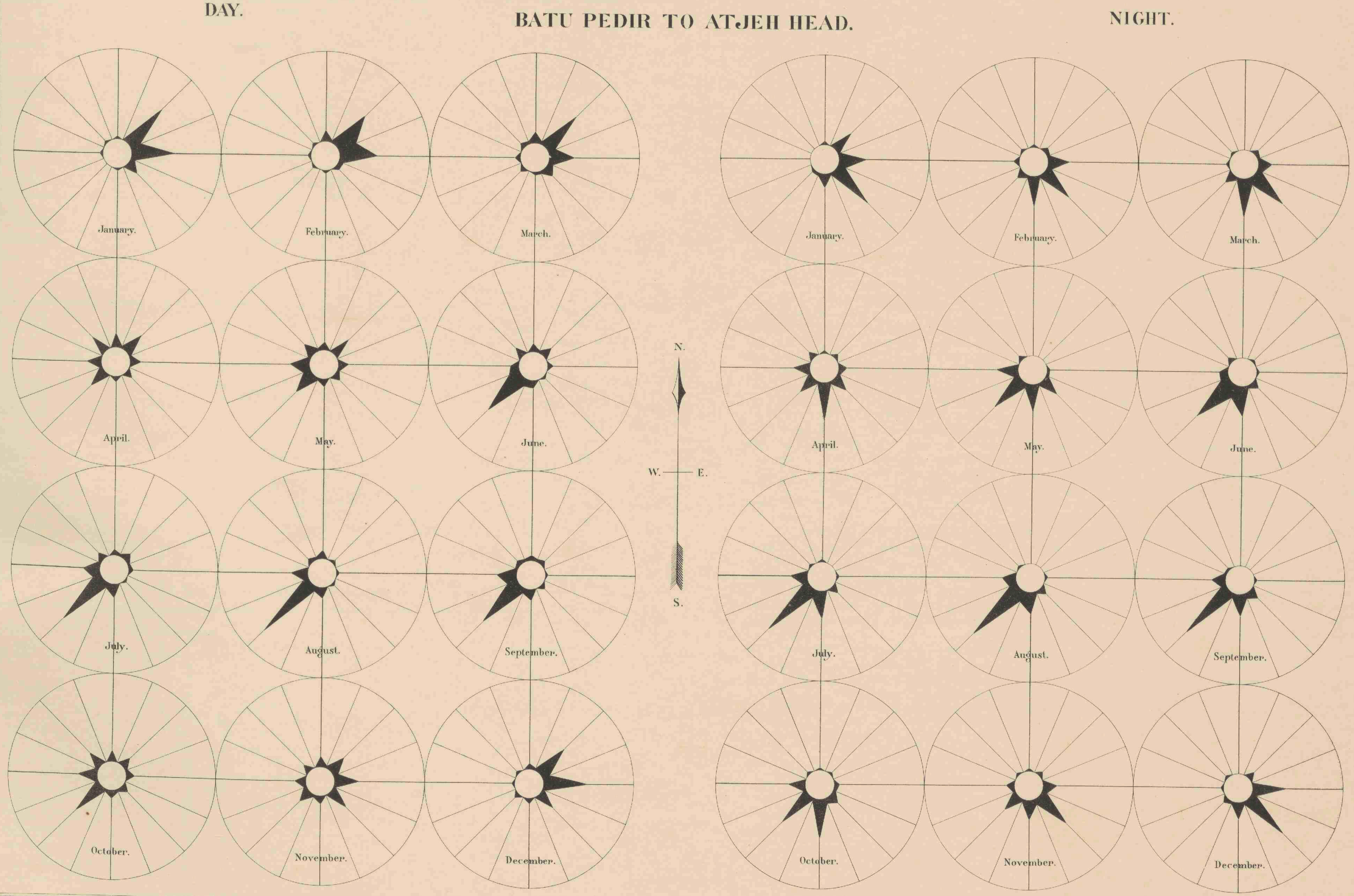
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	21.6	12.1	8.5	10.1	23.1	34.4	31.1	21.4	24.0	21.4	17.9	21.2	24.0	17.1
High Swell.	0.1	0.8	—	—	0.1	1.2	0.3	0.7	0.4	0.9	0.1	0.4	0.5	0.4
Waves	—	0.2	0.1	—	0.2	0.1	0.2	0.2	0.3	0.2	0.2	0.6	0.2	0.2
Sea	17.5	10.4	4.1	7.6	6.6	10.0	12.1	20.9	12.7	5.0	6.5	8.9	11.7	8.7
High Sea	—	0.3	—	0.2	—	0.1	0.4	0.3	0.2	—	—	0.2	0.2	0.1
Calm	61.4	76.4	87.4	82.3	70.2	54.4	56.1	56.8	62.7	72.8	75.4	69.0	63.8	73.7
Number of Observations .	953	1043	1393	712	691	1386	1606	1133	1018	1200	1609	1742	6546	7940

CONDITION OF THE WEATER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	59.2	65.2	62.5	59.6	60.5	48.0	50.1	38.0	44.2	43.8	43.3	56.9	50.1	55.2
Overcast	25.1	23.1	24.4	24.1	24.3	30.6	26.2	26.5	23.9	27.0	25.5	24.9	25.9	25.0
Showery	3.3	1.5	1.7	3.5	2.0	6.3	7.2	9.6	8.4	4.2	2.0	1.5	6.2	2.4
Rain	11.8	8.4	8.9	10.6	10.6	13.3	13.1	22.0	21.7	24.3	28.1	16.1	15.2	16.3
Squalls	—	0.1	0.3	0.5	0.6	0.8	2.1	3.4	1.6	0.1	0.4	0.1	1.5	0.2
Thunder	0.2	0.4	1.1	0.9	0.9	—	0.2	—	0.1	0.5	0.3	0.5	0.4	0.5
Hazy	0.7	1.5	1.4	1.1	1.3	1.2	1.6	0.7	0.5	0.5	0.7	0.5	1.1	0.9
Mist	—	—	—	—	—	—	—	—	—	—	0.1	0.1	—	0.0
Number of Observations .	1048	1109	1551	844	733	1433	1673	1325	1089	1247	1760	1851	7097	8566

IV. ATJEH, NORTHERN COAST FROM BATU PEDIR TO ATJEH HEAD.



V. PULU BRAS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	10	86	N 83° E	E	87 %	1.9	256
February	14	79	N 80° E	E	80	1.6	213
March	11	57	N 79° E	E N E	58	1.4	252
April	—15	— 1	S 3° W	S	15	1.3	194
May	—34	—39	S 49° W	S W	52	1.5	183
June	—36	—47	S 53° W	S W	59	1.6	226
July	—49	—56	S 49° W	S W	74	1.6	249
August	—48	—58	S 51° W	S W	75	1.7	222
September	—37	—57	S 57° W	W S W	68	1.6	224
October	—37	—49	S 53° W	S W	61	1.4	255
November	—20	0	S	S	20	1.5	268
December	5	60	N 85° E	E	60	1.5	270
Year	—20	— 2	S 6° W	S	20	1.55	2812

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	— 3	80	S 88° E	E	80 %	1.5	249
February	1	73	N 89° E	E	73	1.4	195
March	— 9	43	S 78° E	E S E	44	1.1	241
April	—29	— 7	S 14° W	S S W	30	1.1	158
May	—43	—40	S 43° W	S W	59	1.2	197
June	—48	—54	S 48° W	S W	72	1.4	196
July	—50	—52	S 46° W	S W	72	1.3	203
August	—35	—57	S 58° W	W S W	67	1.3	190
September	—38	—55	S 55° W	S W	67	1.4	211
October	—39	—48	S 51° W	S W	62	1.2	253
November	—24	— 4	S 10° W	S	24	1.3	232
December	—10	50	S 79° E	E S E	51	1.3	251
Year	—27	— 6	S 13° W	S S W	28	1.29	2536

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	4	83	N 87° E	E	83 %	1.7	505
February	8	76	N 84° E	E	76	1.5	408
March	1	50	E	E	50	1.3	493
April	—22	— 4	S 10° W	S	22	1.2	352
May	—39	—40	S 46° W	S W	56	1.4	380
June	—42	—51	S 51° W	S W	66	1.5	422
July	—50	—54	S 47° W	S W	74	1.5	452
August	—42	—58	S 54° W	S W	72	1.5	412
September	—38	—56	S 56° W	S W	68	1.5	435
October	—38	—49	S 53° W	S W	62	1.3	508
November	—22	— 2	S 5° W	S	22	1.4	500
December	— 3	55	S 87° E	E	55	1.4	521
April—November	—37	—39	S 47° W	S W	54	1.41	3461
December—March	2	66	E	E	66	1.48	1927
Year	—24	— 4	S 9° W	S	24	1.43	5388

The monsoons prevailing near *Pulu Bras* may be considered to constitute the best type of the monsoons of *North-Sumatra*.

The generally admitted definition „monsoons are winds which blow for six months in one direction and for the other six in the contrary direction" is, however, not applicable here, no more than at the north- and north-east-coast.

Neither do the two prevailing directions, namely S W and E, differ 180 degrees, nor are they equally distributed over the whole year.

On the whole north- and north-east-coast of *Atjeh* the Tables C show, for the average direction for the whole year, southerly and south-south-easterly winds with percentages of 20, 27 and 24 %, thus exhibiting the fact, that the general motion of the air is toward the northward.

It is obvious that, if the definition given above holds good, the average values of the components ought to be nearly zero as, for instance, in the *China-sea*.

Land- and seabreezes are very feeble near *Pulu Bras*, only during the E monsoon an appreciable difference is shown by Tables A and B, the seabreeze blowing from the N E, the landbreeze from the S W.

The S W monsoon sets in in April, when the wind is more constant from the S W than from any other point, but W, E and S winds will also be experienced; at the same time the rainfall, which, taken over the whole year, is about twice as heavy as at the N E and N coast, increases, the sky becomes cloudy and showers and occasionally heavy squalls from the W and S W may be expected.

From May to October the wind blows steadily from S W, W and S; fine weather seldom occurs, this monsoon being signalized by foul weather, a clouded sky and a relatively large percentage of showery and squally weather.

During this monsoon a force of the wind greater than 3 was registered 63 times, and frequently with the annotation: storm and continuous gusts.

In November the direction is less steady, the wind blowing at times from the East: in this respect November bears a strong resemblance to April, but rainfall, showers and squalls are about as frequent as during the foregoing bad months.

From December, when the E monsoon sets in — attaining to full development in January and February — to March the rain decreases gradually and with the E winds fine weather may be expected. February and March are the dry months, when the weather is best and showers and squalls are very seldom met with.

The S W and E monsoons blowing near *Pulu Bras* are not to be considered — as is erroneously stated in some books — as continuations resp. of the south-easterly tradewinds of the southern hemisphere, which in passing the equator bend to the right, and of the N E tradewinds of the northern hemisphere, but they must be regarded as true monsoonwinds due to the influence excercised by the vast continent of *Asia*.

The condition of the sea is, as might be expected, on the whole not favourable: the observations evidently having been mostly made at the eastern shore of the isle, the swell of the sea is less than at the north-coast of *Atjeh*, but the percentages of „sea" and „high sea" are considerably higher.

March, April and May are, in this respect, the best months with percentages of „calm sea" amounting to 75, 84 and 88 %; August, September and October follow with percentages resp. of 71, 71 and 76 %.

During December and January the sea is roughest.

TABLE D. PULU BRAS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	0.7	0.9	2.9	1.5	2.8	0.5	0.7	—	1.1	2.5	0.2	1.0	1.1	1.4
N N E	—	1.2	2.6	—	0.7	—	0.7	0.3	0.8	—	—	1.4	0.4	0.9
N E	17.5	24.7	18.1	11.7	2.5	0.3	0.2	0.3	2.0	2.5	10.2	23.3	2.8	16.1
E N E	10.4	6.2	6.9	3.9	2.1	0.3	—	—	—	0.3	2.5	4.1	1.1	5.1
E	**56.9**	**51.2**	**37.5**	12.8	6.0	1.0	1.5	1.5	0.8	2.8	20.9	**39.4**	3.9	**34.8**
E S E	4.5	4.1	2.9	1.5	0.7	—	0.5	0.5	—	0.3	2.2	3.8	0.5	3.0
S E	6.3	5.0	6.9	3.9	1.4	2.4	0.5	3.0	0.6	3.3	6.2	8.6	2.0	6.1
S S E	—	—	—	—	—	—	0.2	0.8	0.8	0.5	0.5	0.2	0.3	0.4
S	0.4	1.0	1.7	8.5	10.0	6.5	9.0	4.3	4.5	5.5	2.7	3.4	7.1	2.5
S S W	—	—	0.3	0.4	4.4	2.7	4.0	6.1	2.5	0.3	1.2	0.5	3.4	0.4
S W	0.6	2.6	5.4	**24.5**	**35.1**	**48.4**	**54.1**	**50.5**	**53.9**	**50.7**	**30.5**	5.6	**44.4**	15.9
W S W	—	—	—	0.2	4.8	5.1	4.2	7.0	4.5	6.6	2.0	0.7	4.3	1.6
W	0.6	—	3.4	9.3	16.3	14.6	12.1	15.5	10.5	11.4	8.2	3.8	13.1	4.6
W N W	—	—	0.3	—	2.1	1.0	0.7	1.1	0.3	2.8	2.5	—	1.0	0.9
N W	0.4	1.0	2.3	3.1	1.8	3.5	1.5	3.2	9.3	4.1	3.0	0.7	3.7	1.9
N N W	—	—	0.3	0.4	—	—	1.5	—	0.6	1.4	0.5	0.5	0.4	0.5
Circulating	1.4	1.2	5.2	11.7	5.3	7.6	1.7	2.7	4.0	3.0	2.7	2.4	5.5	2.7
Variable	0.2	1.2	2.9	4.3	2.8	5.9	4.0	3.5	2.8	1.1	3.5	0.2	3.9	1.5
Calm	—	—	0.6	1.5	0.7	—	0.2	—	0.8	0.8	0.2	—	0.5	0.3

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	0.8	2.2	3.5	—	0.4	0.7	0.4	—	2.0	2.8	0.3	1.2	0.6	1.8
N N E	—	—	0.7	0.5	—	—	0.7	—	0.3	—	—	1.8	0.3	0.4
N E	10.8	13.4	11.5	5.6	1.6	1.8	1.1	1.9	2.3	0.3	7.8	11.2	2.4	9.2
E N E	7.1	10.8	4.2	2.5	0.4	—	—	—	—	—	1.6	4.9	0.5	4.8
E	**52.0**	**50.5**	**31.1**	12.2	5.0	0.4	1.1	2.6	2.3	3.4	18.0	**35.8**	3.9	**31.8**
E S E	11.5	1.8	2.8	1.5	0.4	—	2.2	—	0.3	0.6	2.6	4.2	0.7	3.9
S E	11.5	10.5	16.4	8.6	5.8	3.2	2.6	2.3	0.7	5.4	8.1	16.7	3.9	11.4
S S E	0.3	0.4	0.2	1.0	0.8	0.7	0.4	0.7	0.3	0.3	—	1.5	0.7	0.5
S	0.8	1.8	5.6	9.8	13.5	9.5	10.6	6.0	11.4	6.5	6.8	1.8	10.1	3.9
S S W	0.3	0.4	1.0	1.5	1.6	2.1	2.2	3.0	2.0	1.9	2.3	0.3	2.1	1.0
S W	1.3	1.8	7.3	**25.9**	**36.7**	**51.6**	**54.7**	**43.1**	**45.1**	**45.5**	**23.3**	8.2	**42.9**	14.6
W S W	0.3	—	0.4	2.0	5.0	4.2	1.8	4.5	4.5	4.6	1.9	3.0	3.7	1.7
W	2.4	1.8	7.3	9.8	17.2	16.5	15.7	19.1	16.2	14.0	14.6	4.9	15.8	7.5
W N W	0.3	—	0.7	1.0	—	3.2	0.4	3.0	2.6	2.4	2.3	0.6	1.7	1.1
N W	0.3	0.4	1.4	3.5	4.1	1.4	3.3	7.1	6.2	3.4	1.9	1.2	4.3	1.4
N N W	—	—	—	—	—	—	—	0.4	0.3	0.9	0.3	—	0.1	0.2
Circulating	0.3	1.4	1.0	3.5	1.6	3.5	—	2.3	2.0	1.5	1.9	0.6	2.2	1.0
Variable	0.3	1.1	0.7	1.5	1.6	0.4	1.5	1.1	1.0	1.2	0.6	0.6	1.2	0.8
Calm	—	1.8	3.5	9.8	4.5	1.1	1.5	3.0	2.6	5.1	2.9	1.5	3.8	2.5

CONDITION OF THE SEA, PERCENTAGE.

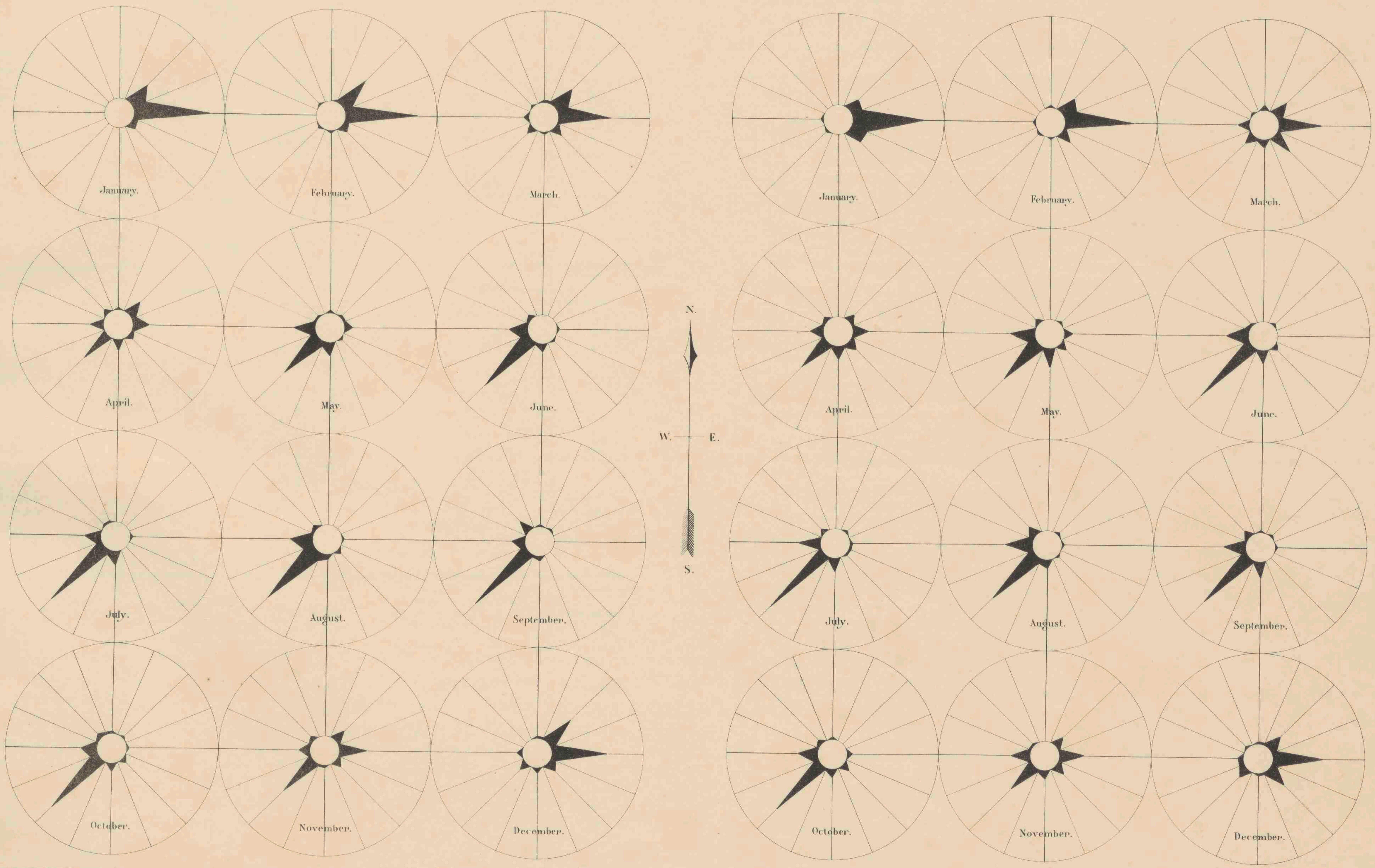
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	16.0	12.3	11.7	7.3	6.2	33.3	23.3	19.8	22.4	19.9	25.5	28.7	18.7	19.0
High Swell	1.8	0.5	0.8	0.6	0.7	3.2	0.8	1.5	—	0.6	1.3	—	1.1	0.8
Waves	—	0.5	—	—	—	—	—	—	—	—	0.7	—	—	0.2
Sea	48.1	27.7	12.1	8.6	5.8	3.9	7.6	8.0	6.6	3.6	16.5	29.7	6.8	23.0
High Sea	4.2	3.2	—	—	—	—	—	0.7	—	—	—	1.3	0.1	1.5
Calm	30.0	56.1	75.4	83.6	87.5	59.6	68.4	70.5	71.0	76.1	56.3	40.4	73.4	55.7
Number of Observations	257	218	228	164	140	126	119	141	141	167	143	234	831	1247

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	51.4	72.0	65.1	46.4	32.9	26.0	35.9	30.8	37.4	32.6	36.1	55.4	34.9	52.1
Overcast	19.1	16.4	19.2	24.1	26.4	15.2	19.1	19.3	15.0	15.2	14.9	16.6	19.9	16.9
Showery	6.8	0.3	2.7	5.0	7.5	14.0	8.9	9.6	9.9	7.0	4.8	3.6	9.2	4.2
Rain	20.8	10.7	10.6	22.4	28.9	40.1	32.0	35.4	33.6	42.3	42.0	23.3	32.1	25.0
Squalls	1.3	0.3	0.6	1.1	3.2	4.7	3.6	4.3	4.1	2.8	1.9	1.0	3.5	1.3
Thunder	—	—	1.2	—	0.3	—	0.6	0.3	0.2	—	0.2	0.2	0.2	0.3
Hazy	0.8	0.5	0.9	1.1	0.8	—	—	0.5	—	0.2	0.2	—	0.4	0.4
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	487	404	491	350	377	417	473	443	468	535	550	528	2528	2995

V. PULU BRAS.

DAY. NIGHT.



VI. ATJEH, WEST-COAST, FROM ATJEH HEAD TO TRONG.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	6	22	N 75° E	E N E	23 %	1.1	540
February	— 7	3	S 22° E	S S E	8	1.2	635
March	— 5	1	S 11° E	S	5	1.2	660
April	—12	— 1	S 2° W	S	12	1.2	481
May	—27	—17	S 31° W	S S W	32	1.1	269
June	—30	—28	S 43° W	S W	41	1.5	327
July	—26	— 5	S 11° W	S	26	1.4	263
August	—35	— 6	S 10° W	S	36	1.3	265
September	—14	— 8	S 31° W	S S W	16	1.4	393
October	—12	—16	S 55° W	S W	20	1.3	413
November	—21	16	S 37° E	S E	26	1.1	376
December	—10	16	S 58° E	E S E	19	1.1	443
Year	—16	— 2	S 7° W	S	16	1.24	5065

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	13	53	N 76° E	E N E	55 %	1.1	499
February	15	56	N 75° E	E N E	58	1.2	596
March	15	47	N 73° E	E N E	49	1.2	634
April	15	41	N 69° E	E N E	44	1.1	467
May	—18	10	S 30° E	S S E	21	1.3	261
June	—17	7	S 23° E	S S E	18	1.5	311
July	—14	23	S 59° E	E S E	27	1.4	264
August	—13	31	S 70° E	E S E	34	1.3	254
September	—11	24	S 65° E	E S E	26	1.5	377
October	1	21	N 88° E	E	21	1.3	383
November	— 3	50	S 86° E	E	50	1.1	331
December	8	58	N 82° E	E	59	1.2	409
Year	— 1	35	E	E	35	1.27	4786

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	10	38	N 75° E	E N E	39 %	1.1	1039
February	4	30	N 82° E	E	30	1.2	1231
March	5	24	N 79° E	E N E	25	1.1	1294
April	2	20	N 84° E	E	20	1.0	948
May	—23	— 4	S 10° W	S	23	1.2	530
June	—24	—11	S 25° W	S S W	26	1.6	638
July	—20	9	S 21° E	S S E	22	1.4	527
August	—24	13	S 28° E	S S E	27	1.4	519
September	—13	8	S 32° E	S S E	15	1.5	770
October	— 6	3	S 27° E	S S E	7	1.2	796
November	—12	33	S 70° E	E S E	35	1.3	707
December	— 1	37	S 86° E	E	37	1.2	852
May—November	—24	7	S 16° E	S S E	25	1.37	4487
December—April	2	30	N 86° E	E	30	1.12	5364
Year	— 9	17	S 62° E	E S E	19	1.27	9851

On looking at the summarizing table of the introduction, it is at once evident, that the monsoons on *Atjeh's* west-coast bear a totally different character from these observed near *Pulu Bras*. Less rain, far less showers, practically no heavy squalls, habitually clear skies and, on the other hand, an increase of haziness and a pretty large percentage of land- and seabreezes: all these features show that, on these shores, the monsoons begin considerably to abate and local influences to prevail.

In consequence of this condition of the atmosphere the percentages of steadiness are about half of those near *Pulu Bras*.

Likewise a small average value of the force of the wind and large percentages of calms occur.

This is so markedly the case that the S W monsoon — which near *Pulu Bras* blows with great force — is here entirely absent, whilst from July to November S S E winds blow here more steadily than from any other point.

As the charts given in this work are based merely on data collected *in loco*, they do not afford an explanation of this phenomenon: in order to understand the causes which bring about this condition of the climate, it is necessary to consult a windchart exhibiting the distribution of the winds over the whole area of the *Indian Ocean* and *China-sea*, for instance tables 20 and 21 of the atlas published by the *Deutsche Seewarte* (1891).

These charts demonstrate the fact that the S W monsoon, caused by the heating of the air over the *Asian* continent blows steadiest in the *Gulf* of *Bengal* and that, in this respect, *Atjeh's* north-coast is to be regarded rather as a border-region of that gulf, than as a part of the western *Indian Ocean*.

In fact the generally adopted denomination of „monsoons of the *Indian Ocean*" for these monsoons of north *Sumatra* is based upon erroneous suppositions and might lead to false notions about the real state of affairs. *Atjeh's* north-coast belongs to the domain of the monsoons of the *Gulf* of *Bengal*, but *Atjeh's* west-coast to those of the *Indian Ocean*.

At a latitude of one degree south during July and August S E winds prevail in mid-ocean: at the equator they deviate to the right and blow from southerly and south-south-westerly directions. Off *Atjeh's* west-coast, therefore, the S W monsoon attains but to feeble development and the air current, on approacting *Atjeh's* coast, deviates — at least partly — to the left on following the coast-line and gives rise to S S E winds in stead of S W winds.

This view is confirmed by a comparison of the wind prevailing on those shores during July and August with those that blow in more southerly parts of *Sumatra's* west-coast.

On these parts of the coast, from *Trong* to *Singkel* and from *Singkel* to *Ajerbangies* N N W winds dominate at this time of the year.

The S S E monsoon blowing at *Atjeh's* west-coast cannot, therefore, be regarded as a direct continuation of the true S E monsoon prevailing in the ocean south of *Java*.

The charts show that a feebly developed S W aircurrent on approaching *Sumatra's* coast divides into two branches which follow opposite directions, the one flows in a N N W direction from *Trong* onward along *Atjeh's* west-coast, the other in a S S E direction from *Trong* to *Ajerbangies*.

This explanation tallies with the fact — stated in some sailing directions — that the main marine current branches off into two currents setting along the coast into two opposite directions in the same manner as the aircurrents.

From November to April easterly winds prevail; a proof that in this season *Atjeh's* west-coast — and the more southern shores as far as *Ajerbangies* as well — belong to the area of the monsoons of the *Bay of Bengal*.

The border-regions of this S E monsoon, therefore, are situated considerably more to the south than those of the S W monsoon; a consequence which is easily understood on inspecting the general wind-charts mentioned above.

For the land- and seabreezes the average components of Tables A and B give the directions S 68° W and N 68° E and a percentage of 21 %.

From December to March the E N E monsoon-winds set with the landbreeze and in a direction opposite to that of the seabreeze.

At daytime, therefore, during this season very low percentages of steadiness are registered; in fact, as is exhibited by the table on the next page, the wind blows with almost equal percentages from all points of the compass: at night-hours the monsoon-winds, now strengthened by the landbreeze, may be fairly depended on, blowing with percentages amounting to 59 % as shown by Table A.

During the months from May to October, when the monsoon-wind blows along the coast, land- and seabreezes will combine with those S S E and E S E air currents to form S and S S W winds which blow by daytime and to E S E winds blowing at night-hours with about equal probability.

As a consequence of the feeble development of the monsoons, rain is experienced throughout the whole year: in this respect the two seasons are not well marked: however the first four months may be regarded as the dry season with a rainfall about half that for the months August to November.

A force of the wind greater than 3 has been observed 18 times and in all cases the wind was from the W and W S W.

One characteristic of the weather, which this part of the coast has in common with *Pulu Bras*, is the relative absence of clouds.

With respect to this *Pulu Bras* and *Atjeh's* west-coast head the list of the 41 regions adopted in this work.

The advantages resulting from this condition of the weather are however neutralized by a heavy swell setting in from the *Indian Ocean* and rolling on the coast with a frequency which very far surpasses that registered on all other shores of the Archipelago.

In this respect the best month is January with a percentage of „calm sea" amounting to 75 % and the next February, March and April: the swell is heaviest from June to September when „calm seas" occur with percentages not surpassing 20 %.

Stations where rainfall and tides are observed have been established at *Pulu Raja* aud *Melaboeh*.

TABLE D. ATJEH, WEST-COAST, FROM ATJEH HEAD TO TRONG.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	5.7	8.5	5.6	1.7	5.4	1.5	5.1	3.9	5.5	6.1	5.2	5.3	3.9	6.1
N N E	2.9	0.6	0.3	0.5	0.9	0.8	1.8	0.4	1.2	0.7	0.2	1.4	0.9	1.0
N E.	**18.3**	11.7	**11.7**	8.2	4.8	5.9	6.2	5.3	9.7	6.9	5.1	**13.4**	6.7	**11.2**
E N E.	6.4	1.8	1.3	1.1	0.6	1.6	0.7	0.9	0.7	—	1.8	3.0	0.9	2.4
E	12.9	9.3	11.2	**17.9**	3.6	4.8	2.3	4.6	3.8	4.5	14.5	9.7	6.2	10.4
E S E.	1.4	1.3	1.0	0.6	0.9	1.4	0.7	1.8	1.6	1.6	2.3	10.1	1.2	3.0
S E	9.0	10.4	9.6	7.9	11.2	6.1	14.1	11.7	5.7	8.8	**17.5**	10.7	9.5	11.0
S S E.	1.8	1.5	1.4	2.0	2.8	0.8	4.5	2.7	4.6	2.3	5.1	0.8	2.9	2.2
S	7.5	10.7	9.2	8.1	15.1	9.8	**23.1**	**29.6**	**18.3**	**14.4**	14.0	9.1	**17.3**	10.8
S S W	1.6	1.5	1.3	2.5	1.8	3.8	3.2	0.8	4.2	3.4	1.0	2.8	2.7	1.9
S W	6.9	**12.7**	11.6	15.8	**20.8**	**30.3**	7.2	12.7	10.9	12.9	8.4	10.9	16.3	10.6
W S W.	1.1	2.0	1.0	1.6	2.6	5.1	0.9	0.4	0.5	2.2	0.7	1.7	1.9	1.5
W	6.3	8.1	9.5	9.8	10.1	11.9	9.5	8.7	5.6	9.9	5.0	7.4	9.3	7.7
W N W	2.8	1.0	1.0	0.5	1.5	0.6	2.3	1.7	1.0	1.0	1.1	1.5	1.3	1.4
N W	5.2	7.2	9.9	12.1	6.6	6.0	8.7	8.6	14.2	13.9	10.2	5.2	9.4	8.6
N N W.	0.3	0.8	0.5	0.4	1.2	0.6	1.2	0.7	1.3	3.3	0.3	0.9	0.9	1.0
Circulating	3.2	2.0	6.4	3.0	2.8	3.3	4.5	3.7	5.5	2.0	2.6	2.2	3.8	3.1
Variable	1.1	1.8	—	—	1.2	0.6	4.0	—	3.5	1.9	1.1	—	1.6	1.0
Calm	6.1	7.3	7.8	6.8	6.8	5.5	0.7	2.3	3.0	4.7	4.6	4.3	4.2	5.8

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	5.2	7.9	7.1	5.2	6.2	2.7	6.0	3.9	4.1	8.1	2.5	3.2	4.7	5.7
N N E	4.2	2.4	3.1	2.9	2.6	1.1	2.3	0.4	3.3	2.2	1.7	3.5	2.1	2.9
N E.	**25.4**	**24.3**	**26.0**	**28.0**	9.1	14.2	16.0	15.7	**18.7**	13.2	16.8	**26.5**	**17.0**	**22.0**
E N E.	7.6	4.4	3.9	3.6	1.0	2.4	2.1	3.5	2.0	1.1	4.1	4.6	2.4	4.3
E	21.6	23.5	19.0	19.0	7.1	12.4	7.2	13.4	7.9	**14.4**	**25.1**	22.9	11.2	21.1
E S E.	3.0	5.3	1.8	3.8	2.4	3.8	3.2	4.5	2.0	4.1	6.6	2.8	3.3	3.9
S E	11.6	14.0	14.6	5.3	**16.5**	8.8	**18.1**	14.5	14.2	11.8	14.9	17.9	12.9	14.1
S S E.	1.5	0.8	0.5	1.4	2.9	1.5	4.3	—	4.5	1.1	1.1	3.3	2.4	1.4
S	3.5	2.6	4.5	6.6	12.1	9.6	11.6	**19.2**	12.5	9.3	6.6	3.5	11.9	5.0
S S W	0.2	0.2	0.1	0.5	2.7	1.2	4.2	0.4	2.4	—	1.7	0.2	1.9	0.4
S W	1.6	1.1	2.0	4.0	12.8	**18.8**	8.9	5.0	7.9	7.5	1.4	1.7	9.6	2.6
W S W.	0.6	—	—	0.5	0.9	4.8	0.4	—	0.6	1.5	1.0	0.5	1.2	0.6
W	3.4	1.6	2.1	2.8	3.5	6.2	2.5	2.3	2.9	4.2	2.7	0.6	3.4	2.4
W N W	0.4	0.2	0.1	0.5	—	0.3	—	0.9	1.6	—	—	0.4	0.6	0.2
N W	1.4	2.3	4.3	3.5	7.5	5.1	6.4	3.2	2.6	8.8	4.1	3.9	4.7	4.1
N N W.	0.2	0.6	—	0.5	1.0	—	1.6	3.2	1.0	0.9	0.2	0.5	1.2	0.4
Circulating	1.7	1.7	1.9	1.0	4.7	1.8	4.3	7.2	4.8	1.9	2.2	0.5	4.0	1.7
Variable	0.4	0.5	1.2	2.3	2.6	1.7	1.2	1.9	5.5	2.3	1.6	—	2.5	1.0
Calm	7.3	7.2	8.1	8.9	5.0	4.1	0.4	1.2	2.0	8.1	6.2	4.1	3.6	6.8

CONDITION OF THE SEA, PERCENTAGE.

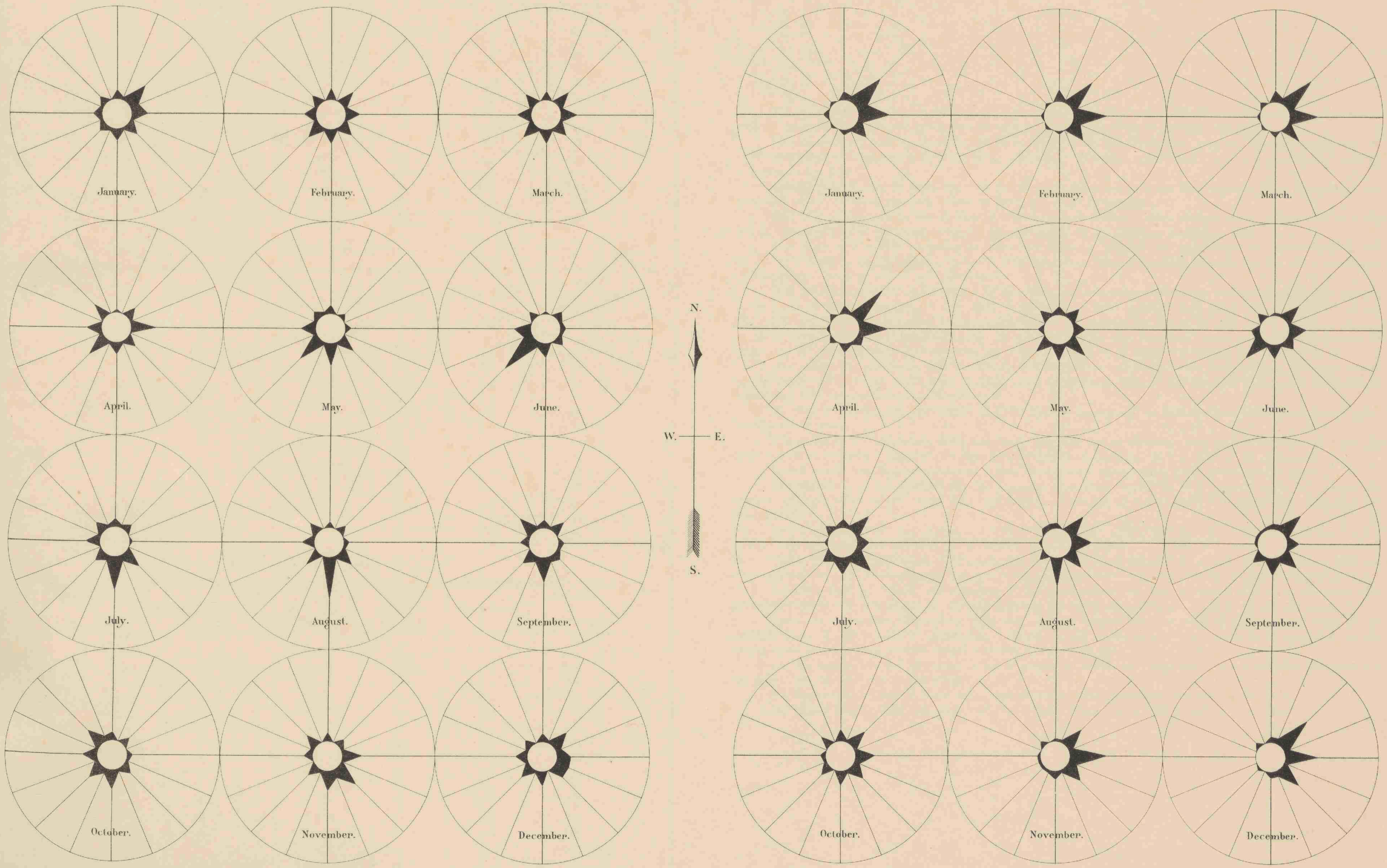
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	23.0	36.2	38.2	32.4	50.1	73.2	71.4	71.6	81.0	66.6	40.3	40.6	63.3	40.8
High Swell.	0.1	0.6	0.2	0.2	2.0	4.3	1.6	0.2	2.3	1.6	0.1	1.2	1.8	0.6
Waves	—	0.2	—	—	0.2	—	—	1.0	0.3	—	—	0.1	0.3	0.1
Sea	1.8	2.5	2.2	3.7	4.6	5.1	7.7	1.7	1.9	3.3	4.0	3.1	4.1	2.8
High Sea.	0.1	—	—	—	—	0.2	0.4	—	—	—	0.3	0.3	0.1	0.1
Calm	75.1	60.8	59.5	64.0	43.3	17.5	19.1	25.7	14.5	28.6	55.5	54.7	30.7	55.7
Number of Observations .	1016	1175	1266	946	447	555	471	505	757	776	723	753	3681	5709

CONDITION OF THE WEATER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	61.9	57.9	53.8	61.4	42.3	56.4	41.2	38.7	43.6	33.8	47.3	49.9	47.3	50.8
Overcast	20.9	24.2	23.3	20.1	26.3	16.8	26.2	32.3	21.6	23.7	21.7	22.7	23.9	22.8
Showery	4.7	1.6	1.4	0.8	4.1	5.4	6.8	2.3	2.6	4.0	2.3	1.5	3.7	2.6
Rain	11.7	14.6	18.5	16.5	25.9	21.0	**24.8**	26.5	29.2	37.1	26.7	24.7	24.0	22.2
Squalls	0.2	0.3	0.3	0.1	0.6	—	0.4	0.2	0.9	0.7	0.2	0.3	0.4	0.3
Thunder	0.6	1.3	1.6	1.3	0.2	—	—	—	0.5	0.4	1.3	1.1	0.3	1.1
Hazy	0.4	0.4	1.6	0.2	0.6	0.7	0.9	0.3	1.9	0.6	0.8	0.2	0.8	0.7
Mist	—	0.1	—	—	0.2	—	—	—	—	—	—	—	0.0	0.0
Number of Observations .	1023	1212	1089	941	523	623	528	517	748	790	699	840	3880	5653

VI. ATJEH, WEST COAST
FROM ATJEH HEAD TO TRONG.

DAY. NIGHT.



VII. ATJEH, WEST-COAST, FROM TRONG TO SINGKEL.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	— 6	— 2	S 20° W	S S W	6 %	1.1	124
February	—13	3	S 11° E	S	13	1.2	21
March	8	—30	N 75° W	W N W	31	1.2	41
April	— 8	—22	S 71° W	W S W	23	1.2	33
May	—18	—24	S 53° W	S W	30	1.1	100
June	50	—40	N 39° W	N W	64	1.5	19
July	25	—25	N 45° W	N W	35	1.4	46
August	28	— 1	N 2° W	N	28	1.3	21
September	35	—36	N 46° W	N W	50	1.4	49
October	41	—40	N 44° W	N W	57	1.3	159
November	3	— 6	N 62° W	W N W	7	1.1	123
December	—22	24	S 47° E	S E	33	1.1	60
Year	10	—17	N 60° W	W N W	20	1.24	796

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	28	39	N 54° E	N E	48 %	1.1	125
February	—33	15	S 24° E	N N E	36	1.2	19
March	23	43	N 62° E	E N E	49	1.2	39
April	17	—30	N 61° W	W N W	34	1.1	21
May	22	14	N 33° E	N N E	26	1.3	91
June	50	50	N 45° E	N E	71	1.5	15
July	40	10	N 14° E	N N E	41	1.4	32
August	10	— 2	N 10° W	N	10	1.3	18
September	63	22	N 19° E	N N E	67	1.5	44
October	52	—61	N 7° W	N	80	1.3	143
November	20	18	N 42° E	N E	27	1.1	112
December	27	44	N 58° E	E N E	52	1.2	54
Year	27	14	N 27° E	N N E	30	1.27	713

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	11	19	N 60° E	E N E	22 %	1.1	249
February	—23	9	S 21° E	S S E	25	1.2	40
March	16	7	N 24° E	N N E	17	1.2	80
April	5	—26	N 79° W	W N W	26	1.2	54
May	2	— 5	N 68° W	W N W	5	1.2	191
June	50	5	N 6° E	N	50	1.5	34
July	33	— 8	N 14° W	N N W	34	1.4	78
August	19	— 2	N 6° W	N	19	1.3	39
September	49	— 7	N 8° W	N	49	1.5	93
October	47	—51	N 47° W	N W	69	1.3	302
November	12	6	N 27° E	N N E	13	1.1	235
December	3	34	N 85° E	E	34	1.2	114
April—October	29	—13	N 24° W	N N W	32	1.34	791
November—March	4	15	N 75° E	E N E	16	1.16	718
Year	19	— 2	N 6° W	N	19	1.27	1509

The monsoons prevailing in these parts of the western shore of *Atjeh* differ from those blowing on the more northern parts of this coast, viz. from *Oleh-leh* to *Trong*, principally in the following respects.

The E monsoon blowing from November to March is far less steady here than on the northern shores: the mean percentage of steadiness being only 16 %, whereas in the region from *Oleh-leh* to *Trong* a percentage of 30 % is shown in the table.

Consequently it may be stated that, on following the coast-line in a southerly direction from *Pulu Bras* down to *Singkel*, the E monsoon gradually looses its force and tends to disappear.

The S W monsoonwinds which blow at *Sumatra's* most northerly point, deviate so as to blow here from the N N W: the explanation of this phenomenon has been given in the foregoing description (vide VI).

The weak S W winds prevailing in mid-ocean in these latitudes on approaching the *Sumatra*-coast branch off into two currents, the one setting to the N N W ward from *Trong* to *Oleh-leh* the other to the S S E ward along the coast from *Trong* to *Singkel* and *Ajerbangies*.

The principal cause for this deflection of the wind into two opposite directions may be found in the presence of the chain of isles — especially of *Pulu Babi* — stretching at some distance along the coast; these islands on one side and the main-land on the other forming a kind of natural channel for the air to rush in.

On consulting the summarizing table of the introduction we find that, apart from the above-mentioned differences, the main features of the weather are about the same as on *Atjeh's* west-coast northerly of *Trong*.

Clear skies are somewhat less, clouded skies and haziness somewhat more frequent: the rainfall is almost equally distributed over the whole year: in this respect these shores rank among the most rainy regions of the whole Archipelago and immediately after *Pulu Bras*.

At *Singkel* a rainfall has been stated of 4564 mm. on the average as deduced from observations taken during 14 consecutive years.

Two minima are observable, both but feebly marked: one in February, and another in June and July: the latter minimum indicates a transition to more southern types of monsoons as e. g. that of the *Java-sea*.

Heavy squalls very seldom occur and a force of the wind greater than 4 has never been recorded.

An inspection of the summarizing table teaches that here, as on the N E coasts of *Atjeh* and *Borneo*, the smallest average values of the wind force are experienced among all the 41 parts into which the Archipelago has been divided.

Land- and seabreezes are experienced with a pretty large percentage viz. 18 %; the directions are N 61° E or E N E for the landbreeze and S 61° W or W S W for the seabreeze.

Consequently from December to February the percentages of steadiness will be high at night-hours, when the monsoonwinds set with the landbreeze and low during day-hours when the seabreeze neutralizes the monsoonwind.

As from April to October the direction of the monsoonwind is from N and N N W *along* the coast, this difference between the percentages for day and night is not observable in Tables A and B during this season.

Owing to the shelter afforded by *Pulu Babi* and the *Banjak Isles*, the swell of the sea is less than on the northern parts of this coast: the percentage, however, is still considerable, equal values being found only in the *Indian Ocean* south of *Java* and the *Sunda* isles and in the *Timor-sea*.

On this account, as well as owing to the frequency of „seas" and „high seas", the N and N N W monsoon is the worst time for this part of the ocean.

The highest percentages of „calm sea" were recorded during December, January and February.

For details about rainfall near the coast vide *Singkel*, where also a tidal station is established.

TABLE D. ATJEH, WEST-COAST, FROM TRONG TO SINGKEL.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	9.6	8.3	13.2	—	0.9	**33.3**	14.5	3.7	4.0	14.9	6.6	14.5	9.4	11.2
N N E	0.7	—	—	—	—	—	1.6	—	4.0	0.9	—	—	0.9	0.3
N E	8.1	4.2	7.6	6.7	5.1	3.7	3.2	3.7	8.0	5.9	6.0	17.4	5.1	8.2
E N E	0.7	—	—	—	—	—	—	—	—	0.5	1.3	—	—	0.4
E	13.2	4.2	5.7	13.3	5.9	3.7	6.5	25.9	2.7	3.2	4.6	1.5	9.7	5.4
E S E	4.4	—	—	—	3.4	—	1.6	—	—	—	0.7	5.8	0.8	1.8
S E	6.5	**25.0**	7.6	11.1	6.8	—	6.5	7.4	4.0	3.2	17.2	**20.3**	6.0	13.3
S S E	—	8.3	1.9	—	1.7	—	1.6	—	—	—	2.0	2.9	0.6	2.5
S	11.8	12.5	7.6	4.4	11.9	—	1.6	—	—	1.8	4.0	18.8	3.0	9.4
S S W	1.5	—	—	—	—	—	1.6	—	—	—	—	4.3	0.3	1.0
S W	12.5	4.2	11.3	**22.2**	**17.0**	—	8.1	—	9.3	6.8	7.3	10.1	9.4	8.7
W S W	—	—	—	—	4.2	3.7	—	—	—	0.9	—	—	1.3	0.2
W	**13.2**	—	**22.6**	20.0	15.2	25.9	6.5	11.1	10.7	14.5	9.3	1.5	14.9	10.2
W N W	2.9	16.7	11.3	—	1.7	—	11.3	—	5.3	3.2	0.7	—	3.1	5.8
N W	7.4	8.3	9.4	13.3	15.2	22.2	**25.8**	**29.6**	**34.7**	**36.7**	**19.2**	—	**23.5**	**13.5**
N N W	—	4.2	—	6.7	0.9	—	—	7.4	5.3	3.2	1.3	—	3.4	1.5
Circulating	2.2	4.2	1.9	—	5.9	3.7	—	—	—	0.9	2.0	1.5	1.6	2.1
Variable	0.7	—	—	—	—	—	3.2	—	6.7	0.9	—	—	1.7	0.3
Calm	4.4	—	—	2.2	4.2	3.7	6.5	11.1	5.3	2.7	17.9	1.5	5.5	4.4

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	13.8	—	10.9	7.7	9.8	4.8	20.0	8.3	17.9	**25.7**	8.6	17.9	11.4	12.8
N N E	3.6	—	4.3	—	0.9	9.8	—	—	9.0	5.9	2.3	—	3.3	2.7
N E	19.6	4.5	**23.9**	7.7	**20.5**	**61.9**	**24.5**	**20.8**	**26.8**	15.5	20.3	**34.3**	**27.0**	**19.7**
E N E	2.9	—	2.2	—	—	—	—	—	10.5	0.5	2.3	1.5	1.8	1.6
E	**26.8**	13.6	17.4	11.5	13.4	9.8	11.1	4.2	6.0	3.7	7.0	9.0	9.3	12.9
E S E	—	**18.2**	4.3	—	—	—	—	—	—	0.5	1.6	1.5	—	4.4
S E	7.2	18.2	10.9	7.7	7.1	—	—	8.3	—	3.7	4.7	19.4	3.9	10.7
S S E	—	—	—	—	—	—	—	—	—	1.1	—	3.0	—	0.7
S	5.1	4.5	4.3	—	8.0	—	—	8.3	—	2.7	6.3	1.5	2.7	4.1
S S W	—	4.5	—	—	—	—	—	—	—	—	—	—	—	0.8
S W	1.5	18.2	—	11.5	3.6	9.8	2.2	16.7	—	1.6	1.6	—	7.3	3.8
W S W	0.7	—	2.2	7.7	—	—	—	—	—	—	0.8	—	1.3	0.6
W	2.9	9.1	—	7.7	4.5	—	—	4.2	3.0	9.1	3.9	3.0	3.2	4.7
W N W	0.7	4.5	—	7.7	1.8	—	—	—	—	1.1	—	—	1.6	1.1
N W	6.5	4.5	4.3	**19.2**	12.5	—	17.8	12.5	16.4	20.9	7.8	4.5	13.1	8.1
N N W	2.9	—	2.2	3.8	3.6	—	11.1	4.2	3.0	2.7	—	—	4.3	1.3
Circulating	3.6	—	10.9	3.8	8.9	—	8.9	8.3	4.5	1.6	1.6	4.5	5.7	3.7
Variable	—	—	—	—	—	4.8	2.2	—	—	—	—	—	1.2	—
Calm	2.2	—	2.2	3.8	5.4	—	2.2	4.2	3.0	3.7	**31.3**	—	3.1	6.6

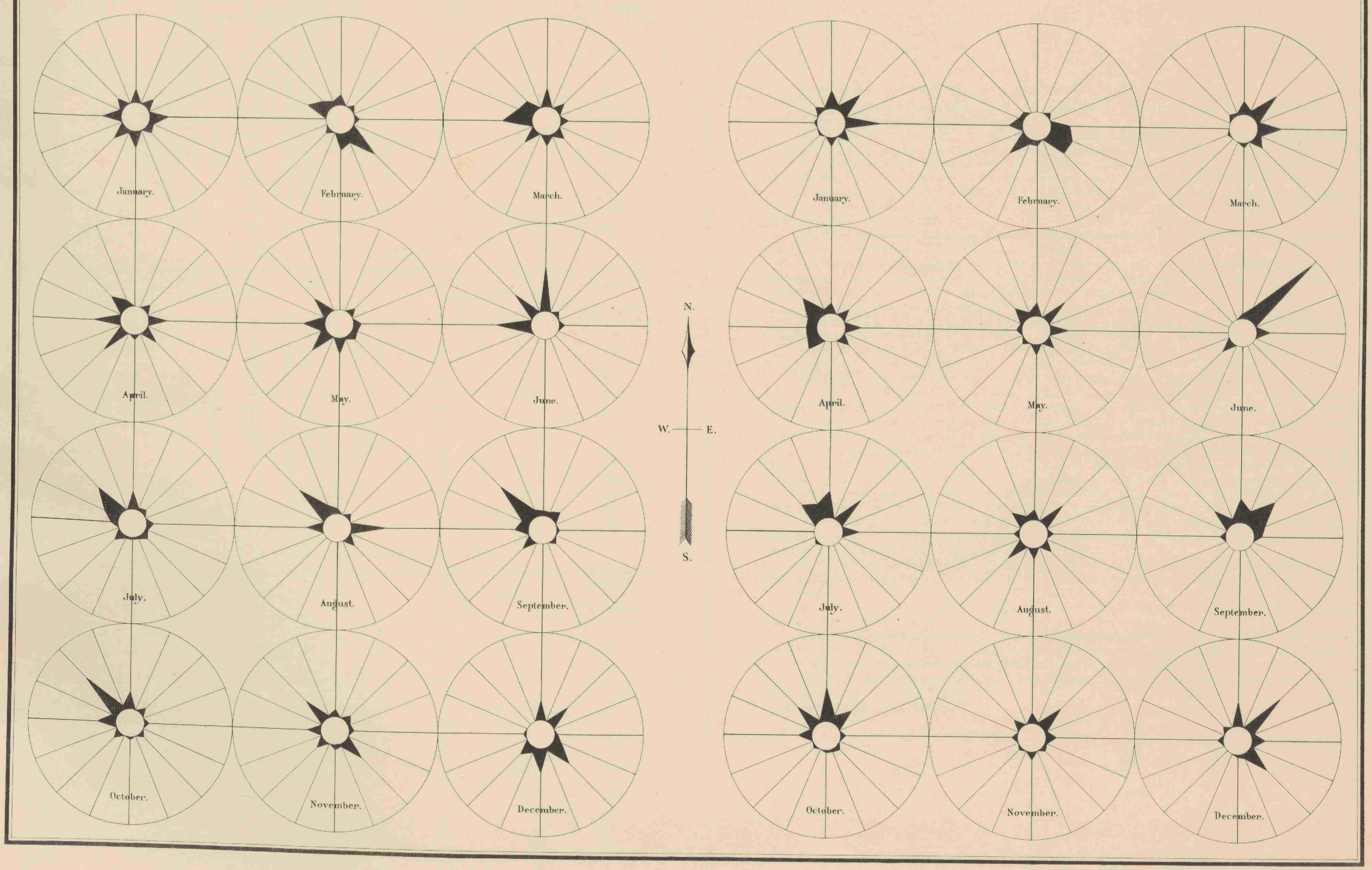
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	29.9	7.6	28.1	40.0	36.8	43.5	42.9	35.9	63.2	52.0	49.1	24.8	43.7	31.9
High Swell	—	—	—	—	—	5.9	1.1	—	—	2.1	—	—	1.2	0.4
Waves	0.8	—	—	—	—	—	—	—	—	—	2.5	—	—	0.6
Sea	0.4	—	2.8	6.8	—	5.0	5.8	7.7	6.8	3.1	2.9	—	5.4	1.5
High Sea	—	—	—	—	—	5.0	—	—	—	—	—	—	0.8	—
Calm	68.9	92.5	69.1	53.2	63.2	40.6	50.3	56.5	30.0	42.9	45.5	75.2	49.0	65.7
Number of Observations	244	39	79	55	188	27	77	39	87	291	231	112	473	996

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	59.1	53.7	39.1	49.6	39.4	58.2	55.1	40.7	42.2	40.4	46.5	34.2	47.5	45.5
Overcast	16.2	24.3	33.2	22.0	32.3	23.9	21.4	26.8	24.6	20.0	21.1	37.2	25.2	25.3
Showery	0.4	9.9	2.5	—	0.5	—	3.2	2.8	6.4	3.0	2.8	1.0	2.2	3.3
Rain	23.9	7.3	22.8	26.1	25.2	17.9	14.7	27.5	21.9	33.2	29.8	26.8	22.2	24.0
Squalls	—	—	—	—	—	—	1.6	—	—	0.7	—	—	0.3	0.1
Thunder	—	—	2.6	—	1.7	—	—	—	—	0.4	—	1.0	0.3	0.7
Hazy	0.4	4.9	—	2.4	1.1	—	4.3	2.3	5.1	2.4	—	—	2.5	1.3
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	247	41	83	53	189	34	78	40	83	297	217	113	477	998

VII. ATJEH, WEST COAST FROM TRONG TO SINGKEL.



VIII. SUMATRA'S WEST-COAST, FROM SINGKEL TO AJERBANGIES.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—16	—13	S 38° W	S W	21 %	1.4	233
February	—13	—11	S 40° W	S W	17	1.4	115
March	—18	—13	S 35° W	S W	22	1.5	112
April	— 3	—20	S 80° W	W	20	1.4	201
May	1	—13	N 87° W	W	13	1.4	250
June	2	—27	N 85° W	W	27	1.6	126
July	14	—24	N 60° W	W N W	28	1.4	261
August	15	—33	N 66° W	W N W	36	1.6	223
September	23	—41	N 60° W	W N W	47	1.6	123
October	21	—33	N 57° W	W N W	39	1.5	157
November	4	—33	N 83° W	W	33	1.5	197
December	— 4	—21	S 79° W	W S W	21	1.5	308
Year	2	—24	N 85° W	N	24	1.48	2306

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	6	32	N 79° E	E N E	33 %	1.4	194
February	— 2	13	S 79° E	E S E	13	1.4	116
March	0	33	E	E	33	1.4	100
April	20	23	N 49° E	N E	30	1.4	179
May	17	16	N 43° E	N E	23	1.4	237
June	28	23	N 39° E	N E	36	1.6	125
July	33	12	N 20° E	N N E	35	1.3	237
August	32	— 2	N 4° W	N	32	1.5	219
September	49	21	N 2° E	N	53	1.6	108
October	44	2	N 3° E	N	44	1.5	150
November	26	13	N 26° E	N N E	29	1.5	176
December	16	22	N 53° E	N E	27	1.4	296
Year	22	17	N 38° E	N E	28	1.45	2137

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	— 5	10	S 63° E	E S E	11 %	1.4	427
February	— 8	1	S 7° E	S	8	1.4	231
March	— 9	10	S 48° E	S E	13	1.5	212
April	9	2	N 13° E	N N E	9	1.4	380
May	9	2	N 13° E	N N E	9	1.4	487
June	15	— 2	N 8° W	N	15	1.6	251
July	24	— 6	N 14° W	N N W	25	1.4	498
August	24	—18	N 37° W	N W	30	1.6	442
September	36	—10	N 16° W	N N W	37	1.6	231
October	33	—16	N 26° W	N N W	37	1.5	307
November	15	—10	N 34° W	N N W	18	1.5	373
December	6	1	N 9° E	N	6	1.5	604
June—November	25	—10	N 22° W	N N W	27	1.53	2102
December—May	0	4	E	E	4	1.43	2341
Year	12	— 3	N 14° W	N N W	12	1.48	4443

As shown by the summarizing table of the introduction and table C, this part of *Sumatra's* west-coast constitutes the frontier-region of the monsoons.

During the three first months the results of the analysis still show vestiges of an existing E monsoon, but the percentages of steadiness are so low as to render them unavailable for practical purposes.

The N N W monsoon which, as has been explained above, is a branch of the south-westerly aircurrent in mid-ocean, does not set in with any appreciable percentages before July, and abates again in November.

It might be stated therefore that in this region there is only experienced one monsoon blowing from the N N W and from July to October, whilst during the other months circulating and varying winds are mostly experienced, especially at daytime.

Land- and seabreezes consequently dominate, the directions being S 65° W or W S W for the seabreeze, N 65° E or E N E for the landbreeze, and the percentage of steadiness 23 %.

As the N N W monsoon-wind blows along the coast from July to September, almost equal percentages of steadiness are found for night- and day-hours and at day-time S W winds may be expected from December to March, westerly winds from April to June, and W N W winds from July to October.

During night-hours the wind generally blows from the N E quadrant.

Notwithstanding this uncertainty of the weather no frequent calms and high percentages of bright sky occur as is the case off the shore from *Trong* to *Singkel*, the wind at the same time being considerably stronger.

Forces of the wind greater than 3 have been recorded 13 times at day- and 17 times at night-hours and almost exclusively from June to November i. e. in the N N W monsoon and from the W and N W.

The summarizing tables show that the bright skies, characteristic of the weather in strait *Malakka* and on the whole coast of *North-Sumatra*, east, north and west, are not observed on these shores south of *Singkel*, whilst the percentages of cloudy sky are remarkably high, those of blue sky remain much below the average for the archipelagic seas.

Rains however are somewhat less frequent than on the more northern coasts and the weather in these parts may be described as gloomy and threatening with passing showers and few squalls.

No marked seasons can be indicated with respect to either the rainfall, or the general condition of the weather; practically it rains all through the year: but still it may be mentioned that maxima of rainfall occur in March, April and May and from September to December, whereas minima are recorded in January and February, July and August.

Owing to the shelter afforded by the large isle *Pulu Nias*, the swell of the sea is considerably less here than either on the shore between *Trong* and *Singkel* or on the more southern coast.

As the disturbance of the sea keeps pace with the force of the wind it is more considerable here than on the more northern shores on account of the increase of the force; however, as is shown by the summarizing table, it is still moderate as compared with strait *Sunda* or the *Java-sea*.

The observations concerning the condition of the sea are not sufficient to warrant an indication of well marked seasons: still it would appear by the results given in Table D, that February to April and July are the best months in this respect.

The main current sets with the wind: therefore from July to October the direction is to the S S E ward whereas during the other months it is variable.

The tides are semi-diurnal; consequently a port-establishment exists: for *Baros*, *Ajerbangies* and *Goenoeng Sitoli* (*Nias*) $5^h\,30^m$ was found, for *Natal* and *Siboga* resp. $5^h\,54^m$ and $6^h\,12^m$; the range being rather small, namely about 60 c. m.

Tidal streams are weak and the exact relation between tides and tidal streams not yet fully known.

For details concerning tides vide *Baros*, *Natal*, *Goenoeng Sitoli* and *Ajerbangies*; for rainfall on the coast: *Singkel*, *Loeboe Sikaping*, *Goenoeng Sitoli*, *Padang Sidempoean*, *Kotta Nopan* and *Siboga*; for wind on the shore: *Singkel*, *Baros*, *Goenoeng Sitoli*, *Natal* and *Ajerbangies*.

TABLE D. SUMATRA'S WEST-COAST, FROM SINGKEL TO AJERBANGIES.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	6.1	3.8	1.2	6.0	4.2	2.4	11.5	6.1	3.5	3.4	3.0	3.3	5.6	3.5
N N E	1.2	2.6	1.8	—	1.4	1.9	1.6	2.2	2.0	2.5	1.3	3.1	1.5	2.1
N E	2.1	5.1	5.5	2.8	4.5	1.9	1.3	2.2	—	3.8	2.0	3.8	2.1	3.7
E N E	3.4	—	3.0	1.8	3.1	0.5	1.1	0.8	—	0.8	—	2.4	1.2	1.6
E	3.4	3.2	3.7	3.5	4.2	2.8	2.9	1.9	3.0	1.3	1.3	1.3	3.1	2.4
E S E	1.8	3.8	1.2	5.3	3.1	1.9	2.4	1.9	3.5	0.4	1.0	1.3	3.0	1.6
S E	5.5	8.3	6.7	8.1	6.8	9.0	4.5	2.8	2.5	3.4	5.7	7.1	5.6	6.1
S S E	5.2	2.6	1.8	2.1	2.8	3.3	4.0	2.5	1.0	2.1	2.0	3.6	2.6	2.9
S	10.1	10.9	8.5	4.6	3.1	0.5	6.1	5.3	1.0	2.1	4.3	4.0	3.4	6.7
S S W	4.9	5.8	9.1	4.2	2.3	1.4	2.9	3.3	0.5	2.1	3.3	5.5	2.4	5.1
S W	**11.3**	6.4	11.0	6.3	7.6	9.0	7.5	7.2	4.5	5.1	7.0	8.4	7.0	8.2
W S W	6.1	5.1	5.5	5.3	7.1	6.2	2.7	4.7	6.0	4.2	7.0	7.9	5.3	6.0
W	5.2	7.1	7.3	10.6	5.9	8.5	8.3	6.7	7.5	7.6	6.4	7.1	7.9	6.8
W N W	3.7	5.8	3.0	10.2	7.1	12.8	2.1	8.9	14.0	9.3	13.0	6.8	9.2	6.9
N W	5.8	6.4	3.7	10.2	9.0	9.0	**22.7**	**20.6**	**27.5**	**20.7**	12.0	7.9	**16.5**	9.4
N N W	2.4	2.6	3.7	1.4	4.0	6.6	4.5	7.5	4.5	8.9	6.7	5.1	4.8	4.9
Circulating	9.5	**10.9**	**12.2**	**11.3**	**12.1**	**16.1**	3.2	7.0	7.0	8.9	**13.0**	8.8	9.5	10.6
Variable	11.0	9.6	10.4	5.3	11.3	5.2	6.7	6.1	11.0	12.7	8.7	**12.1**	7.6	**10.8**
Calm	1.2	—	0.6	1.1	0.3	0.9	4.0	1.9	1.0	0.8	2.0	0.4	1.5	0.8

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	6.1	2.4	6.3	7.7	6.0	13.1	**14.8**	4.5	10.1	11.5	5.7	5.3	9.4	6.2
N N E	3.8	4.9	6.3	4.1	6.0	9.5	6.3	5.1	10.6	11.5	6.1	10.2	6.9	7.1
N E	11.0	4.3	16.1	12.6	**12.1**	**13.1**	10.0	9.0	**15.1**	**14.1**	12.3	**12.3**	**12.0**	**11.7**
E N E	11.8	3.0	3.5	8.1	8.5	7.5	11.5	7.8	6.7	7.5	5.4	7.2	8.4	6.4
E	6.8	4.9	7.0	**13.4**	3.9	6.5	6.9	6.9	5.0	2.6	6.5	7.4	7.1	5.9
E S E	6.8	**15.9**	4.9	4.1	5.4	6.5	2.1	2.4	0.6	—	6.5	6.5	3.5	6.8
S E	**15.6**	6.7	**16.8**	6.1	6.3	5.5	3.6	1.2	0.6	2.6	6.1	5.1	3.9	8.8
S S E	2.7	3.7	4.9	0.8	2.1	2.0	3.3	0.3	—	0.9	1.5	2.3	1.4	2.7
S	3.4	2.4	8.4	2.4	4.2	1.5	1.8	1.8	1.1	—	1.9	2.8	2.1	3.2
S S W	2.7	2.4	0.7	1.6	1.5	3.0	0.6	2.4	—	0.9	0.4	6.0	1.5	2.2
S W	4.6	3.7	1.4	3.3	4.2	—	3.3	0.9	0.6	2.2	2.7	2.8	2.1	2.9
W S W	—	1.2	—	—	1.2	4.7	0.6	2.7	1.7	0.9	1.5	1.6	1.8	0.9
W	1.5	6.1	3.5	2.4	3.0	—	5.1	5.4	3.9	5.7	1.9	1.9	3.3	3.4
W N W	0.4	4.9	1.4	3.3	2.7	4.5	3.9	2.1	7.3	6.2	2.7	1.4	4.0	2.8
N W	8.4	5.5	3.5	10.2	5.1	3.0	10.3	**17.4**	13.4	11.5	**14.9**	5.6	9.9	8.2
N N W	2.3	3.0	0.7	1.2	7.3	5.5	4.2	9.9	7.3	4.0	6.1	5.6	5.9	3.6
Circulating	4.6	7.9	6.3	9.8	11.5	7.0	4.2	10.5	8.9	10.6	7.3	5.3	8.7	7.0
Variable	7.2	15.2	6.3	8.1	8.2	7.0	3.6	7.5	5.0	6.6	8.8	10.2	6.6	9.1
Calm	0.4	1.8	2.1	0.8	0.6	—	3.6	2.1	2.2	0.9	1.5	0.7	1.6	1.2

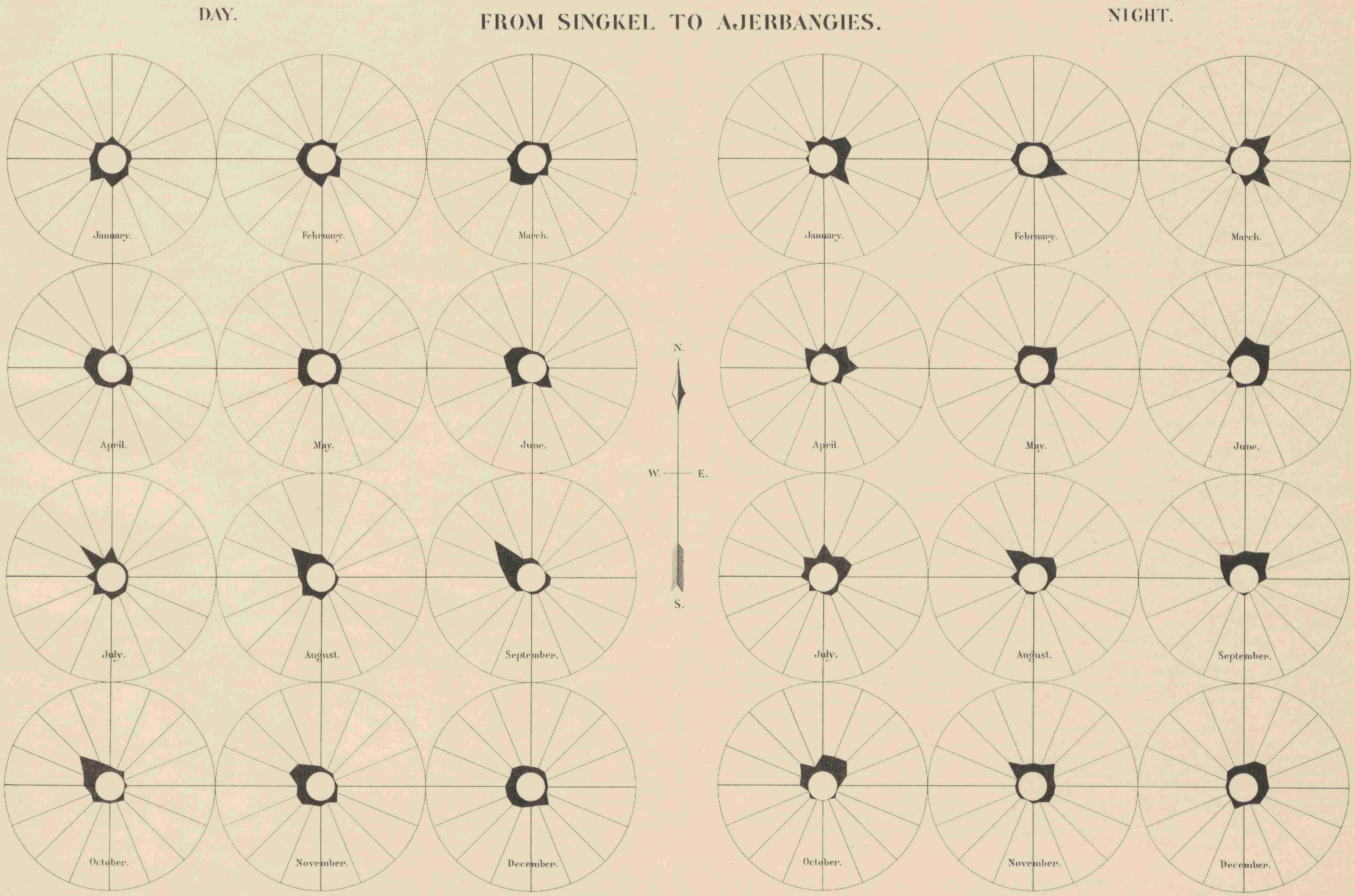
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	46.6	9.9	3.1	10.8	42.6	—	11.6	19.1	10.8	37.3	16.1	27.2	19.0	23.4
High Swell	—	—	—	—	—	—	0.5	—	—	—	—	4.2	0.1	0.7
Waves	—	—	—	—	—	—	—	0.9	1.9	—	—	—	0.6	—
Sea	16.9	1.8	—	2.1	4.9	—	1.5	6.6	25.4	10.3	5.4	11.3	8.1	7.6
High Sea	—	—	—	0.9	—	—	—	9.7	5.3	—	—	—	3.2	—
Calm	36.6	88.3	97.0	86.2	52.6	—	86.5	63.8	56.8	52.4	78.6	57.4	69.2	68.4
Number of Observations	77	50	66	97	48	—	196	104	46	79	42	29	491	343

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	31.2	31.1	31.7	34.6	34.8	23.3	42.8	24.8	28.0	24.2	21.8	19.0	31.4	26.5
Overcast	44.4	44.8	44.6	33.4	42.5	49.4	33.6	39.8	44.6	37.7	46.0	50.2	40.6	44.6
Showery	5.2	4.8	6.7	3.5	6.9	6.5	5.2	8.9	8.0	10.6	4.9	6.8	6.5	6.5
Rain	12.5	14.9	16.6	23.7	12.5	17.3	16.2	20.7	19.1	25.7	26.4	22.0	18.3	19.7
Squalls	0.5	—	—	0.5	0.2	—	0.8	2.7	0.5	—	—	0.2	0.8	0.1
Thunder	3.5	1.8	0.5	3.9	2.2	—	1.0	1.4	—	1.7	—	1.0	1.4	1.4
Hazy	2.9	2.7	—	0.5	1.1	3.6	0.6	1.8	—	0.3	1.1	1.0	1.3	1.3
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	426	228	213	385	482	249	505	442	230	305	375	606	2293	2153

VIII. SUMATRA, WEST COAST FROM SINGKEL TO AJERBANGIES.



IX. SUMATRA'S SOUTH-WEST-COAST, FROM AJERBANGIES TO STRAIT SUNDA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	— 3	—33	S 85° W	W	33 %	1.5	305
February	—11	—31	S 71° W	W S W	33	1.5	311
March	11	—48	N 77° W	W N W	49	1.7	276
April	— 9	—18	S 63° W	W S W	20	1.4	455
May	—22	9	S 22° E	S S E	24	1.5	355
June	— 9	2	S 77° E	E S E	9	1.4	360
July	— 1	—10	S 84° W	W	10	1.6	356
August	— 7	— 1	S 9° W	S	7	1.6	319
September	—18	1	S 4° E	S	18	1.6	256
October	—25	8	S 17° E	S S E	26	1.6	218
November	11	—33	N 72° W	W N W	35	1.6	420
December	— 5	—22	S 77° W	W S W	23	1.6	255
Year	— 7	—16	S 66° W	W S W	17	1.55	3886

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	21	— 6	N 18° W	N N W	22 %	1.5	303
February	12	2	N 8° E	N	12	1.4	309
March	26	—16	N 32° W	N N W	31	1.7	274
April	1	13	N 86° E	E	13	1.5	472
May	— 3	34	S 85° E	E	34	1.5	349
June	6	32	N 79° E	E N E	33	1.5	347
July	11	16	N 55° E	N E	19	1.5	326
August	12	33	N 71° E	E N E	35	1.6	336
September	— 3	28	S 83° E	E	28	1.6	243
October	—12	39	S 72° E	E S E	41	1.4	208
November	24	8	N 18° E	N N E	25	1.5	416
December	16	— 8	N 27° W	N N W	18	1.7	250
Year	10	15	N 56° E	N E	18	1.53	3833

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	9	—20	N 66° W	W N W	22 %	1.5	608
February	1	—15	N 86° W	W	15	1.5	620
March	19	—32	N 60° W	W N W	37	1.7	550
April	— 4	— 3	S 37° W	S W	5	1.5	927
May	—13	22	S 59° E	E S E	26	1.5	704
June	— 2	17	S 83° E	E	17	1.5	707
July	5	3	N 31° E	N N E	6	1.6	682
August	3	16	N 79° E	E N E	16	1.6	655
September	—11	15	S 54° E	S E	19	1.6	499
October	—19	24	S 52° E	S E	31	1.5	426
November	18	—13	N 36° W	N W	22	1.6	836
December	6	—15	N 68° W	W N W	16	1.7	505
May—October	— 6	16	S 69° E	E S E	17	1.55	3673
November—April	8	—16	N 63° W	W S W	18	1.58	4046
Year	1	0	N	N	1	1.57	7719

On the south-west coast of *Sumatra*, southward from *Ajerbangies* the monsoons are but feebly developed: Table C shows that from November to March W, W N W and N W winds prevail and from May to October E and S E winds.

The monsoons in these regions therefore bear a decidedly southern character, but the percentages are low and irregularly distributed throughout the whole year, whereas the mean force of the wind, viz. 1.57, is pretty strong.

Varying winds and land- and seabreezes consequently dominate, the former occurring with large percentages, as shown in the summarizing table: for the latter a percentage of 18 % and directions S 61° W for the seabreeze and N 61° E for the landbreeze are deduced from the differences between the components at night- and daytime.

At nighthours, therefore, from May to October, the monsoonwinds and the landbreeze blowing in the same direction, pretty large percentages of steadiness are found and there is a strong probability of E, E N E and N E winds blowing during the same months: at daytime, on the contrary, practically no prevailing direction exists; the monsoonwinds and the seabreeze neutralize each other and winds are blowing from all parts of the compass.

From November to April the reverse obtains: the seabreeze is strengthened by the monsoon and at daytime W, W S W and W N W winds blow with a steadiness far surpassing that at nighthours.

The practical sailor therefore, basing his statement on his experience only, would summarize his observations by saying: land- and seabreezes prevail, but during the W monsoon the landbreeze is much stronger than the seabreeze and in the E monsoon only seabreezes are experienced.

This statement, though giving a fair representation of the facts, would however be intrinsically incorrect.

Strong winds with a force of 4 and more were recorded 40 times at daytime and 53 times during nighthours and in almost all cases from the N W, W N W or W, or from the sea: they are mostly accompanied by heavy squalls and showers.

Once, in May, with light easterly winds, several waterspouts were seen.

The weather generally is bad near these shores, the percentages of „bright sky" are lower, those of overcast and gloomy higher than any where else in the Archipelago.

As to the frequency of showers this region in classed, with the *Banda-sea* and the *Indian Ocean* south of the *Sunda* isles, among the most showery of the archipelagic seas.

The same observation applies to the rainfall, which is about the same as on *Atjeh's* west-coast so that these shores must be classed among the most rainy parts of the Indian seas.

The rain comes down heaviest from September to December: May till August are the best months in this respect, and in February a well marked minimum is shown in the records, as well of those collected on board ship as of those taken at land-stations.

Not too much importance must however be attached to the expressions maxima and minima, as the differences are only small, and practically rain may be expected during all seasons.

The westerly showers and squalls are frequently accompanied by heavy thunderstorms, in which respect this region, along with strait *Sunda*, shows a maximum of frequency in the summarizing table.

Notwithstanding the incessant rainfall the sky near the coast is often hazy, a remarkable fact because, as is clearly shown in the summarizing table, haziness is a feature characteristic of the dry Australian climates in the eastern parts of the Archipelago.

The south-west coast of *Sumatra* being freely exposed to the influence of the *Indian Ocean* a heavy swell rolls on the coast, comparable with that on *Java's* south-coast and *Atjeh's* west-coast south of *Trong*.

High swells have been recorded oftener on this shore than on any other: calm seas occur but rarely: in this respect the general condition of the sea is as bad as on *Atjeh's* west-coast: there however it is better during certain months, whereas on *Sumatra's* south-west coast it would be difficult to indicate any good season at all.

On inspecting the current-charts it will be found that a perennial current flows along the shore towards the south-east-ward, a current which is, as might be expected, considerably stronger from November to March than from April to October; on the whole it will be found stronger during nighthours than at daytime.

Observations of tides are being made in *Emma-harbour* near *Padang* by means of a selfregistering tide-gauge: semidiurnal tides prevail; the port-establishment is 6^h 6^m: springtide occurs 2 days after full and change with a range of 97 c. m. and high water at 7^h 14^m, neaptide 2 days after first and last quarter with a range of 38 c. m.; other tidal stations have been established at *Priaman* and *Pulu Tello*.

For details about rainfall near the coast and at inland stations, vide: *Ajerbangies, Fort de Kock, Pajacombo, Padang Pandjang, Padang, Loeboe Selassi, Solok, Loeboe Sampir* and *Benkoelen*.

Wind observations have been made at *Padang, Poeloe Bodjo, Poeloe Pandan* and *Benkoelen*.

TABLE D. SUMATRA'S WEST-COAST, FROM AJERBANGIES TO STRAIT SUNDA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	1.9	4.1	3.0	2.8	1.7	7.8	7.1	3.7	6.5	1.7	5.1	4.5	4.9	3.4
N N E	0.6	1.3	0.4	2.2	1.0	1.0	1.1	1.8	0.7	0.8	1.2	0.9	1.3	0.9
N E	1.1	0.9	0.9	2.4	3.4	1.9	2.7	3.5	1.4	0.8	3.3	1.4	2.6	1.4
E N E	2.2	1.1	1.7	2.5	3.4	3.7	1.4	1.6	1.4	0.8	1.6	1.9	2.3	1.6
E	1.9	1.7	3.4	3.3	5.1	5.0	3.2	2.8	1.2	1.7	2.4	2.4	3.4	2.3
E S E	3.0	3.9	2.1	3.4	7.6	7.4	4.6	6.9	5.8	8.5	0.9	2.5	6.0	3.5
S E	3.4	3.4	4.3	7.3	**14.1**	**14.4**	14.1	**15.4**	**17.7**	**26.6**	3.7	9.7	**13.8**	8.5
S S E	3.9	4.7	4.1	7.8	8.8	4.9	4.8	9.1	13.4	10.2	3.7	6.9	8.1	5.6
S	6.9	5.8	4.1	5.2	6.5	3.3	5.0	3.7	4.6	4.5	2.7	5.0	4.7	4.8
S S W	4.5	7.1	2.4	4.0	4.0	3.3	2.3	2.8	4.1	2.5	3.3	5.2	3.4	4.2
S W	7.5	9.7	5.8	8.7	6.2	5.0	5.3	2.8	3.4	1.7	4.2	4.7	5.2	5.6
W S W	5.2	9.5	5.8	7.8	2.9	5.4	3.6	3.3	1.7	4.0	9.0	6.9	4.1	6.7
W	8.2	9.5	9.6	5.4	5.1	6.4	5.5	4.9	7.2	6.8	7.8	8.3	5.8	8.4
W N W	**15.3**	6.7	16.2	9.5	5.1	5.6	8.9	8.3	5.5	5.4	13.2	8.3	7.2	10.9
N W	13.6	**11.0**	**19.9**	**11.2**	4.0	6.6	**14.2**	13.0	8.9	9.6	**15.7**	**15.5**	9.7	**14.2**
N N W	3.2	4.1	6.4	3.3	3.2	2.5	3.6	4.1	3.4	4.5	4.5	3.8	3.4	4.4
Circulating	8.2	6.0	4.7	7.5	6.2	8.7	6.6	4.9	6.0	5.6	8.4	5.7	6.5	6.4
Variable	6.5	8.4	4.1	3.6	9.9	5.4	5.3	7.1	6.7	2.8	9.1	5.5	6.3	6.1
Calm	2.8	1.1	1.3	1.8	1.5	1.6	0.7	0.4	0.5	1.4	0.3	0.9	1.1	1.3

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	5.2	3.7	5.8	4.6	3.2	7.2	4.1	7.5	6.5	6.0	8.5	7.0	5.5	6.0
N N E	3.0	4.8	2.6	2.9	3.6	7.4	9.1	4.5	2.0	6.6	7.1	3.7	4.9	4.6
N E	12.1	8.3	8.0	8.0	7.4	10.3	4.9	13.1	6.5	7.9	9.7	7.0	8.4	8.8
E N E	3.7	5.0	2.8	5.4	6.4	4.8	5.9	7.9	7.0	3.6	4.7	2.3	6.2	3.7
E	3.9	6.1	3.2	7.3	10.6	7.9	5.5	4.5	5.8	6.3	6.0	5.1	6.9	5.1
E S E	3.7	2.6	4.3	6.8	10.6	7.7	3.1	10.7	9.0	7.6	3.1	6.0	9.7	4.6
S E	4.5	5.5	3.7	**10.3**	**14.0**	**17.3**	**14.8**	**14.6**	**17.3**	**28.1**	4.2	6.7	**14.7**	8.8
S S E	4.1	5.7	4.3	4.6	5.7	5.9	4.5	5.2	9.8	5.6	3.9	3.0	6.0	4.4
S	1.5	4.4	2.6	2.1	5.1	0.4	2.6	0.9	4.3	6.0	1.6	3.7	2.6	3.3
S S W	2.8	3.7	1.3	2.1	0.9	0.7	1.4	0.6	0.8	0.7	1.6	1.6	1.1	2.0
S W	1.9	2.2	2.6	4.1	1.5	2.0	1.6	0.6	2.0	0.7	2.7	2.3	2.0	2.1
W S W	3.0	2.2	1.7	2.6	1.1	0.7	0.4	1.1	0.8	1.3	1.4	3.2	1.1	2.1
W	7.8	3.9	7.3	6.4	3.4	2.9	2.6	2.8	2.3	1.3	2.8	9.5	3.4	5.4
W N W	7.1	5.9	8.9	3.6	1.9	1.1	5.1	1.1	1.5	1.3	5.0	7.7	2.4	6.0
N W	**14.5**	**13.1**	**19.4**	5.8	3.2	6.6	7.5	7.3	7.0	4.3	6.6	**12.8**	6.2	**11.8**
N N W	5.2	4.1	8.9	2.7	2.6	1.7	6.9	4.1	7.5	0.7	8.3	5.8	4.3	5.5
Circulating	7.6	8.5	5.4	9.0	8.7	7.6	12.6	5.8	4.5	6.6	10.3	5.8	8.0	7.4
Variable	6.9	7.6	5.0	9.6	8.9	4.4	5.5	6.2	4.3	3.6	**11.4**	6.0	6.5	6.8
Calm	1.3	2.6	2.2	2.1	1.3	3.3	2.0	1.7	1.8	1.7	1.1	0.7	2.0	1.6

CONDITION OF THE SEA, PERCENTAGE.

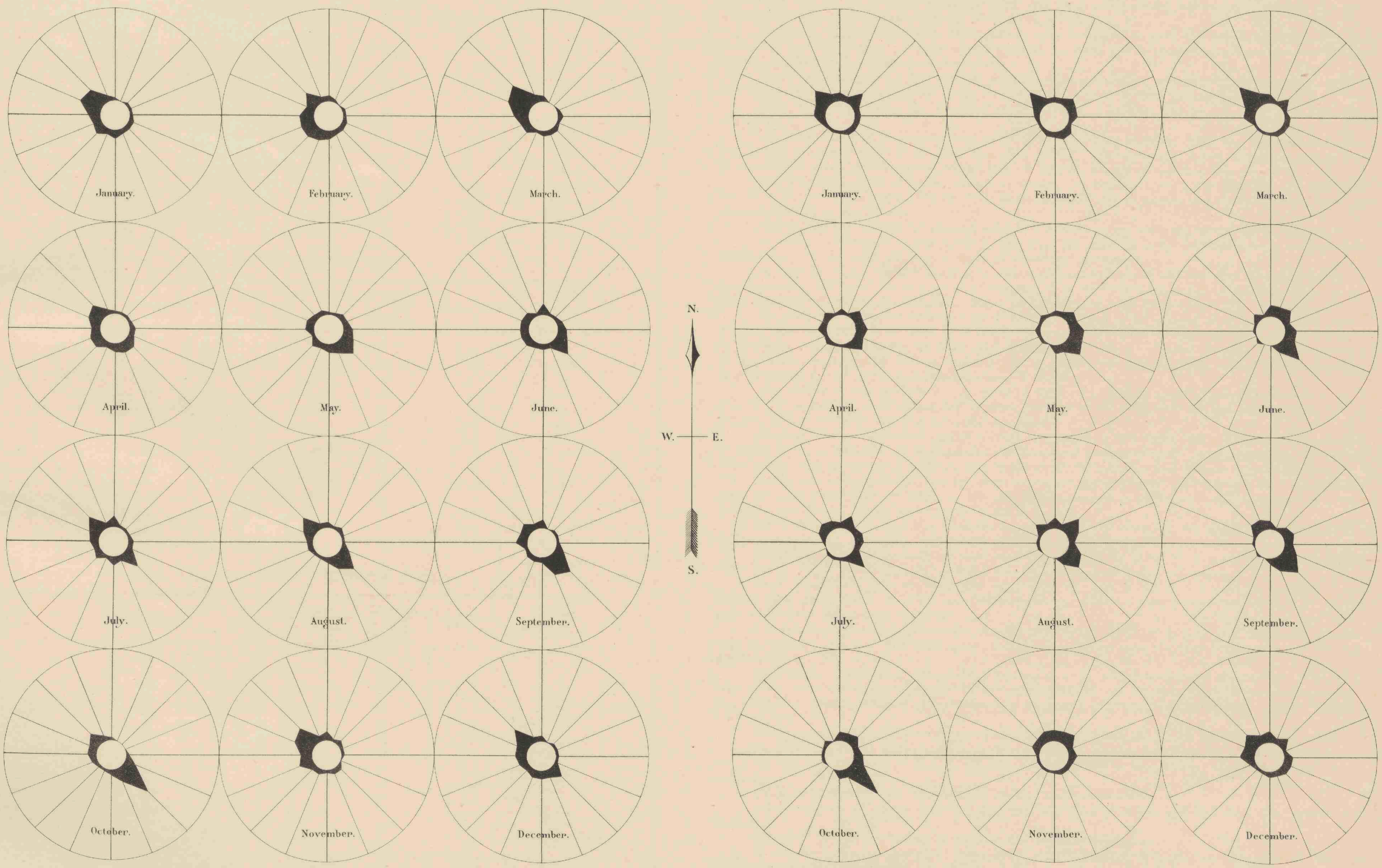
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	20.9	37.6	15.3	47.4	54.5	51.9	31.9	19.4	45.3	50.6	52.5	28.9	41.7	34.3
High Swell	5.7	1.5	20.7	3.2	2.4	7.6	12.8	4.1	3.7	6.9	11.8	0.9	5.6	7.9
Waves	10.1	—	—	—	—	0.7	0.7	—	1.8	—	4.6	—	0.5	2.5
Sea	—	4.4	7.1	5.3	3.1	12.0	7.6	7.1	9.2	18.2	2.5	19.1	7.4	8.6
High Sea	—	—	2.9	0.9	—	—	—	3.9	2.3	—	—	—	1.2	0.5
Calm	63.5	56.6	54.1	43.3	40.1	27.9	47.1	65.6	37.8	24.2	28.7	51.2	43.6	46.4
Number of Observations	67	67	72	128	138	161	181	72	167	132	42	110	847	490

CONDITION OF THE WEATER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	28.8	27.7	27.7	26.5	28.1	36.7	31.5	29.2	27.7	23.1	15.8	17.7	30.0	23.5
Overcast	34.0	41.3	38.9	38.6	45.3	38.6	36.2	40.9	36.6	36.7	42.7	38.7	39.4	38.7
Showery	10.5	9.3	9.0	5.9	4.4	3.6	9.1	6.2	5.5	11.8	5.9	9.5	5.8	9.3
Rain	22.0	14.8	21.8	20.6	15.4	16.0	18.6	15.9	20.7	25.4	30.6	31.2	17.9	24.3
Squalls	0.3	0.5	0.9	0.3	0.6	0.3	0.8	1.5	0.8	0.3	0.2	0.2	0.7	0.4
Thunder	2.5	3.1	0.2	2.8	3.8	1.9	1.1	1.2	2.3	1.7	1.5	2.7	2.2	2.0
Hazy	2.0	3.5	1.7	5.4	2.6	3.1	3.0	5.3	6.7	1.2	3.5	0.2	4.4	2.0
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	610	615	553	918	704	703	682	647	500	424	828	496	4154	3526

IX. SUMATRA, SOUTH WEST COAST FROM AJERBANGIES TO STRAIT SUNDA.

DAY. NIGHT.



X. CHINA-SEA, NORTHERN PARTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	83	—21	N 14° W	N N W	86 %	1.8	34
February	74	12	N 9° E	N	75	2.1	73
March	48	14	N 16° E	N N E	50	1.4	143
April	19	8	N 23° E	N N E	21	1.4	174
May	—24	— 6	S 14° W	S S W	25	1.5	335
June	—47	—15	S 18° W	S S W	49	1.6	234
July	—48	12	S 13° E	S S E	49	1.7	121
August	—46	—20	S 23° W	S S W	50	1.7	173
September	—65	—20	S 17° W	S S W	68	1.8	255
October	— 2	—24	S 85° W	W	24	1.6	178
November	11	—24	N 66° W	W N W	26	1.6	271
December	43	—18	N 23° W	N N W	47	1.8	238
Year	4	— 9	N 67° W	W N W	10	1.67	2229

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	72	— 2	N 2° W	N	72 %	1.8	31
February	71	24	N 19° E	N N E	75	2.4	70
March	43	28	N 33° E	N N E	51	1.2	136
April	12	35	N 72° E	E N E	37	1.4	165
May	—28	37	S 53° E	S E	46	1.5	352
June	—54	29	S 28° E	S S E	61	1.6	213
July	—64	24	S 21° E	S S E	68	1.7	115
August	—47	20	S 23° E	S S E	51	1.6	161
September	—67	3	S 3° E	S	67	1.6	236
October	— 9	18	S 63° E	E S E	20	1.6	176
November	6	4	N 36° E	N E	7	1.5	271
December	48	11	N 13° E	N N E	49	1.7	235
Year	— 2	19	S 86° E	E	19	1.63	2161

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	77	—11	N 9° W	N	78 %	1.8	65
February	72	—18	N 14° W	N N W	74	2.3	143
March	46	21	N 25° E	N N E	51	1.3	279
April	15	22	N 56° E	N E	27	1.4	339
May	—26	15	S 30° E	S S E	30	1.5	687
June	—50	7	S 8° E	S	50	1.6	447
July	—56	18	S 18° E	S S E	59	1.7	236
August	—46	0	S	S	46	1.7	334
September	—66	— 9	S 8° W	S	67	1.7	491
October	— 6	— 3	S 27° W	S S W	7	1.6	354
November	8	—10	N 51° W	N W	13	1.6	542
December	45	— 3	N 3° W	N	45	1.8	473
May—October	—42	3	S 4° E	S	42	1.63	2549
November—April	44	0	N	N	44	1.70	1841
Year	1	2	N 63° E	E N E	2	1.67	4390

In the northern parts of the *China-sea* i. e. north of the equator, two well marked monsoons are observed, the direction and duration of which are in conformity with the generally adopted definition of a monsoon as a wind which blows from opposite directions during two parts of the year.

From May to October southerly winds prevail, from November to April the general direction is from the northward, and the resulting coëfficient of steadiness for the whole year is about zero, which shows that the two currents almost exactly counterbalance each other.

The S monsoon sets in in May when E and S E winds begin to blow with pretty large percentages, but S W and W winds may also be experienced during this month and even N W winds sometimes occur.

From June to September the steadiness of the monsoon is greatest, the direction of the wind being from S E to S W.

October is the period of transition from the S monsoon to the N monsoon: during this month no one direction can be said to prevail whilst all directions are equally probable: the same might be said of November when N W, W and W N W winds begin to prevail, though they are still too unsteady to be relied upon.

The N monsoon comes to full development in January and February only: in December the wind blows from the W, N W and N, N N E and N E with about equal percentages, but in January and February the directions are almost exclusively N and N N W.

During these two months the monsoons blow with a regularity far surpassing that of the S monsoon.

In March this monsoon begins to abate: the wind still generally blows from the northern quarters of the compass, but N E and E N E and even E winds are occasionally experienced.

In April the general direction continues to veer to the eastward and at the same time the steadiness decreases to a minimum. Still April, though a period of transition, is, in this respect, not comparable to October and November, when practically no general direction exists: during April N E and E winds distinctly prevail.

The abruptness of the transition from the N to the S monsoon — as compared with that from the S to the N monsoon — may therefore be stated to be a characteristic of the monsoons in these parts: the former transition is effectuated within a fortnight, the latter takes more than two months. Another characteristic of the monsoons in these parts consists in the veering round through all points of the compass of the average monthly resultants, notwithstanding the fact of the main directions being N and S.

This shifting of the directions — as shown in Table C — follows a positive direction from left to right: from N N W in February to N N E and N E in March and April to S S E and S in the next six months, to S W in October, N W in November and N in December and January.

The force of the wind in these regions is pretty considerable: a force larger than 3 has been recorded 60 times of which 29 at daytime and 41 at nighthours; in this respect February shows a decided maximum: these strong winds mostly occur during the N monsoon, from November to February, and from the two northern quarters.

During both monsoons bright skies and clear weather are rarely observed: in this respect the *China-sea* resorts under the least favoured of the different seas: the cloudiness shows a maximum value, about equal in the two monsoons, consequently gloomy weather may be said to prevail.

Notwithstanding this, rainfall is moderate, squalls very seldom occur and only during the N monsoon, light showers however occur with pretty large percentages, also principally during the N monsoon.

Thunderstorms, on the contrary, are experienced almost exclusively during the S monsoon: this latter may be called the dry season; but the difference between dry and wet monsoons is not well marked.

These parts of the *China-sea* being shut in by land, the swell of the sea is moderate: a turbulent sea has been recorded mostly during December and February, but the number of observations is not sufficient to establish general rules as to the condition of the sea.

The currents, principally monsoon-drifts, are very variable and depend much upon local circumstances: generally speaking therefore „calm sea" will mostly occur when the monsoons are weak i. e. from March to May and in October and November.

Observations of tides have been made at *Pemangkat*, at the west-coast of *Borneo* near *Sambas*. Though the tides in the more southern parts of the *China-sea* bear a distinctly and almost exclusively mono-diurnal character, the tides on this northern part of *Borneo's* west-coast are what is generally — but erroneously — called „regular" i. e. semi-diurnal.

Consequently a simple relation between the time of high water and the moon's hourangle may be stated.

The port-establishment at *Pemangkat* is $3^h\ 48^m$: high water, therefore, occurs, full and new moon, at $3^h\ 48^m$ a. m. and p. m., the range being about 55 c. m.; the tides are not affected by such a large „diurnal irregularity" as f. i. at *Singapore*.

For details concerning tides vide *Pemangkat* in the chapter about tides.

Rain-observations at stations near the coast have been made at *Sambas* and *Singkawang*, also farther inland at *Sintang*.

The results of wind-observations are given in this work for *Singkawang*.

By order of H. E. the Governor of *British Borneo* tidal stations have been established also at *Kudat*, *Pulu Gaya* and *Labuan* resp. at *Borneo's* north- and north-west-coasts.

TABLE D. CHINA-SEA, NORTHERN PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**58.3**	**24.2**	15.8	10.6	3.6	0.5	3.8	0.3	0.2	5.3	3.9	**14.4**	3.2	**20.3**
NNE	—	14.3	4.8	5.5	1.0	0.8	—	0.7	—	0.4	4.3	13.4	1.3	6.2
NE	3.3	21.1	**20.6**	**12.2**	2.2	1.1	3.4	1.0	1.8	3.2	6.4	10.0	3.6	10.8
ENE	—	7.5	9.1	5.9	2.6	—	1.0	0.7	—	4.6	3.4	1.2	1.7	4.3
E	—	0.6	5.7	7.9	6.9	2.9	2.4	3.4	0.7	5.3	5.7	2.2	4.0	3.3
ESE	—	0.6	3.3	1.6	4.7	4.5	2.4	1.4	2.2	3.2	1.4	0.7	2.8	1.5
SE	—	—	1.4	4.7	**12.3**	10.9	13.9	6.1	5.3	3.5	2.7	1.9	8.9	1.6
SSE	—	—	—	4.3	7.7	13.3	21.2	9.6	10.5	4.9	1.4	—	11.1	1.1
S	—	—	—	2.4	8.3	11.7	**23.1**	15.4	20.6	6.0	3.4	0.5	**13.6**	1.7
SSW	—	—	—	3.1	2.6	9.1	7.7	11.3	**21.1**	3.2	4.8	2.4	9.2	1.7
SW	5.0	0.6	1.9	3.9	11.9	**14.9**	6.7	**17.1**	20.6	8.4	8.9	3.3	12.5	4.7
WSW	—	—	4.3	2.4	7.7	6.4	4.8	4.4	4.2	9.8	7.7	4.5	5.0	4.4
W	—	—	4.3	6.3	9.3	9.6	0.5	7.5	2.9	11.2	**9.8**	10.8	6.0	6.0
WNW	1.7	2.5	—	5.9	4.0	3.5	1.0	4.4	—	6.0	8.9	7.2	3.1	4.4
NW	18.4	14.3	10.5	4.7	6.3	4.5	1.4	2.4	3.3	**13.7**	9.3	11.7	3.8	13.0
NNW	13.4	9.3	8.6	3.5	1.6	1.3	—	1.4	0.7	3.5	8.4	6.5	1.4	8.3
Circulating	—	—	0.5	6.3	2.2	1.6	2.9	6.5	2.2	3.5	3.9	1.7	3.6	1.6
Variable	—	1.2	2.4	7.1	3.6	2.9	1.9	6.5	3.3	2.5	4.5	7.4	4.2	3.0
Calm	—	3.7	6.7	1.6	1.8	0.3	1.9	—	0.7	2.1	1.1	0.2	1.1	2.3

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**45.7**	17.3	14.9	5.6	2.4	—	—	1.2	—	2.5	7.3	14.6	1.5	**17.1**
NNE	—	15.0	12.2	8.2	0.7	—	—	1.2	—	2.5	5.2	16.7	1.7	8.6
NE	18.6	**34.7**	**14.9**	12.5	5.8	2.1	2.0	3.9	2.1	7.1	6.9	**17.7**	4.7	16.7
ENE	—	2.3	13.3	9.5	3.9	2.7	1.5	3.5	0.5	5.0	3.6	3.8	3.6	4.7
E	—	3.5	6.6	**16.4**	12.7	13.1	6.1	7.1	2.3	7.8	**10.4**	4.8	9.6	5.5
ESE	—	—	3.9	3.9	14.2	7.5	4.0	6.6	3.9	**13.5**	9.2	2.3	6.7	4.8
SE	—	1.7	3.3	8.2	**19.3**	**20.9**	**26.3**	17.3	12.5	7.1	3.8	2.0	**17.4**	3.0
SSE	—	—	—	1.3	8.8	13.4	21.2	11.8	19.5	8.9	1.7	0.8	12.7	1.9
S	—	—	1.1	5.6	6.0	13.4	15.2	**20.4**	**22.9**	7.1	5.7	1.0	13.9	2.5
SSW	—	—	0.6	1.7	2.1	7.5	5.1	2.4	10.6	1.1	2.1	0.3	4.9	0.7
SW	8.5	0.6	—	2.6	5.4	9.3	6.1	9.4	12.5	2.5	5.0	0.3	7.6	2.8
WSW	3.4	—	1.7	3.0	1.3	1.5	5.6	3.1	2.3	3.6	8.1	1.8	2.8	3.1
W	—	1.2	4.4	2.2	4.5	3.6	3.0	2.0	4.9	3.6	6.2	6.3	3.4	3.6
WNW	—	—	0.6	0.9	2.1	—	—	3.1	0.3	6.8	3.6	4.5	1.1	2.6
NW	—	10.4	3.3	3.9	1.9	0.6	—	0.8	1.3	5.0	8.3	3.8	1.4	5.1
NNW	20.3	9.8	6.1	1.7	0.4	—	—	0.8	—	2.8	2.8	8.8	0.5	8.4
Circulating	—	—	3.3	2.2	2.2	2.4	1.5	2.4	1.6	5.0	4.7	2.3	2.1	2.6
Variable	—	2.3	2.7	9.1	4.7	1.8	1.0	2.0	1.8	5.7	3.6	6.8	3.4	3.6
Calm	3.4	1.2	7.2	1.7	1.9	0.3	1.5	1.2	1.0	2.5	1.9	1.5	1.3	3.0

CONDITION OF THE SEA, PERCENTAGE.

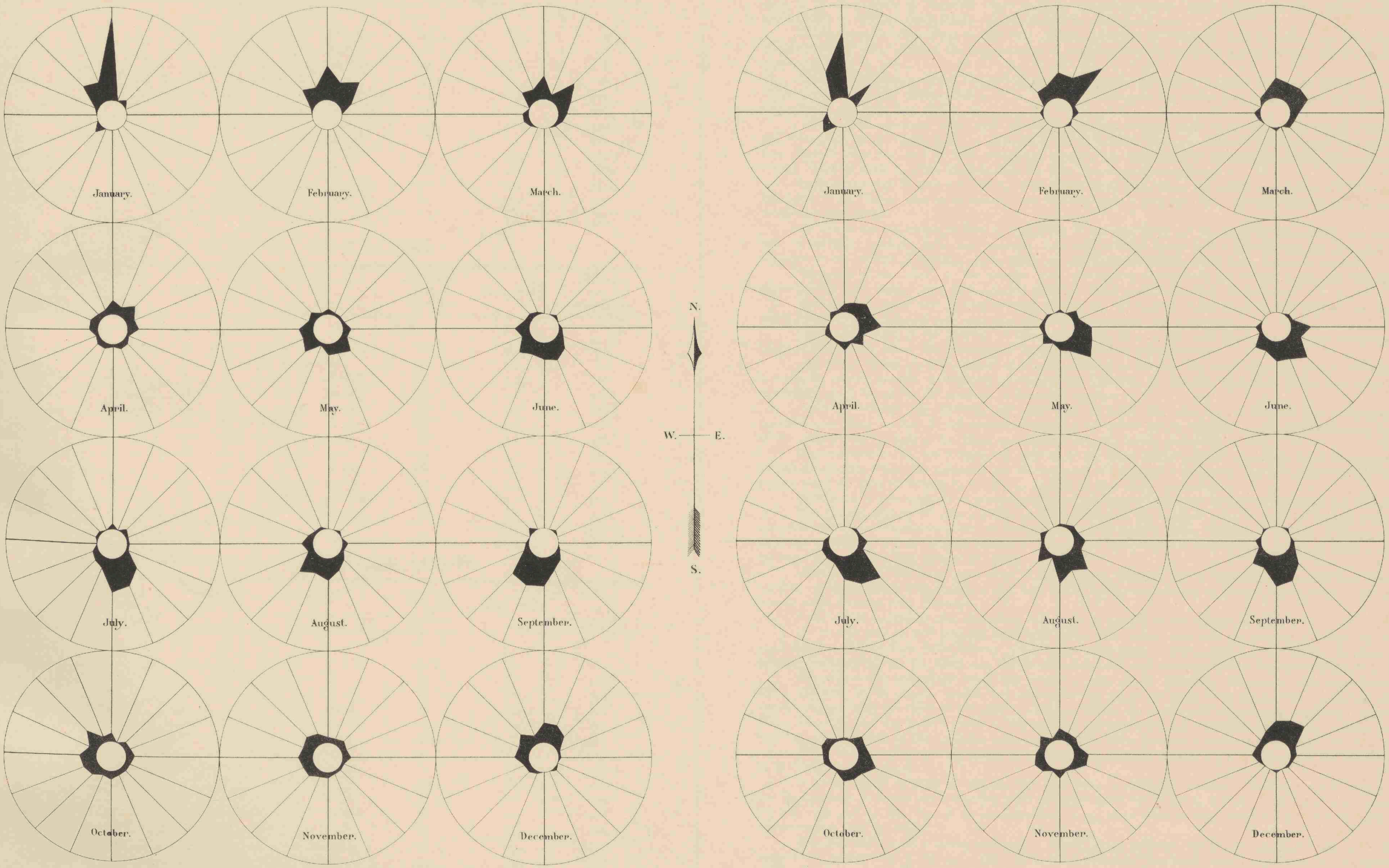
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	36.7	18.8	9.0	4.2	12.8	25.7	25.6	15.6	8.6	8.1	21.9	16.0	15.4	18.4
High Swell	13.2	3.9	—	—	—	3.2	—	—	—	—	—	3.5	0.5	3.5
Waves	—	—	—	—	—	—	—	—	3.6	—	—	—	0.6	—
Sea	10.0	3.9	1.5	—	6.9	8.3	15.7	7.2	7.5	—	4.2	24.6	7.6	7.4
High Sea	—	41.5	—	—	1.2	1.0	—	—	3.4	3.4	—	40.4	0.9	14.2
Calm	40.0	32.1	89.6	95.9	79.1	62.1	58.8	77.3	76.9	88.6	74.0	15.7	75.0	56.7
Number of Observations	30	22	67	120	171	132	70	97	72	36	73	57	662	285

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	42.1	23.4	48.3	36.4	43.6	32.1	28.9	28.7	22.3	15.8	22.5	14.9	32.0	27.8
Overcast	45.4	43.6	35.0	42.4	34.4	50.6	48.4	42.8	56.4	57.9	42.7	44.8	45.8	44.9
Showery	4.8	7.4	2.9	5.9	5.9	4.3	4.3	3.6	2.6	9.0	9.5	7.2	4.4	6.8
Rain	6.3	21.4	11.1	11.8	13.9	11.1	9.1	20.2	11.2	15.6	24.1	26.7	12.9	17.5
Squalls	1.6	—	—	—	0.2	—	0.5	—	0.2	—	0.7	0.9	0.2	0.5
Thunder	—	—	0.7	0.9	0.9	0.5	2.2	0.6	0.8	1.2	—	1.7	1.0	0.6
Hazy	—	2.9	2.2	2.1	1.2	0.5	5.1	4.2	6.6	0.6	0.6	3.6	3.3	1.7
Mist	—	1.5	—	0.6	0.2	1.0	1.8	—	—	—	—	0.5	0.6	0.3
Number of Observations	64	140	281	338	684	366	233	332	492	354	548	473	2445	1860

X. CHINA SEA, NORTHERN PARTS.

DAY. NIGHT.



XI. CHINA-SEA, SOUTHERN PARTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	74	—42	N 30° W	N N W	85 %	2.5	48
February	88	—11	N 7° W	N	89	1.7	65
March	46	— 1	N 2° W	N	46	1.4	116
April	—22	8	S 19° E	S S E	23	1.5	191
May	—41	16	S 21° E	S S E	44	1.4	226
June	—53	38	S 35° E	S E	65	1.7	218
July	—59	33	S 29° E	S S E	68	1.6	189
August	—73	25	S 19° E	S S E	77	1.7	161
September	—50	21	S 23° E	S S E	54	1.7	120
October	—31	4	S 7° E	S	31	1.6	117
November	9	—36	N 76° W	W N W	37	1.4	113
December	51	—49	N 44° W	N W	71	2.0	127
Year	— 5	1	S 11° E	S	5	1.68	1691

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	78	—28	N 20° W	N N W	83 %	2.6	48
February	80	—12	N 9° W	N	81	1.7	64
March	40	10	N 14° E	N N E	41	1.5	117
April	—31	8	S 15° E	S S E	32	1.4	183
May	—55	25	S 25° E	S S E	60	1.5	211
June	—46	30	S 33° E	S S E	55	1.6	193
July	—55	44	S 38° E	S E	70	1.6	178
August	—52	38	S 36° E	S E	64	1.7	156
September	—62	33	S 28° E	S S E	70	1.7	119
October	—40	14	S 20° E	S S E	42	1.5	113
November	11	—18	N 59° W	W N W	21	1.4	115
December	59	—36	N 31° W	N N W	69	1.8	128
Year	— 6	9	S 56° E	S E	11	1.67	1625

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	76	—35	N 26° W	N N W	84 %	2.6	96
February	84	—12	N 8° W	N	85	1.7	129
March	43	5	N 5° E	N	43	1.5	233
April	—27	8	S 17° E	S S E	28	1.5	374
May	—48	21	S 24° E	S S E	52	1.5	437
June	—50	34	S 34° E	S S E	60	1.7	411
July	—57	39	S 35° E	S E	69	1.6	367
August	—63	32	S 28° E	S S E	71	1.7	317
September	—56	27	S 26° E	S S E	62	1.7	239
October	—36	9	S 14° E	S S E	37	1.6	230
November	10	—27	N 70° W	W N W	29	1.4	228
December	55	—43	N 38° W	N W	70	1.9	255
April—October	—48	24	S 27° E	S S E	54	1.61	2375
November—March	54	—22	N 29° W	N N W	58	1.82	941
Year	— 6	5	S 40° E	S E	8	1.70	3316

Whereas in the northern parts of the *China-sea* the general directions of the monsoonwinds are from the North and South, the prevailing winds of the southern parts begin to assume a direction in conformity with the general outlines of the neighbouring shores, the N monsoon veering to the N N W, the S monsoon to the S S E.

At the same time the latter monsoon begins to increase in duration and steadiness, as is exhibited by the signs of the components in Table C, where southerly components (minus signs) are seen to occur during the *seven* months April to October, and northerly components during *five* months only.

Westerly components appear in the *four* months November to February, easterly during the *eight* months March to October; thus showing the preponderance of southerly over the northerly and of easterly over the westerly components.

This preponderance of S and E directions is however partly balanced by a greater steadiness of the N and W winds; consequently the general motion of the air, taken throughout the whole year, is from the S E, but with a percentage of not more than 8 %.

The S S E monsoon sets in in April, when S E, S S E and S winds begin to prevail, but S W and N W winds still occasionally occur; from April to August the S S E monsoon gradually increases in steadiness as well as in force, blowing from the S 27° E with remarkable regularity; in September the steadiness begins to decrease and in October — as in April — winds blowing from the S W quarter begin to appear.

In November the W monsoon sets in, at first with small percentages, but before December the N N W monsoon has come to full vigour, blowing in January and February with a force and regularity surpassing those experienced during the S E monsoon.

On comparing the results of Table C with those of the same table for the northern parts of this sea, we see that in the more southern parts the transition from one monsoon to another is more abrupt, the percentages of steadiness in the months of transition being larger and therefore the turning points more accurately marked.

The force of the wind, on the average 1.70, is relatively considerable, the *Banda-sea* only showing higher figures; forces larger than 3 have been recorded 46 times, 19 at nighttime and 27 at dayhours.

These strong winds were mostly recorded during the W monsoon from the N W and W N W, but strong winds from the same direction were also experienced at times during the E monsoon.

The general state of the weather is somewhat better than in the more northern parts: the percentage of bright skies increases, whilst the percentage of cloudiness decreases correspondingly.

Still these regions are to be classed among those where an overcast sky most frequently occurs; the rainfall is moderate, passing showers, accompanied by thunder and lightning, are frequent, and heavy squalls from the N N W occasionally occur during the W monsoon, in December mostly.

October, November and December are what may be called the rainy season when 20 days in 30 may be expected to be rainy; in July a well marked minimum is observable and in February a secondary minimum is shown by the records; still throughout the whole year there is a pretty strong probability of rain.

The condition of the sea is much the same as in the more northern parts: a moderate swell is experienced during the months when the monsoons are blowing most steadily, and a rough sea may be expected during these periods when the wind is blowing in a direction opposite to that of the driftcurrent.

Smooth sea is met with with very high percentages of probability from March to May and in October and November.

The average velocity of these currents is less here than in the northern parts of the *China-sea* and from the current-charts it would appear that the direction of the currents bears a closer resemblance to those of the *Java-sea*, than the aircurrents do: the average direction of the marine currents in the corresponding monsoons being more to the east- and westward than that of the winds.

Observations of tides have been made at *Pontianak*, at *Singapore* and at *Tandjong Kalean*, near the northern entrance of strait *Banka*, and recently a new tidal station has been established at *Soengei Kakap*, about three hours rowing down the river from *Pontianak*.

As to details concerning tidal phenomena the reader is referred to the chapter on tides.

As in this part of the *China-sea* three tidal waves meet, namely one from the northern *China-sea*, one from strait *Malakka* and one from strait *Makasser* which bends round *Borneo's* south coast, it is not possible to make any accurate generalisations for the whole area, but the general character may be safely stated to be almost exclusively diurnal.

The semi-diurnal constituent being very small, or even totally vanishing, the time of high water does not follow the time of the moon's transits, but varies from one day to the other with sidereal time: springtides occur one or two days after the dates of the moon's maximum declination, indifferently southerly or northerly; neaptides one or two days after the moon's transit of the equator: therefore spring and neaptides occur in these regions 24.74 times per year, whereas in the European parts of the *Atlantic* these phenomena occur 26.74 times in 365 days.

When about June high water occurs at half past nine p. m., as it does f. i. at *Pontianak*, it will be observed in December at $9^h\ 30^m$ a. m.

It is often stated in books of reference that high water is observed during the E monsoon at a given hour and in the W monsoon 12 hours later or earlier; this statement gives rise to wrong notions because tides and monsoons are not connected by any known causal connection; if by some cause or other the monsoons were changed, the tides would be just the same.

Even less exact is the following statement: „during the W monsoon, full and change, high water occurs etc." because, if, on the dates of full and change, high water is observed at a fixed hour, i. e. when a port-establishment exists, this hour ought to be the same throughout the whole year. In these regions, where diurnal tides dominate, however, a port-establishment does not exist.

TABLE D. CHINA-SEA, SOUTHERN PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	11.4	**57.8**	**22.2**	4.9	2.1	—	1.3	1.4	1.5	5.5	2.4	20.6	1.2	**20.0**
N N E	4.9	5.5	7.6	1.7	1.2	—	0.3	2.1	0.5	—	6.1	2.0	1.0	4.4
N E	2.4	7.3	14.0	2.1	3.0	0.8	1.0	1.4	1.0	7.7	2.4	1.2	1.6	5.8
E N E	—	—	1.2	1.0	3.3	2.1	0.3	1.4	3.4	4.4	0.6	—	1.9	1.0
E	—	—	7.0	7.3	5.2	6.4	4.3	4.6	4.9	2.2	3.0	—	5.5	2.0
E S E	—	—	—	4.9	7.0	12.5	11.2	6.4	7.4	7.7	1.2	—	8.2	1.5
S E	—	—	5.3	**15.7**	**16.1**	**33.1**	**28.1**	**26.1**	**18.2**	**11.5**	4.3	0.8	**22.9**	3.7
S S E	—	—	0.6	6.6	15.8	12.5	16.2	17.9	16.3	8.7	0.6	—	13.9	1.7
S	—	—	2.3	6.6	14.0	12.8	17.8	10.0	15.8	10.4	3.0	2.0	12.8	3.0
S S W	—	—	0.6	7.3	4.0	1.1	4.3	7.9	4.9	8.7	3.0	—	4.9	2.1
S W	—	—	1.2	6.3	5.8	4.0	3.3	5.0	4.9	9.8	12.8	3.6	4.9	4.6
W S W	—	—	3.5	1.7	1.2	2.7	1.0	0.7	3.4	3.3	4.9	4.0	1.8	2.6
W	1.6	3.7	7.0	4.2	4.9	1.6	2.3	2.5	3.4	10.9	12.2	9.9	3.2	7.6
W N W	17.9	1.8	3.5	3.8	0.3	1.1	0.3	3.2	0.5	0.5	8.5	7.1	1.5	6.6
N W	15.4	10.1	11.1	6.6	4.0	3.5	1.0	1.8	2.5	1.6	**15.2**	**38.5**	3.2	15.3
N N W	**42.3**	13.8	7.6	1.4	1.5	—	1.0	1.1	—	1.1	6.1	5.2	8.3	12.7
Circulating	—	—	1.8	5.6	1.8	1.3	2.6	2.5	3.4	0.5	9.1	2.4	2.9	2.3
Variable	4.1	—	1.8	9.8	6.4	4.5	3.3	3.9	7.9	5.5	3.7	2.4	6.0	2.9
Calm	—	—	1.8	2.4	2.4	—	0.3	—	—	—	0.6	0.4	4.5	0.5

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	19.5	**49.1**	**18.8**	4.1	1.2	0.6	0.4	1.1	—	1.7	5.9	23.7	1.2	**19.8**
N N E	6.5	10.9	15.5	1.9	0.6	—	—	—	0.5	—	5.9	3.8	0.5	7.1
N E	3.3	3.6	15.5	2.6	3.1	0.6	2.5	2.3	1.0	3.9	5.9	4.2	2.0	6.1
E N E	—	—	1.1	2.6	0.3	1.6	2.5	—	0.5	6.2	2.4	2.5	1.3	2.1
E	—	1.8	3.9	3.0	6.1	3.8	7.8	7.6	1.4	10.1	2.9	0.4	5.0	3.2
E S E	1.6	—	0.6	6.4	9.8	11.9	12.8	10.3	13.0	3.4	1.8	—	10.7	1.2
S E	—	—	6.6	**17.6**	17.7	**38.1**	**28.1**	**29.3**	31.9	14.6	8.2	1.3	**27.1**	5.1
S S E	—	—	1.1	12.0	**18.0**	14.4	18.5	18.6	15.5	8.4	1.2	—	16.2	1.8
S	—	—	2.8	10.1	17.4	15.6	12.1	10.3	15.5	**17.4**	2.4	1.3	13.5	4.0
S S W	1.6	—	2.2	3.0	5.8	2.2	2.8	3.0	1.9	2.8	1.8	0.4	3.1	1.5
S W	—	0.9	4.4	7.9	6.7	0.9	4.3	3.8	6.3	9.6	8.2	0.4	5.0	3.9
W S W	—	2.7	1.1	6.0	2.1	0.3	0.4	0.4	3.4	7.9	7.1	3.0	2.1	3.5
W	3.3	3.6	4.4	3.4	0.9	1.9	0.7	1.9	1.0	2.2	8.8	10.2	1.6	5.4
W N W	2.4	1.8	1.7	3.4	1.2	0.6	1.4	1.1	—	3.4	7.6	3.8	1.3	3.5
N W	15.4	10.9	7.2	4.5	1.8	0.6	—	1.5	0.5	0.6	**10.6**	**34.3**	1.5	13.2
N N W	**44.7**	12.7	4.4	2.6	0.3	0.6	0.4	0.8	1.0	—	4.7	7.2	1.0	12.3
Circulating	—	—	2.8	3.7	0.9	1.6	2.5	3.0	3.0	2.2	6.5	3.0	2.5	2.4
Variable	1.6	—	2.8	3.4	2.4	3.4	1.1	3.8	3.4	3.4	4.1	—	2.9	2.0
Calm	—	1.8	3.3	1.9	3.4	1.3	1.8	1.1	0.5	2.2	4.1	0.4	1.7	2.0

CONDITION OF THE SEA, PERCENTAGE.

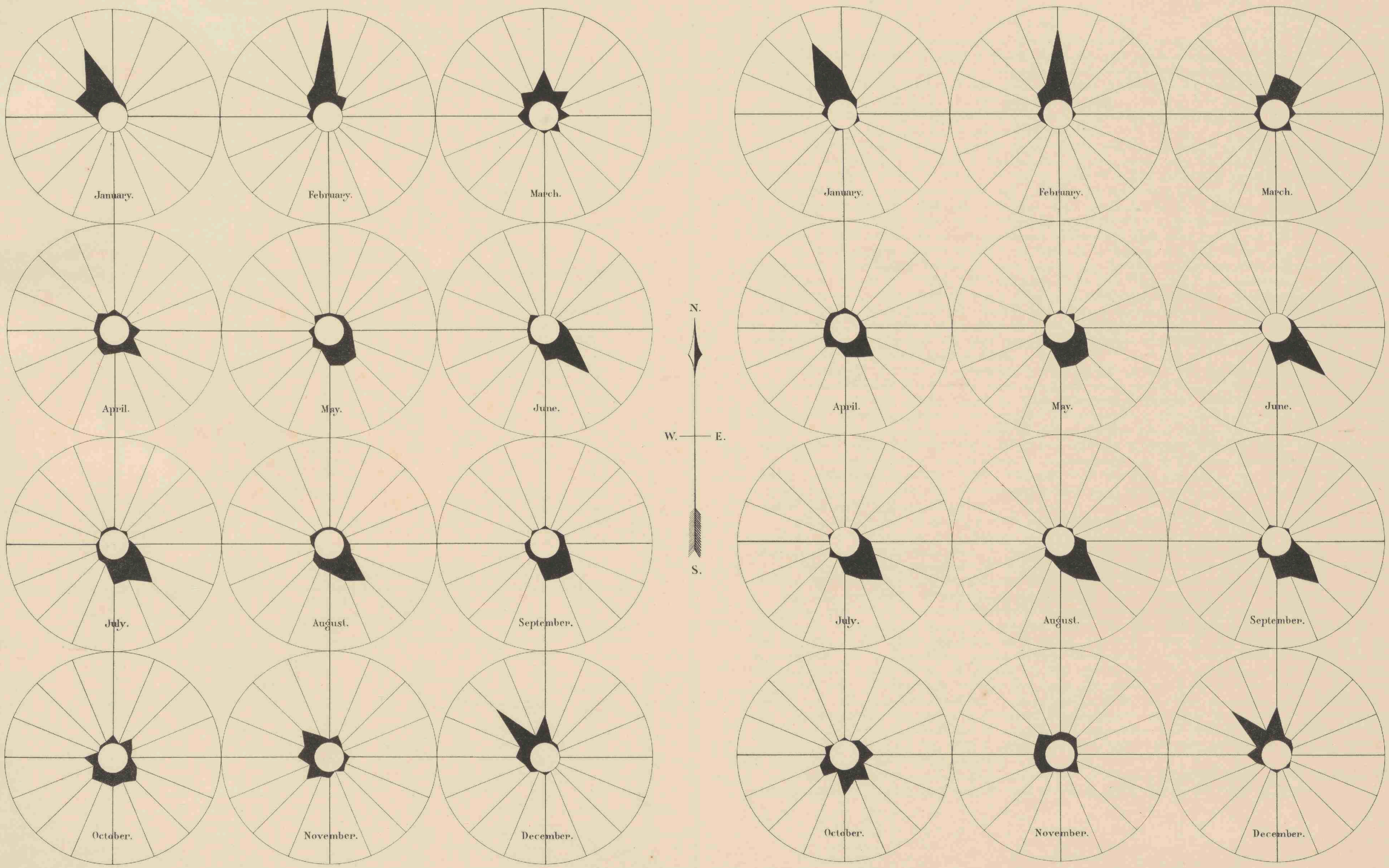
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	21.5	27.5	5.1	7.4	12.0	26.7	18.6	5.3	35.5	11.8	17.0	29.6	17.6	18.8
High Swell	—	—	—	—	0.6	1.5	—	—	—	0.9	—	8.6	0.4	1.6
Waves	28.6	1.0	0.9	—	1.5	—	—	—	—	1.9	—	1.4	0.3	5.6
Sea	14.3	13.7	10.9	1.6	6.2	16.2	11.3	3.9	10.4	8.0	1.2	34.9	8.3	13.8
High Sea	7.2	—	—	1.6	—	—	—	1.4	2.2	—	—	6.9	0.9	2.4
Calm	28.6	57.8	83.2	89.6	79.9	55.8	70.2	89.5	52.2	77.6	81.9	18.8	72.9	58.0
Number of Observations	14	88	119	120	194	226	98	78	90	111	83	143	806	558

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	15.7	49.0	34.2	34.1	43.1	32.3	38.2	33.2	29.9	29.8	26.4	21.1	35.1	29.4
Overcast	60.5	20.2	37.7	43.4	35.3	48.1	36.4	39.6	46.1	40.8	38.8	32.8	41.5	38.5
Showery	8.4	8.9	7.8	7.8	5.1	4.5	5.8	2.8	3.3	2.7	6.2	12.3	4.9	7.7
Rain	12.5	19.5	14.3	9.4	14.5	12.1	16.8	20.4	12.1	11.5	22.5	27.0	14.2	17.9
Squalls	—	—	0.9	0.6	0.5	—	0.6	1.0	—	0.9	—	3.8	0.5	0.9
Thunder	1.1	—	3.0	2.7	0.9	0.8	0.6	1.0	2.5	3.1	2.7	0.4	1.4	1.7
Hazy	2.1	2.5	2.2	2.2	0.7	2.4	1.6	2.2	6.2	10.9	2.7	2.3	2.6	3.8
Mist	—	—	—	—	—	—	0.3	—	—	0.5	0.9	0.4	0.1	0.3
Number of Observations	96	123	231	373	436	382	367	319	241	228	227	262	2118	1167

XI. CHINA SEA, SOUTHERN PARTS.

DAY. NIGHT.



XII. RIOUW AND LINGGA ARCHIPELAGO.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	84	1	N 1° E	N	84 %	1.7	143
February	75	12	N 9° E	N	76	1.7	286
March	44	17	N 21° E	N N E	47	1.5	239
April	— 4	0	S 1° E	S	4	1.5	243
May	—48	18	S 21° E	S S E	51	1.5	352
June	—60	21	S 19° E	S S E	64	1.6	265
July	—62	20	S 18° E	S S E	65	1.7	330
August	—58	21	S 20° E	S S E	62	1.7	337
September	—48	16	S 18° E	S S E	50	1.7	333
October	—35	—10	S 16° W	S S W	36	1.5	257
November	24	—21	N 42° W	N W	32	1.6	336
December	62	—16	N 14° W	N N W	64	1.7	305
Year	— 2	7	S 72° E	E S E	7	1.61	3426

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	83	2	N 1° E	N	83 %	1.7	141
February	84	13	N 9° E	N	85	1.7	248
March	49	18	N 20° E	N N E	53	1.5	210
April	4	19	N 78° E	E N E	19	1.4	220
May	—34	22	S 33° E	S E	40	1.4	312
June	—59	23	S 22° E	S S E	63	1.5	230
July	—61	34	S 29° E	S S E	69	1.7	297
August	—59	26	S 24° E	S S E	64	1.5	329
September	—55	25	S 25° E	S S E	61	1.7	302
October	—38	—13	S 19° W	S S W	40	1.5	239
November	19	—26	N 54° W	N W	32	1.6	316
December	60	—20	N 19° W	N N W	63	1.8	292
Year	— 1	10	N 87° E	E	10	1.57	3136

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	83	2	N 1° E	N	83 %	1.7	284
February	80	13	N 9° E	N	81	1.7	534
March	47	18	N 21° E	N N E	50	1.5	449
April	0	9	S 89° E	E	9	1.5	463
May	—41	20	S 26° E	S S E	45	1.4	664
June	—59	22	S 20° E	S S E	63	1.6	495
July	—61	27	S 24° E	S S E	67	1.7	627
August	—58	24	S 22° E	S S E	63	1.6	666
September	—52	21	S 22° E	S S E	56	1.7	635
October	—36	—12	S 18° W	S S W	38	1.5	496
November	21	—24	N 12° W	N N W	32	1.6	652
December	61	—18	N 17° W	N N W	64	1.8	597
May—October	—51	17	S 19° E	S S E	54	1.58	3583
November—April	49	0	N	N	49	1.63	2979
Year	— 1	8	S 81° E	E	8	1.61	6562

The first impression gained from the average monthly directions, as exhibited in Table C, is, that the monsoon-winds run through the different points of the compass in a positive direction i. e. from left to right.

The wind describes a circle on the compass, moving from one point to another as follows: N in January and February, N N E and E in March and April, S S E from April to September, S S W in October, N N W in November and December, and N again in the two first months of the year.

The epoch of turning is April, when practically no preponderant direction can be observed and winds from every point of the compass may be expected with equal probability.

Towards the latter half of April the S S E monsoon sets in and soon attains to full vigour, blowing with remarkable regularity from the S 22° E; this condition of the weather lasts till September. In October westerly components commence to appear, S S W, S W and W winds are mostly experienced, but S E and S S E winds as well. In November northerly components appear and N, N N W and N W winds begin to prevail.

In December N N W winds occur with pretty large percentages, but in January and February the N monsoon blows with almost absolute steadiness, far surpassing that of the S S E monsoon. In March this monsoon begins to abate and at the same time the easterly components increase, N E winds being mostly met with.

As might be expected the influence of the near land — the numerous isles constituting this Archipelago and the mainland of *Malakka* and *Sumatra* — makes itself felt in a lessening of the wind (a decrease of the wind's force) this being less than in the *China-sea*. However forces larger than 3 have been recorded 48 times, of which 15 coincide with daytime and 33 with nighthours, and in January the registers once mentioned a force of 6, i. e. storm from the N. During the E monsoon too, whenever a force more than 3 was experienced, the wind mostly blew from the S and S W.

As shown by the percentages of Table D, showers and showery weather are mostly recorded during the four months November to February, but heavy squalls on the contrary were almost exclusively experienced during the E monsoon, whenever westerly gusts occurred.

Although the monsoons, as determined by the direction of the wind, are strongly marked, the rainfall is nearly equally distributed throughout the whole year and it is not possible to mark out two distinct seasons, a dry and a wet one. Here, as in other regions, the rainmonsoons are not coëval with the windmonsoons and the fluctuations of the rainfall cannot be explained by the variations in the direction of the wind. From the average values deduced from a series of rain-observations made during 14 years at *Tandjong Pinang (Riouw)*, it appears, that a maximum of rainfall occurs in October and December, a well marked minimum in February, and a secondary minimum in July.

The condition of the sea is, as is natural in an Archipelago, on the whole very favourable: in the summarizing table of the introduction this region shows, with *Banka* strait, the largest percentages of „smooth sea" and in Table D it is seen that, in this respect, only December and January make an exception to the rule, „sea" and „high sea" being recorded with pretty large percentages.

Owing to the effect of the S S E winds the drift-currents on the average are stronger during the E than in the W monsoon: the individual values however occasionally rise during the W monsoon; the highest record for that time being 48 miles per 24 hours, whilst for the E monsoon it is 29 miles, the average values being resp. 12.1 and 19.5.

Observations of tides have been made at *Singapore* and at *Tandjong Kalean* (northern entrance of strait *Banka*) and new tidal stations have been established at *Riouw, Tandjoeng Boeton, Kwala Ladjan* and *Kariman*.

At *Singapore* the tides are semi-diurnal, but largely affected by diurnal irregularity: the most important of the semi-diurnal tides follows the transit of the moon and causes (full and change) high water at $10^h\ 18^m$. The diurnal tide, generally denoted by K_1, varying its phase with siderial time, gives high water about 21st June at $6^h\ 42^m$ p. m. The amplitude of the former semi-diurnal tide is 79 cM., that of the latter 29 cM.: consequently the main feature is semi-diurnal. At *Tandjong Kalean*, on the contrary, the amplitude of the diurnal tide is 93 cM. and that of the semi-diurnal lunar tide M_2 23 cM., consequently the tides must be considered to be diurnal, but affected by semi-diurnal irregularity: about 21st June high water of the diurnal tide sets in at $10^h\ 30^m$ p. m. and about 21st December at $10^h\ 30^m$ a. m. The lunar semi-diurnal tide causes high water $6^h\ 24^m$ after the moon's upper and lower transits.

In consequence of the necessarily gradual transition from semi-diurnal tides at *Singapore* to mono-diurnal tides at *Tandjong Kalean*, the gradients will be steep; or, in other words, on a chart of cotidal lines between the two places, these lines would run very close to each other and, in order to accurately determine their position, observations at a great many stations would be necessary.

Observations of rain have been made near the coast at *Singapore, Tandjoeng Pinang, Singkep, Tandjoeng Boeton, Ringat* and *Djambi*; observations of wind at *Tandjoeng Pinang, Kwala Ladjang* and *Tandjoeng Boeton*.

TABLE D. RIOUW AND LINGGA ARCHIPELAGO.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**42.3**	**28.5**	19.0	7.5	1.6	0.2	1.0	1.3	—	2.0	12.5	**21.4**	1.9	**21.0**
N N E	22.1	16.6	9.9	4.6	0.8	—	0.3	—	1.0	0.5	6.6	10.7	1.1	11.1
N E	6.7	19.5	**20.9**	6.2	0.8	1.2	1.2	0.9	1.4	1.5	5.1	11.1	2.0	10.8
E N E	—	3.1	5.2	0.5	0.4	0.2	1.9	1.6	3.5	1.5	2.2	3.4	1.4	2.6
E	1.2	3.7	7.1	5.4	6.6	5.1	2.6	2.5	6.5	5.1	1.5	0.4	4.8	3.2
E S E	—	—	0.5	4.8	6.6	5.1	7.3	8.6	7.9	4.1	1.1	0.2	6.7	1.0
S E	—	—	3.6	**11.1**	**24.3**	**23.0**	18.4	**20.2**	**16.3**	10.1	4.5	—	**18.9**	3.0
S S E	—	—	1.1	4.0	12.5	16.5	19.4	16.2	13.8	8.1	0.7	—	13.7	1.7
S	—	—	2.7	6.5	13.3	19.1	**19.9**	15.7	10.0	9.4	2.8	0.4	14.1	2.6
S S W	0.8	—	0.8	5.4	4.0	4.9	8.3	8.8	7.0	7.1	3.0	0.4	6.4	2.0
S W	1.6	1.2	3.0	5.9	6.4	7.7	6.1	6.1	11.9	**12.4**	6.4	0.8	7.2	4.2
W S W	—	—	—	3.8	3.3	2.1	1.9	2.1	3.1	7.6	4.1	1.1	2.7	2.1
W	—	0.4	4.7	3.5	5.6	1.6	1.0	2.1	3.0	8.9	9.6	10.2	2.8	5.6
W N W	—	1.7	4.9	8.4	0.8	1.4	1.7	—	0.7	1.3	5.2	4.7	2.2	3.0
N W	10.7	12.7	5.5	5.1	2.5	1.2	0.5	0.4	2.3	3.8	**13.7**	14.3	2.0	10.1
N N W	11.5	8.9	3.0	3.2	0.8	—	0.3	0.2	0.2	1.8	5.6	13.4	0.8	7.4
Circulating	0.8	0.4	3.8	7.3	2.9	5.1	1.9	5.0	3.8	4.6	7.7	2.8	4.3	3.4
Variable	0.4	1.5	3.0	6.2	5.0	5.1	5.5	7.9	7.3	8.9	6.4	4.5	6.2	4.1
Calm	2.0	1.7	1.1	0.5	2.1	0.5	0.5	0.2	0.3	1.5	1.1	0.4	0.7	1.3

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**43.0**	**40.4**	20.1	10.6	3.8	0.3	0.4	0.8	0.2	2.4	**12.7**	**19.8**	2.7	**23.1**
N N E	21.9	24.8	13.7	4.0	0.9	—	0.6	1.0	0.4	1.3	4.9	11.9	1.2	13.1
N E	7.2	17.4	**21.4**	5.9	3.1	2.3	1.6	1.2	1.0	1.9	4.7	7.4	2.5	10.0
E N E	—	0.7	4.8	4.0	3.8	—	1.8	0.2	1.6	1.3	1.2	1.5	1.9	1.6
E	1.2	1.0	4.8	8.1	5.8	4.0	6.7	7.0	5.5	4.5	2.7	1.7	6.2	2.7
E S E	—	—	1.6	7.8	4.7	4.5	13.2	10.7	10.5	5.6	0.4	0.9	8.6	1.4
S E	—	—	1.3	**11.5**	**24.3**	**29.1**	19.1	**21.7**	**19.8**	9.9	1.8	0.2	**20.9**	2.2
S S E	—	—	0.6	5.9	10.9	15.8	**20.5**	14.9	16.6	5.6	1.8	—	14.1	1.3
S	—	—	2.6	7.5	9.8	14.4	15.9	16.1	15.8	10.4	4.1	0.9	13.3	3.0
S S W	0.8	—	1.0	3.1	3.1	6.2	6.5	7.9	5.7	11.5	4.5	1.3	5.4	3.1
S W	1.6	0.2	3.5	1.2	5.8	7.3	6.1	8.3	5.1	**12.0**	9.2	0.9	5.6	4.6
W S W	—	—	1.3	1.9	2.9	1.7	1.6	0.4	2.4	6.7	7.3	1.1	1.8	2.7
W	—	2.5	1.9	2.2	3.3	2.0	1.0	2.7	2.4	11.7	5.3	8.7	2.3	5.0
W N W	0.4	2.0	1.6	3.7	1.1	1.1	—	0.6	1.6	2.1	7.3	7.7	1.4	3.5
N W	9.6	5.6	8.6	7.2	3.6	0.8	0.2	0.2	0.8	2.4	9.9	15.1	2.1	8.5
N N W	11.2	4.9	2.6	5.6	1.8	0.8	0.4	0.4	—	0.5	9.2	14.7	1.5	7.2
Circulating	0.8	—	4.5	3.4	1.6	2.5	3.5	1.9	4.4	2.4	5.9	2.8	2.9	2.7
Variable	0.4	—	2.2	5.0	3.8	5.6	0.4	1.7	5.3	5.1	5.3	2.3	3.6	2.7
Calm	2.0	0.5	1.9	1.2	5.8	1.4	0.6	2.3	0.8	2.7	2.0	0.9	2.0	1.7

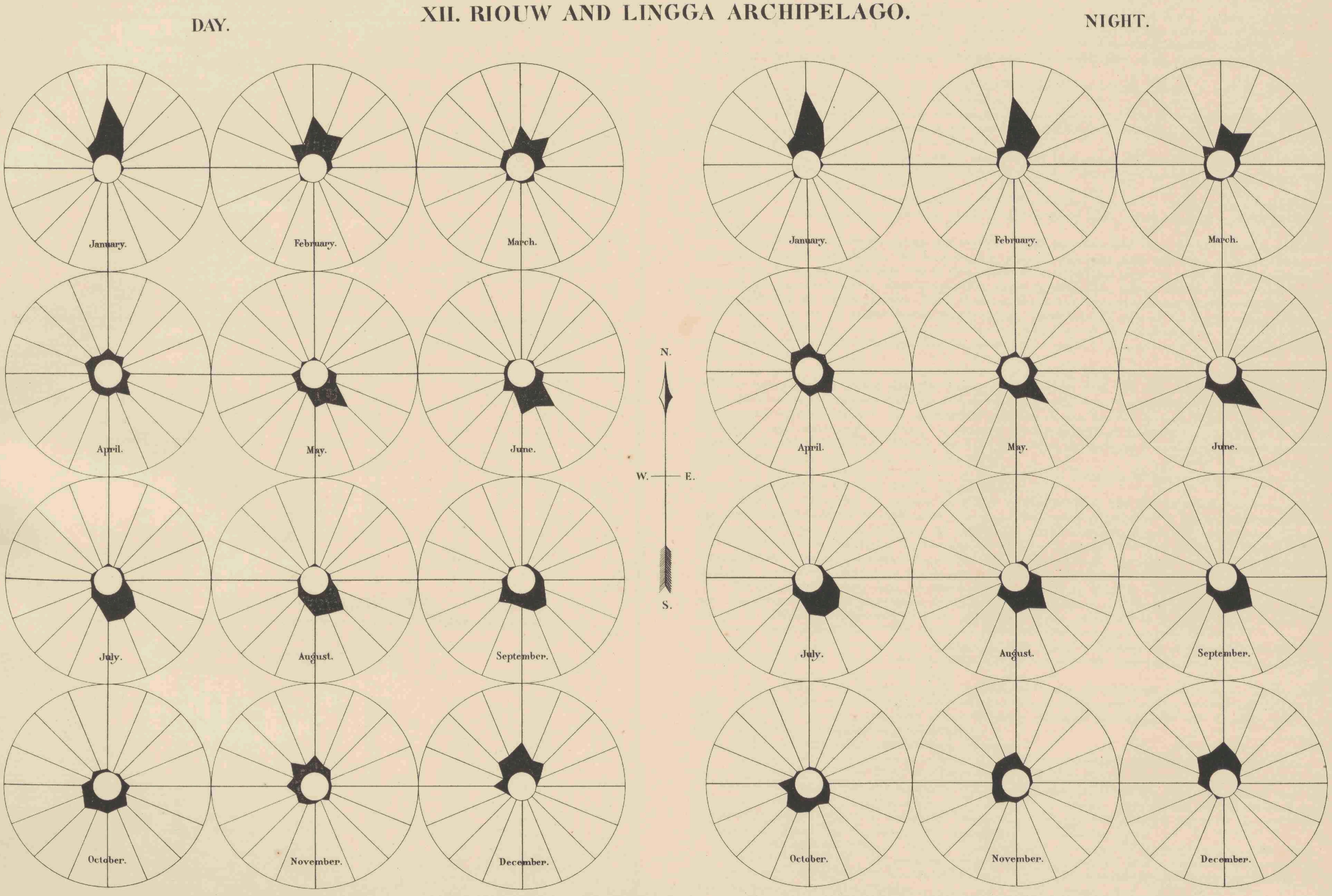
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	14.7	6.3	6.0	5.7	4.5	14.7	15.9	11.5	13.7	11.4	10.4	14.1	11.0	10.5
High Swell	4.0	—	—	—	0.3	—	0.6	0.4	—	—	—	—	0.2	0.7
Waves	2.0	0.7	—	1.2	2.2	1.1	—	—	0.8	—	—	7.1	0.9	1.6
Sea	9.9	8.6	5.7	1.1	2.5	6.9	6.6	6.5	5.5	3.3	8.0	2.0	4.9	6.3
High Sea	2.0	1.4	—	—	0.3	—	3.0	0.9	—	—	—	7.6	0.7	1.8
Calm	67.5	83.2	88.3	92.1	90.3	77.4	74.1	80.8	80.1	85.4	81.6	69.3	82.5	79.2
Number of Observations	101	290	267	174	362	230	194	247	155	181	225	156	1362	1220

CONDITION OF THE WEATER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	35.2	54.3	52.0	38.5	49.4	41.7	37.4	38.4	38.1	32.1	27.1	28.3	40.6	38.2
Overcast	48.6	24.5	29.7	39.9	31.5	37.9	43.5	38.6	39.0	38.4	44.3	43.4	38.4	38.2
Showery	6.4	7.4	3.9	3.9	3.3	4.2	5.5	4.3	4.2	4.9	8.6	7.7	4.2	6.5
Rain	7.8	9.8	11.2	14.3	12.1	14.4	10.6	12.0	11.7	15.5	14.8	18.1	12.5	12.9
Squalls	—	—	0.8	1.1	0.5	0.4	1.2	0.2	0.5	0.7	0.5	0.3	0.7	0.4
Thunder	—	0.4	1.0	1.6	1.2	0.5	0.2	2.5	0.3	1.3	1.9	1.1	1.1	1.0
Hazy	2.1	3.3	1.4	0.9	1.9	1.1	1.7	4.1	6.3	6.9	3.1	1.2	2.7	3.0
Mist	—	0.4	0.3	—	0.4	—	—	—	—	0.4	—	—	0.1	0.2
Number of Observations	284	534	428	463	643	494	625	651	649	494	656	596	3525	2992

XII. RIOUW AND LINGGA ARCHIPELAGO.



XIII. STRAIT BANKA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	58	—59	N 46° W	N W	83 %	1.5	137
February	71	—33	N 25° W	N N W	78	1.6	128
March	66	—11	N 9° W	N	67	1.6	212
April	10	12	N 49° E	N E	16	1.4	204
May	—34	36	S 47° E	S E	50	1.5	235
June	—40	42	S 47° E	S E	58	1.5	110
July	—39	43	S 47° E	S E	58	1.5	97
August	—36	47	S 52° E	S E	59	1.6	159
September	—44	60	S 54° E	S E	74	1.6	84
October	—30	29	S 17° E	S S E	42	1.5	146
November	17	—19	N 48° W	N W	25	1.3	185
December	48	—33	N 34° W	N N W	58	1.6	192
Year	4	10	N 68° E	E N E	11	1.52	1889

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	52	—41	N 38° W	N W	66 %	1.5	117
February	56	—28	N 27° W	N N W	63	1.4	103
March	69	— 6	N 5° W	N	69	1.6	212
April	—31	9	S 17° E	S S E	32	1.4	178
May	—38	26	S 34° E	S S E	46	1.5	211
June	—59	21	S 19° E	S S E	63	1.7	101
July	—51	27	S 25° E	S S E	58	1.5	95
August	—55	39	S 34° E	S S E	67	1.5	152
September	—43	42	S 45° E	S E	60	1.5	84
October	—39	15	S 21° E	S S E	42	1.5	140
November	— 5	—29	S 80° W	W	29	1.3	176
December	33	—37	N 48° W	N W	50	1.7	187
Year	— 9	3	S 18° E	S S E	9	1.51	1756

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	55	—50	N 43° W	N W	74 %	1.5	254
February	64	—31	N 27° W	N N W	71	1.5	231
March	68	— 9	N 7° W	N	70	1.6	424
April	—11	11	S 45° E	S E	16	1.4	382
May	—36	31	S 41° E	S E	48	1.5	446
June	—50	32	S 33° E	S S E	59	1.6	211
July	—45	35	S 39° E	S E	57	1.5	192
August	—46	43	S 43° E	S E	63	1.6	311
September	—44	51	S 50° E	S E	67	1.6	168
October	—35	22	S 32° E	S S E	41	1.5	286
November	6	—24	N 76° W	W N W	25	1.3	361
December	41	—35	N 41° W	N W	54	1.7	379
April—October	—38	32	S 40° E	S E	50	1.53	1996
November—March	47	—30	N 33° W	N N W	56	1.52	1649
Year	— 3	6	S 63° E	E S E	7	1.53	3645

At the time when N winds prevail in the *Riouw* and *Lingga Archipelago*, i. e. during January and February, N W and N N W winds blow in strait *Banka*; an inspection of Table C and a comparison of the average monthly directions of the wind during the E monsoon in strait *Banka* with those of the *Riouw Archipelago* shows that, during the corresponding months, the E monsoon is blowing from a more easterly point of the compass in the former than in the latter region.

To an average direction of N and S 19° E in the *Archipelago*, an average direction of N 33° W and S 40° E corresponds in strait *Banka* during the W en E monsoon respectively.

It is of some importance to point out this fact because in some books the W monsoon in these regions is considered as the result of the deviation to the westward of the northerly aircurrents, as they arrive in southern latitudes, a well known effect of the rotation of the earth.

This is not so: deviations to the westward as considerable as those observed in strait *Banka* and strait *Karimata* and in such immediate proximity of the equator cannot be ascribed to the effect of the earth's rotation because this effect is proportionate to the sine of the latitude.

The true reason of the westerly directions of these aircurrents, due to the inrush of air caused by the ascension of the heated atmosphere over the mainland of *Australia*, is found in their limitation to the lower layers of the atmosphere.

Owing to this reason they naturally rush over the smooth sea-surfaces and avoid the land where their course is impeded by friction as well as by the descending and ascending aircurrents which give rise to land- and seabreezes.

In so far as heights less than 500 to 1000 metres are concerned this propensity of the aircurrents to travel along sea-ways is evident even in relatively small and narrow straits as those between the *Sunda-Isles*, and this theory is corroborated by the wind-observations made at stations in *Sumatra* and *Borneo* showing the great differences experienced in the monsoons at sea and at land-stations, even when they are so near the shore as f. i. *Singkawang* or *Batavia*.

When, in January, strong westerly winds are experienced in the *Java-sea* at night- as well as at daytime, calms are regularly observed during nighthours at *Batavia* and — unless a heavy shower is coming on — the clouds mostly show very little motion.

From table C it may be seen that the E monsoon sets in in April, which month evidently belongs to the period of both monsoons. During this time S E, S and S W winds blow with about equal percentages, but N E winds also occur. From May to October the E monsoon may be relied upon for steadiness and direction; in November the monsoon veers to the W N W, the percentages of steadiness are low, and S, S E, S W, W and N W winds may be expected with about equal probability. In December winds from the N W quarter prevail, but the W monsoon attains to full vigour in January, February and March only, when the steadiness is greatest, the mean direction at the same time varying from N W to N N W and N.

Land- and seabreezes, though weakened by the proximity of *Banka-Isle*, are perceptible, the direction of the former being S 28° W, of the latter N 28° E, the percentage 7.4 %.

At daytime during the W monsoon the N N W monsoon-winds set with the N N E seabreeze: consequently high percentages of steadiness are exhibited in Table A; on the contrary at nighttime, in this season, monsoonwinds and landbreezes blow in opposite directions, for which reason smaller coëfficients of probability are shown in Table B.

This difference in reliability of the monsoons for night- and dayhours is not observable during the E monsoon because then the prevailing S E aircurrent meets the land- and seabreezes at right angles, consequently the steadiness remains the same, but the direction is slightly different, inclining to the South at nighthours and to the East at daytime.

The percentages of rainy days, as shown in Table D, fail to give an exact idea of the probability of rain: observations of rainfall made during 15 consecutive years at *Muntok* point to the conclusion that the average quantity of rainy days in November, December and January is resp. 18, 23 and 19 in the 30 and 31 days of the months and therefore considerably higher than would appear from the percentages given in Table D.

These three months are what might be called the rainy season; in February the rainfall slightly decreases to augment again in March. The dry season lasts from May till September, the driest month being July with an average rainfall of 108 mm. and 8 rainy days in the 31.

A force of the wind greater than 3 has been recorded 11 times at nighthours and 3 times at daytime and mostly in March, April and June from a W S W direction. Showery and squally weather therefore may be said to occur during both moonsoons, but almost exclusively during nighthours and with S W and W winds only, its occurrence during the E monsoon being an exception.

Haziness is mostly experienced during the E monsoon.

The general direction of the sea is, as might be expected, very favourable; when the pretty strong tidal streams are running against the direction of the wind however „sea" and „high sea" are experienced during both seasons.

Observations of tides and tidal streams have been made at *Tandjong Kalean* and *Pulu Besar*, situated resp. at the northern and southern entrances of the strait. The tides are diurnal, with high and low water once during 24 hours, but slightly affected by semi-diurnal irregularity: semi-diurnal tides, therefore, are mostly observed about the time of the moon's transit of the equator, when neaps of the diurnal tide occur.

High water occurs at 10[h] p. m. about 21[st] June and at 10[h] a. m. about 31[st] December with a retrograde motion of 2 hours for every month. The prevailing system of tidal streams in the strait is rather intricate owing to a perennial current running in a S direction under the *Sumatra* coast; for details about tides and tidal streams the reader is referred to the chapter on tides.

Observations of rainfall have been made at *Muntok*, *Djambi* and *Palembang*; observations of wind at *Palembang*, *Batoe Radja*, *Tandjong Kalean*, *Muntok* and *Pulu Besar*.

TABLE D. STRAIT BANKA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	15.3	**41.0**	**27.9**	5.4	1.7	0.6	2.6	3.1	0.7	6.4	8.6	10.2	2.4	18.2
N N E	2.0	1.0	5.5	4.1	1.1	1.2	3.3	1.1	1.4	4.1	3.3	1.6	2.0	2.9
N E	—	—	10.9	**12.2**	5.1	1.8	5.3	3.8	5.8	2.3	6.2	3.8	5.7	3.9
E N E	0.5	1.0	1.4	5.1	5.1	2.4	0.7	3.8	4.3	1.8	3.3	0.6	3.6	1.4
E	—	—	0.9	4.4	7.3	12.9	12.6	10.0	6.5	10.6	1.6	2.2	9.0	2.6
E S E	—	—	0.6	6.4	8.8	11.2	9.3	9.2	15.9	5.0	2.1	1.0	10.1	1.5
S E	—	—	0.6	7.1	**26.6**	**26.5**	**31.1**	**36.0**	**44.2**	**23.9**	2.9	2.2	**28.6**	4.9
S S E	—	—	—	6.4	10.2	8.2	10.6	9.2	3.6	8.7	3.7	2.2	8.0	2.4
S	0.5	1.5	0.6	3.7	8.8	10.0	7.9	4.2	7.2	7.8	6.2	2.2	7.0	3.1
S S W	—	—	—	1.0	1.4	4.7	4.6	1.5	2.9	5.5	1.2	0.6	2.7	1.2
S W	2.5	0.5	0.9	3.7	4.2	2.4	2.0	3.1	1.4	5.0	6.2	1.0	2.8	2.7
W S W	2.0	1.5	0.3	2.0	3.4	—	2.0	0.4	—	1.8	2.5	2.2	1.3	1.7
W	10.8	6.8	3.2	5.4	1.1	0.6	4.0	2.7	—	1.8	7.0	4.1	2.3	5.6
W N W	14.3	1.0	3.4	2.4	1.4	—	—	—	—	—	9.5	7.0	0.6	5.9
N W	**41.9**	29.3	13.5	9.1	1.4	2.4	0.7	0.8	—	2.3	**15.2**	**28.9**	2.4	**21.9**
N N W	9.4	11.2	17.8	4.7	2.3	1.2	—	—	—	—	4.5	21.0	1.4	10.7
Circulating	1.0	2.4	4.6	7.1	2.8	7.6	2.6	3.1	1.4	3.7	4.1	3.5	4.1	3.2
Variable	—	1.5	6.9	9.1	4.8	4.7	—	8.0	4.3	8.7	10.7	5.1	5.2	5.5
Calm	—	1.5	1.1	0.7	2.5	1.8	0.7	—	—	0.5	1.2	0.6	1.0	0.8

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	19.0	20.7	**29.5**	3.1	3.7	—	3.4	0.4	—	2.0	4.6	9.4	1.8	14.2
N N E	6.3	4.7	12.1	—	0.6	—	—	0.9	1.6	—	2.1	3.8	0.5	4.8
N E	4.6	4.7	8.4	8.3	5.2	1.2	0.7	2.1	4.7	3.9	4.2	1.9	3.7	4.6
E N E	0.6	0.7	0.3	4.7	0.6	2.3	2.0	0.9	3.1	5.9	1.3	0.3	2.3	1.5
E	—	1.3	1.2	4.3	10.2	6.4	9.4	12.9	16.5	8.8	3.4	1.3	10.0	2.7
E S E	0.6	—	0.6	7.9	6.5	5.8	6.7	8.2	6.3	2.5	1.3	0.3	6.9	0.9
S E	—	—	0.9	**16.5**	**21.3**	**27.5**	**33.6**	**30.9**	**21.3**	**15.2**	6.3	3.1	**25.2**	4.3
S S E	—	1.3	0.6	3.1	11.4	9.9	10.7	11.6	11.0	9.8	3.0	1.3	9.6	2.8
S	1.1	2.0	0.6	10.2	10.5	15.2	4.7	12.4	13.4	13.2	8.9	0.9	11.1	4.5
S S W	1.7	0.7	—	7.5	4.0	11.1	4.7	4.3	6.3	8.3	3.4	1.9	6.3	2.7
S W	3.4	2.0	2.5	12.6	8.0	7.6	15.4	6.9	4.7	9.3	10.5	2.8	9.2	5.1
W S W	3.4	2.0	1.9	5.9	2.5	0.6	2.7	3.9	—	2.9	6.8	4.7	2.6	3.6
W	12.1	6.0	6.8	4.3	3.1	6.4	3.4	—	—	2.9	**11.4**	12.9	2.9	8.7
W N W	12.1	0.7	3.4	0.4	—	—	—	—	—	2.0	10.1	6.6	0.1	5.8
N W	**19.5**	**28.7**	7.8	4.7	1.9	—	0.7	—	0.8	2.0	11.0	16.9	1.4	**14.3**
N N W	13.2	14.7	13.0	—	0.6	—	—	—	—	1.0	3.4	**25.7**	0.1	11.8
Circulating	1.1	2.7	6.5	1.2	3.1	3.5	—	2.6	3.9	3.9	3.4	4.1	2.4	3.6
Variable	0.6	1.3	1.9	2.8	4.0	1.2	0.7	1.3	5.5	5.9	2.1	1.3	2.6	2.2
Calm	0.6	6.0	1.9	2.4	2.8	1.2	1.3	0.9	0.8	0.5	3.0	0.9	1.6	2.2

CONDITION OF THE SEA, PERCENTAGE.

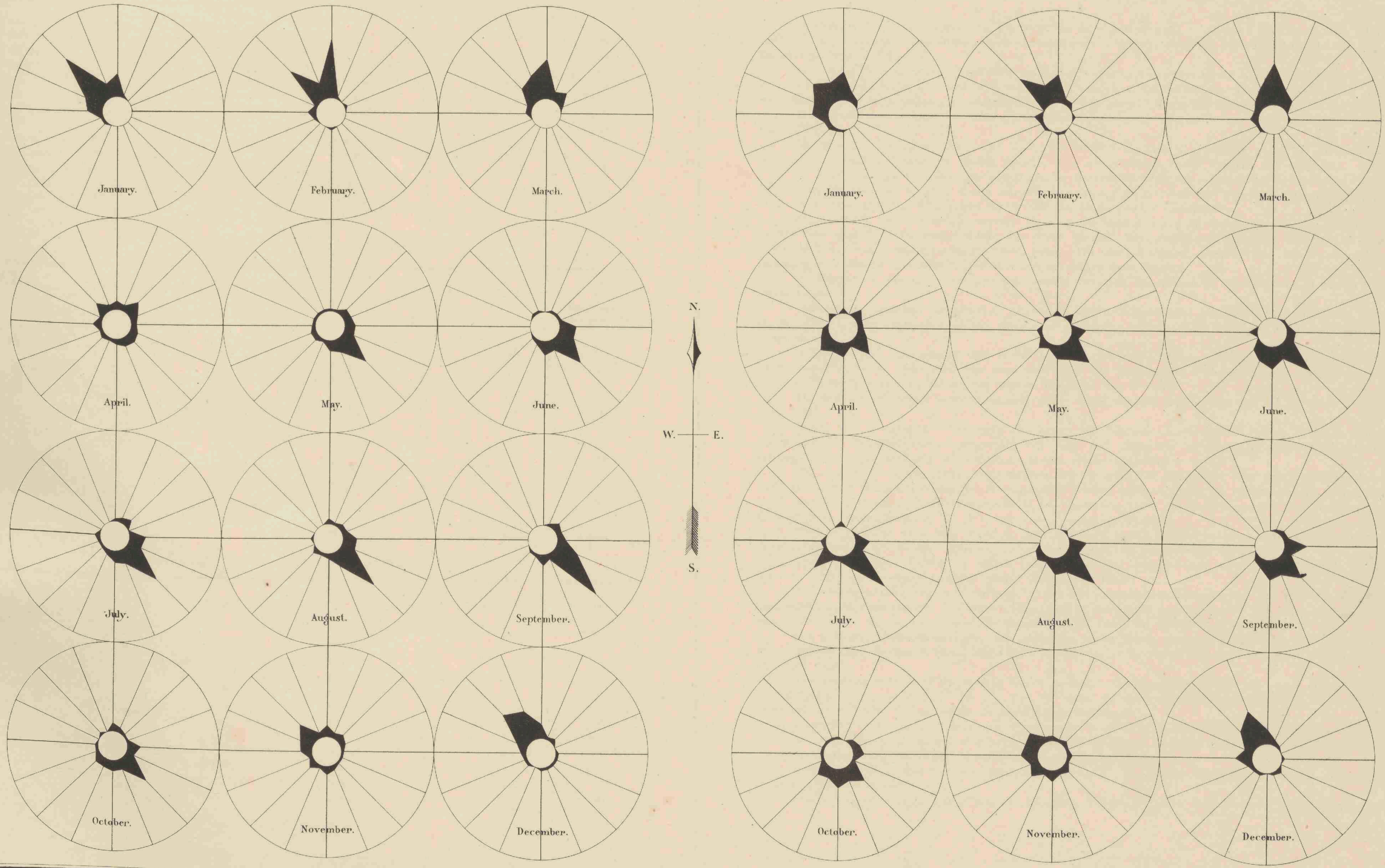
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	10.3	4.4	3.3	2.5	1.4	15.5	7.5	10.5	12.4	10.2	2.9	2.4	8.3	5.6
High Swell	—	—	—	—	—	—	1.2	0.7	—	—	—	—	0.3	—
Waves	6.2	1.1	2.6	—	—	—	—	—	—	3.4	—	5.5	—	3.1
Sea	7.6	5.9	10.9	0.7	2.5	5.1	9.9	11.5	10.6	8.7	—	18.6	6.7	8.6
High Sea	—	—	—	—	—	—	—	—	0.9	—	—	—	0.2	—
Calm	76.1	88.6	83.3	96.9	96.1	79.5	81.5	77.4	76.2	77.9	97.1	73.6	84.6	82.8
Number of Observations	100	164	149	133	155	137	81	122	113	93	70	125	741	701

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	26.4	35.6	33.4	41.1	31.2	42.4	37.1	43.7	40.1	52.4	39.1	23.8	39.3	35.1
Overcast	49.1	49.6	41.6	35.5	40.5	34.8	30.2	33.6	32.8	28.4	40.8	49.5	34.6	43.2
Showery	6.3	5.3	7.2	7.4	13.2	4.8	6.9	3.7	3.9	3.1	6.8	8.6	6.7	6.2
Rain	17.5	7.7	12.6	10.3	11.7	15.3	19.4	12.4	7.4	7.2	9.3	14.7	12.8	11.5
Squalls	—	0.5	—	0.6	0.5	—	0.6	0.4	0.6	—	1.1	0.8	0.5	0.4
Thunder	0.4	0.5	3.8	1.8	1.4	0.5	1.1	—	2.9	2.8	0.6	0.8	1.3	1.5
Hazy	0.4	1.0	1.5	3.5	0.9	2.0	4.3	6.4	11.9	4.9	1.7	1.6	4.8	1.9
Mist	—	—	—	—	0.7	0.5	0.6	—	0.6	1.4	0.8	0.3	0.4	0.4
Number of Observations	250	208	414	383	435	208	186	298	177	292	359	374	1687	1897

XIII. STRAIT BANKA.

DAY. NIGHT.



XIV. STRAITS KARIMATA AND GASPAR.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	55	—64	N 49° W	N W	84 %	1.8	56
February	32	—48	N 56° W	N W	57	1.4	23
March	53	—42	N 39° W	N W	67	1.6	49
April	4	—11	N 70° W	W N W	12	1.3	57
May	—24	42	S 61° E	E S E	48	1.5	119
June	—54	39	S 36° E	S E	67	1.7	103
July	—53	42	S 38° E	S E	67	1.6	118
August	—53	57	S 47° E	S E	77	1.8	88
September	—55	31	S 29° E	S S E	63	1.7	51
October	—31	24	S 38° E	S E	40	1.7	53
November	—14	—35	S 68° W	W S W	38	1.5	91
December	25	—65	N 69° W	W N W	70	1.7	54
Year	—10	— 2	S 10° W	S	10	1.60	862

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	48	—53	N 48° W	N W	71 %	1.5	51
February	42	—39	N 43° W	N W	58	1.7	21
March	30	—31	N 46° W	N W	43	1.4	46
April	—20	1	S 4° E	S	20	1.1	52
May	—32	53	S 59° E	E S E	63	1.4	114
June	—47	59	S 51° E	S E	75	1.7	94
July	—53	58	S 47° E	S E	79	1.7	105
August	—40	62	S 57° E	E S E	73	1.8	84
September	—39	67	S 60° E	E S E	77	1.7	47
October	—27	13	S 26° E	S S E	30	1.5	47
November	3	—35	N 86° W	W	35	1.5	87
December	15	—65	N 77° W	W N W	66	1.8	52
Year	—10	8	S 37° E	S E	13	1.58	800

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	51	—58	N 49° W	N W	78 %	1.6	107
February	37	—43	N 49° W	N W	57	1.5	44
March	41	—37	N 42° W	N W	55	1.5	95
April	—12	— 6	S 27° W	S S W	13	1.2	109
May	—28	48	S 60° E	E S E	55	1.4	233
June	—51	49	S 44° E	S E	70	1.7	197
July	—53	50	S 43° E	S E	73	1.7	223
August	—46	59	S 52° E	S E	75	1.8	172
September	—47	49	S 46° E	S E	68	1.7	98
October	—29	19	S 33° E	S S E	35	1.6	100
November	— 6	—35	S 81° W	W	36	1.5	178
December	20	—65	N 73° W	W N W	68	1.7	106
May—October	—42	49	S 50° E	S E	65	1.66	1023
November—April	22	—41	N 62° W	W N W	47	1.51	639
Year	—10	3	S 16° E	S S E	10	1.59	1662

In these passages the S E monsoon sets in in the latter half of April, attains to a percentage of 55 % in May, and keeps on, increasing in steadiness as well as in force, up to August when the percentage amounts to 75 % and the average force to 1.8.

In October W S W winds occasionally occur, but the general direction is still from the S S E; in November westerly components begin to prevail and winds from varying directions are experienced; both months may be regarded as periods of transition and consequently the turning point of the monsoons occurs about the 1^{st} of November.

Endeavours to accurately fix these turning-points are however useless, as they differ considerably from one year to another.

In December the main direction of the wind is W N W with a percentage of 68 %; in January the N W monsoon reaches a maximum, abating again in force and steadiness during February and March.

In April winds from all directions and frequently intervening calms are experienced; the transition from W to E monsoon, therefore, is a more abrupt one than that from E to W monsoon. This fact proves a preponderance of the E monsoon over the W monsoon, which increases as we proceed southward.

During either monsoon cloudy weather prevails; the differentiations of the monsoons, as to rainfall, is less marked here than in strait *Banka*: during the driest months, July, August and September rain may be expected every third day and a monthly rainfall of from 100 to 175 mm. November, December and January form the wet season, when a rainfall amounting to 500 mm. has not seldom been recorded.

In February a secondary minimum is observable, which is less marked on the west-coast of *Billiton* than at the east-coast.

The seasons, therefore, as defined by rainfall, do not coincide with the monsoons as defined by the direction of the wind, and an explanation of the phenomena concerning rainfall cannot be based on a knowledge of the monsoons only.

A force of the wind greater than 3 has been recorded only 9 times, eight times at nighthours, and once during day-time; in all these cases the wind blew from the same points of the compass as the monsoon-winds; showers and heavy squalls are mostly met with in November and December.

The condition of the sea is not favourable on the whole, the only month when „smooth sea" may be expected being April.

During the W monsoon — especially in January and February — the swell of the sea is pretty strong: in the E monsoon the swell abates considerably, but „sea" and „high sea" are frequently recorded, which is to be ascribed to the general tendency of the currents to flow to the southward.

The currents are mostly drift-currents running *with* the wind, but the average force during the E monsoon is 12.9 miles per 24 hours and during the W monsoon 17.1 miles, whereas during the former monsoon 9 observations in 55 were found to run in a direction *opposite* to the dominating wind; the strongest current was found during the E monsoon to amount to 42, in the W monsoon to 35 miles per 24 hours.

Tidal observations have been made at *Pulu Langkoeas*, in the northern entrance of the *Gaspar* passages, at *Ondiepwater-eiland*, in the southern entrance, and at *Soekadana* on the west-coast of *Borneo*.

The tides in these regions are almost exclusively diurnal, more so than anywhere else: at *Pulu Langkoeas* not even a trace of the so-called regular moon's tide is to be found.

At *Ondiepwater-eiland* there may be traced a very small semi-diurnal motion, which has, however, no practical importance and at *Soekadana* the semi-diurnal tide, following the moon's transits, is only just strong enough to cause high water twice a day at times when the diurnal tides are small, i. e. in March and September.

If a table were made up exhibiting the proportions of the diurnal to the semi-diurnal tides all over the globe, *Pulu Langkoeas* and *Ondiepwater-eiland* would come at the head of the list of stations where exact tidal observations have been made.

The principal features of the tides in these regions are: the occurrence of high water once only in 24 hours and of spring- and neaptide resp. one day after the dates on which the moon's declination attains its maximum value and one day after that on which the moon passes the equator.

About 21^{st} June high water sets in at 9^h 30^m p. m., about 21^{st} July, at springtide, it is high water at 7^h 30^m p. m. and so on with a retrograde motion of 2 hours per month, so that in December high water occurs at 9^h 30^m a. m.

For further details the reader is referred to the chapter on tides.

Observations of rainfall have been made at *Tandjoeng Pandan*, *Boeding*, *Manggar* and *Dendang*, all four places situated on the isle of *Billiton*.

Observations of wind have been made at *Mendanau*, *Tandjoeng Pandan*, *Pulu Langkoeas* and *Ondiepwater-eiland*.

TABLE D. STRAITS KARIMATA AND GASPAR.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	8.2	4.9	16.7	13.4	4.6	1.7	0.5	—	3.4	1.2	4.4	6.7	3.9	7.0
N N E	1.0	—	—	2.7	2.3	0.6	—	—	—	—	—	3.3	0.9	0.7
N E	—	4.9	6.4	1.4	6.9	1.1	1.6	1.2	6.7	—	2.2	—	3.2	2.3
E N E	—	—	2.6	—	1.7	—	1.0	3.1	—	—	1.5	—	1.0	0.7
E	—	4.9	2.6	1.4	**21.1**	9.1	9.8	9.8	2.2	17.4	3.6	1.1	8.9	4.9
E S E	—	—	—	12.0	10.9	7.4	7.3	23.3	2.2	7.0	1.5	—	10.5	1.4
S E	—	—	—	9.4	19.4	**34.9**	**45.6**	**29.4**	**39.3**	**25.6**	5.1	—	**29.7**	5.1
S S E	—	—	2.6	4.0	4.6	13.7	5.7	12.9	9.0	4.7	0.7	—	8.3	1.3
S	—	—	1.3	4.0	7.4	14.9	13.0	9.2	15.7	9.3	7.3	—	10.7	3.0
S S W	—	—	—	—	—	3.4	0.5	1.2	4.5	4.7	5.1	—	1.6	1.7
S W	2.0	7.3	—	8.0	8.6	1.1	3.1	4.3	10.1	2.3	**14.6**	4.4	5.9	5.1
W S W.	4.1	4.9	3.9	5.4	1.1	—	3.1	—	—	—	10.2	7.8	1.6	5.2
W	7.1	12.2	9.0	10.7	4.0	2.9	4.1	—	—	5.8	13.1	**30.0**	3.6	12.9
W N W	12.2	9.8	11.5	1.4	0.6	1.7	—	—	—	4.7	4.4	17.8	0.6	10.1
N W	**56.1**	**39.0**	**41.0**	**13.4**	—	1.1	1.6	—	—	8.1	12.4	14.4	2.7	**28.5**
N N W	5.1	—	2.6	4.0	—	—	1.0	—	—	—	—	4.4	0.8	2.0
Circulating	2.0	—	—	6.7	3.4	1.1	0.5	2.5	—	—	2.9	—	2.4	0.8
Variable	2.0	7.3	—	1.4	2.3	2.3	0.5	2.5	4.5	7.0	8.8	10.0	2.3	5.9
Calm	—	4.9	—	1.4	1.1	2.9	1.0	0.6	2.2	2.3	2.2	—	1.5	1.6

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	5.0	22.2	10.4	3.2	3.1	1.2	0.5	1.3	—	1.4	6.0	5.4	1.6	8.4
N N E	—	5.6	1.5	—	3.1	—	—	1.3	—	1.4	1.5	2.2	0.7	2.0
N E	2.5	—	4.5	4.8	6.7	3.7	1.1	0.6	11.3	5.5	0.7	—	4.7	2.2
E N E	—	—	3.0	—	3.1	—	1.1	1.3	1.3	—	—	—	1.1	0.5
E	—	5.6	1.5	—	12.9	7.4	9.5	13.6	12.5	13.7	4.5	—	9.3	4.2
E S E	—	—	—	17.5	17.2	22.7	22.1	23.4	8.8	6.8	2.2	—	18.6	1.8
S E	—	—	1.5	**19.0**	**28.8**	**45.4**	**43.7**	**31.2**	**52.5**	**17.8**	4.5	2.2	**36.8**	4.3
S S E	—	—	3.0	1.6	2.5	8.0	2.6	8.4	3.8	6.8	4.5	—	4.5	2.4
S	—	—	1.5	1.6	9.2	1.2	11.6	3.9	2.5	9.6	3.7	3.3	5.0	3.0
S S W	—	—	—	3.2	1.8	1.2	1.6	—	—	—	1.5	—	1.3	0.3
S W	1.3	2.8	7.5	12.7	2.5	3.7	2.1	0.6	1.3	2.7	6.7	12.0	3.8	5.5
W S W.	5.0	2.8	6.0	1.6	—	0.6	—	—	—	15.1	0.7	5.4	0.4	5.8
W	11.3	22.2	—	14.3	1.8	1.2	1.6	—	—	2.7	**29.1**	**25.0**	3.2	15.1
W N W	12.5	5.6	9.0	—	0.6	—	—	—	—	5.5	3.0	14.1	0.1	8.3
N W	**52.5**	**22.2**	**31.3**	4.8	0.6	1.8	1.6	—	—	4.1	11.9	21.7	1.5	**24.0**
N N W	2.5	—	1.5	6.3	—	1.2	—	—	—	—	3.7	2.2	1.3	1.7
Circulating	—	2.8	7.5	1.6	1.8	—	—	5.8	—	—	3.0	5.4	1.5	3.1
Variable	5.0	5.6	7.5	—	2.5	—	1.1	7.1	5.0	5.5	9.0	1.1	2.6	5.6
Calm	2.5	2.8	3.0	7.8	1.8	0.6	—	1.3	1.3	1.4	3.7	—	2.1	2.2

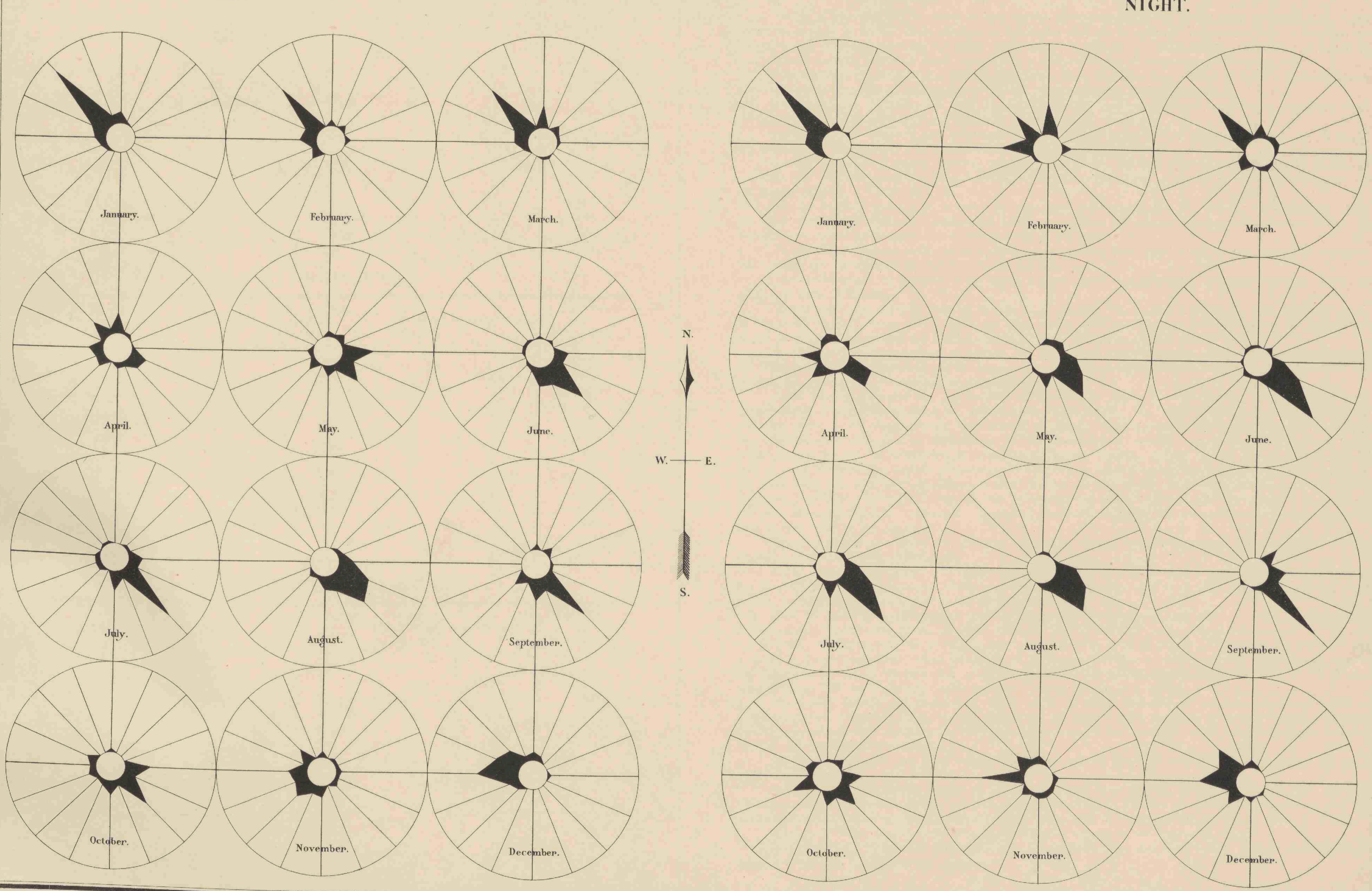
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	59.4	62.5	3.8	7.7	22.8	22.6	21.9	21.4	30.4	3.7	16.7	35.9	21.1	30.3
High Swell.	—	—	—	—	—	—	—	—	—	—	—	8.0	—	1.3
Waves	11.7	—	—	—	—	1.0	3.7	—	1.4	3.6	—	—	1.0	2.6
Sea	10.7	3.6	13.0	1.9	4.1	28.9	11.8	8.3	21.8	5.5	6.4	32.1	12.8	11.9
High Sea.	—	—	3.8	—	—	1.0	—	—	—	—	—	12.2	0.2	2.7
Calm	18.3	34.0	79.4	90.4	73.2	46.6	62.8	70.4	46.5	87.2	77.0	11.9	65.0	51.3
Number of Observations .	43	26	53	45	149	109	131	47	64	54	48	25	545	249

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	21.1	59.8	42.0	45.5	48.9	41.3	40.3	24.2	26.7	28.8	30.4	19.9	37.8	33.7
Overcast	51.6	35.5	30.5	31.9	31.8	38.6	47.0	40.5	49.1	42.7	38.7	42.3	39.8	40.2
Showery	3.8	2.5	6.5	4.5	4.3	2.1	1.3	5.8	1.3	6.8	6.8	17.0	3.2	7.2
Rain	22.7	—	14.8	14.5	14.7	13.9	9.7	24.9	19.8	12.3	22.0	11.4	16.3	13.9
Squalls	—	—	1.1	0.9	—	0.6	0.5	1.2	—	—	1.2	7.6	0.5	1.7
Thunder	—	—	—	0.9	0.5	1.6	—	—	—	1.1	1.1	—	0.5	0.4
Hazy	1.0	2.3	5.2	1.9	—	2.1	1.3	3.6	3.2	2.9	—	1.9	2.0	2.2
Mist	—	—	—	—	—	—	—	—	—	5.8	—	—	—	1.0
Number of Observations .	106	42	95	110	233	195	223	170	91	101	178	106	1022	628

XIV. STRAITS GASPAR AND KARIMATA.



XV. STRAIT SUNDA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	0	—53	W	W	53 %	1.8	86
February	5	—44	N 83° W	W	44	1.6	113
March	— 8	—39	S 78° W	W S W	40	1.7	115
April	— 6	0	S 3° E	S	6	1.6	210
May	— 3	9	S 72° E	E S E	9	1.3	124
June	—16	2	S 7° E	S	16	1.5	149
July	15	27	N 61° E	E N E	31	1.5	74
August	—39	— 2	S 3° W	S	39	1.7	84
September	—40	15	S 21° E	S S E	43	1.6	115
October	—60	—28	S 25° W	S S W	66	1.6	141
November	—37	—24	S 32° W	S S W	44	1.7	75
December	—14	—65	S 77° W	W S W	66	1.8	100
Year	—17	—17	S 45° W	S W	24	1.62	1386

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	22	—50	N 56° W	N W	55 %	1.9	83
February	21	—50	N 66° W	W N W	54	1.7	92
March	—18	—38	S 65° W	W S W	42	1.8	114
April	—24	14	S 30° E	S S E	28	1.5	204
May	—36	24	S 34° E	S S E	43	1.5	120
June	—44	21	S 24° E	S S E	49	1.5	142
July	—22	37	S 59° E	E S E	43	1.6	72
August	—51	21	S 22° E	S S E	55	1.6	87
September	—60	27	S 23° E	S S E	66	1.5	103
October	—69	—29	S 24° W	S S W	75	1.6	140
November	—44	— 6	S 8° W	S	44	1.5	68
December	—24	—42	S 60° W	W S W	48	1.7	111
Year	—29	— 6	S 12° W	S S W	30	1.62	1336

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	11	—52	N 80° W	W	53 %	1.9	169
February	13	—47	N 75° W	W N W	49	1.7	205
March	—13	—39	S 72° W	W S W	41	1.8	229
April	—15	7	S 25° E	S S E	17	1.6	414
May	—20	17	S 40° E	S E	26	1.4	244
June	—30	12	S 22° E	S S E	32	1.5	291
July	— 4	32	S 83° E	E	32	1.6	146
August	—45	10	S 12° E	S S E	46	1.7	171
September	—50	21	S 23° E	S S E	54	1.6	218
October	—65	—29	S 24° W	S S W	71	1.6	281
November	—41	—15	S 20° W	S S W	44	1.6	143
December	—19	—54	S 71° W	W S W	57	1.8	211
April—September	—27	17	S 32° E	S S E	32	1.57	1484
October—March	—19	—39	S 64° W	W S W	43	1.73	1238
Year	—23	—20	S 41° W	S W	30	1.65	2722

Owing to the tendency of winds to blow in the direction of straits the W monsoon, to which strait *Sunda* offers free passage, is, on the whole, stronger in this region than the E monsoon; the average force of the wind and the percentage of steadiness during the former being resp. 1.73 and 43 %, and during the latter resp. 1.57 and 32 %.

The E monsoon sets in in April, when however S W, W and N W winds are met with as well.

This unsettled condition of the weather lasts during May, June and July, when S E and S S E winds prevail, but with small percentages of steadiness, varying and circulating winds occurring frequently.

In August and September the S S E monsoon blows with greater percentages, especially at nighthours under the *Java*-coast when monsoonwind and landbreeze set in the same direction.

At daytime the monsoon and the seabreeze during these months blow in opposite directions, and, therefore, the steadiness of the monsoon will decrease on approaching the *Java*-coast.

In the latter half of October westerly winds begin to appear, but they must be considered rather as streams branching off from the strong S E winds blowing in the *Indian Ocean*, than as true W monsoonwinds: consequently the general direction is S S W and S W.

The W monsoon does not set in before the latter half of November with W, W N W, S W and W S W winds; the force of the wind begins to increase and at the same time the general direction veers to the W S W for December, to the W for January, and to the W N W for February.

In March the monsoon begins to abate, the average direction shifts back to the W S W, as it was in December, and varying and circulating winds are occasionally experienced.

The condition of the weather is in many respects about as unfavourable in strait *Sunda* as under the south-west coast of *Sumatra*.

Cloudy skies and showery weather are the rule, although the average force of the wind, especially in the W monsoon, is pretty strong, heavy squalls and gales seldom occur and the large average value of the force is due to the absence of light breezes and calms rather than to the occurrence of really strong winds.

Showers are experienced during all seasons, but especially in the W monsoon, and are frequently accompanied by thunderstorms: the percentages of the latter attain here values which surpass those for any other part of the Archipelago and even those found at *Sumatra's* south-west coast.

From May to November the sky is very hazy, especially during the first hours of the day, owing to the great quantity of dust-particles which the *Australian* aircurrents convey. As to the rainfall the year may be divided into two parts: a wet season lasting from October to March, and a dry season lasting from April to September; here, therefore, the monsoons, as characterized by the appearance of westerly components in the direction of the wind, and the seasons, as determined by maxima and minima of rainfall, coincide, so that a fixed relation may be said to exist between the westerly components as exhibited in Table C on the one, and an increase of rainfall on the other hand. It is of some importance to point out the fact that, in the vicinity of strait *Sunda*, the secondary minimum of rainfall, observed all along the coast of *Sumatra* and in the *China-sea*, does not exist; on the contrary the observations made during 13 years at *Java's First Point* seem to justify the assumption of a maximum existing here at this time of the year.

The observations concerning the condition of the sea, though not very numerous, still are sufficiently so to pronounce it to to be rather unfavourable.

Large percentages of „swell" and „high swell" are found in December, January and February and also during the E monsoon, whenever westerly winds are blowing in mid-ocean; and as to „sea" and „high sea" the strait belongs to the least favoured regions of the Archipelago.

This fact is due to a perennial current running through the strait in a S W direction, which is strengthened during one, and counteracted during the other half of the day by a pretty strong diurnal tidal stream.

About the first of July the direction of this stream is to the S W at $9^h\,42^m$ p. m., and to the N E at $9^h\,42^m$ a. m. these hours being those when this current is strongest; the hours at which it attains its maximum force in the other months vary in the same way as the transits of the stars; consequently about December 1st the greatest velocity to the S W ward will occur at $9^h\,42^m$ a. m. and that to the N E ward at $9^h\,42^m$ p. m.

These tidal streams, the direction of which might be easily predicted, are strongest one day after that on which the moon's declination attains its maximum value and feeblest when the moon is near the equator. Whenever the tidal stream sets with the perennial S W ward current and, at the same time, S W and W winds are blowing, the sea will be high and troublesome.

Observations of tides and tidal streams have been made at *Java's 4th Point* in the strait, and at *Labuan* at *Java's* westcoast near its western entrance.

Although the characteristic feature of the streams is that their direction changes *once* in 24 hours, the tides themselves are decidedly semi-diurnal, the port-establishment being $7^h\,12^m$ and springtide occurring 3 days after full and change, with a range of 71 cM.; neaptide occurs 3 days after first and last quarter with a range of 19 cM.

For details about tides and tidal streams the reader is referred to the chapter on tides.

Observations of rainfall have been made at *Java's 1st Point*, *Anjer* and *Telok Betong*, of wind at *Vlakke Hoek*, *Java's 1st Point*, *Java's 4th Point* and *Labuan*.

TABLE D. STRAIT SUNDA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	—	6.0	6.8	3.2	4.7	3.1	8.8	1.4	1.1	1.3	2.3	1.6	3.7	3.0
N N E	7.8	4.4	2.6	4.1	4.7	3.5	6.1	2.1	2.7	0.4	2.3	1.1	3.9	3.1
N E	3.2	3.8	6.3	9.6	11.6	7.9	**19.3**	5.6	3.8	0.9	2.3	0.5	9.6	2.8
E N E	1.3	2.2	2.1	5.2	5.2	7.5	3.5	—	3.3	1.3	3.1	—	4.1	1.7
E	1.3	—	0.5	5.5	5.2	6.2	6.1	1.4	6.0	3.1	—	0.5	5.1	0.9
E S E	—	0.6	—	4.9	5.8	3.5	4.4	2.8	4.9	1.8	2.3	1.1	4.4	1.0
S E	—	2.7	1.0	**11.0**	3.5	7.0	13.2	**16.0**	**21.9**	4.9	3.1	0.5	**12.1**	2.0
S S E	—	0.6	1.6	1.2	5.2	4.4	0.9	15.3	8.7	3.6	9.4	1.6	6.0	2.8
S	3.2	2.7	2.1	3.8	5.2	4.8	0.9	6.9	10.9	12.4	8.6	2.2	5.4	5.2
S S W	2.6	2.7	5.8	5.2	4.1	4.0	1.8	9.7	7.7	**27.1**	13.3	6.6	5.4	9.7
S W	11.7	10.4	**19.9**	10.1	4.7	**19.8**	2.6	4.2	7.7	24.4	13.3	11.5	8.2	15.2
W S W	21.4	12.6	17.8	5.5	9.3	3.5	3.5	8.3	6.0	8.4	**14.8**	18.6	6.0	**15.6**
W	**21.4**	**19.8**	5.2	9.0	2.9	4.4	3.5	9.7	3.8	2.2	3.1	**26.8**	5.6	13.1
W N W	1.9	7.7	6.8	2.9	2.9	4.0	—	4.2	1.6	1.3	6.3	12.0	2.6	6.0
N W	10.4	6.0	5.8	6.4	2.3	0.9	2.6	0.7	1.6	0.9	—	4.4	2.4	4.6
N N W	5.2	4.9	1.6	1.7	0.6	1.3	1.8	—	1.1	0.9	0.8	1.1	1.1	2.4
Circulating	3.9	5.5	7.3	6.4	5.2	7.9	13.2	6.9	3.3	0.9	3.1	4.4	7.2	4.2
Variable	2.6	7.1	6.8	3.2	**12.2**	5.3	6.1	4.9	3.3	3.6	10.9	4.9	5.8	6.0
Calm	1.9	—	—	—	4.7	0.9	1.8	—	0.5	0.4	0.8	0.5	1.3	0.6

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	8.6	8.3	0.5	2.5	1.7	2.3	2.6	0.7	—	—	9.4	—	1.6	4.5
N N E	2.5	7.6	1.0	1.3	—	—	—	1.4	—	—	—	1.1	0.5	2.0
N E	8.0	—	1.5	3.8	3.4	3.3	7.7	—	3.2	—	—	2.1	3.6	1.9
E N E	2.5	—	2.9	2.2	5.6	4.7	6.8	2.9	—	—	2.8	1.1	3.7	1.6
E	—	0.6	3.4	10.2	11.2	3.7	5.1	2.2	7.7	0.9	0.9	0.5	6.7	1.1
E S E	—	0.6	0.5	8.6	6.7	9.8	12.8	6.5	8.4	3.6	2.8	3.2	8.8	1.8
S E	—	1.3	4.4	**17.5**	**18.0**	**18.6**	**23.9**	**23.9**	**23.9**	12.1	6.6	2.7	**21.0**	4.5
S S E	—	0.6	2.9	4.5	5.6	14.4	6.8	20.3	15.5	4.9	13.2	6.4	11.2	4.7
S	1.2	1.9	9.3	4.5	9.6	8.4	5.1	13.8	11.0	8.0	**18.9**	3.2	8.7	7.1
S S W	2.5	1.3	2.5	3.2	5.1	5.6	6.0	7.2	10.3	24.1	11.3	8.0	6.2	8.3
S W	4.3	6.4	12.7	8.6	9.0	13.5	—	2.2	9.7	**29.5**	7.5	**17.0**	7.2	12.9
W S W	**18.5**	14.0	**15.7**	3.5	6.2	0.9	1.7	2.9	3.2	13.4	9.4	14.4	3.1	**14.2**
W	14.8	12.1	11.3	6.4	0.6	2.3	2.6	2.9	—	0.9	1.9	9.6	2.5	8.4
W N W	16.0	**15.3**	8.8	5.7	—	0.9	—	1.4	—	—	—	13.3	1.3	8.9
N W	9.3	14.0	8.8	1.3	1.7	2.8	3.4	4.3	—	0.9	1.9	3.2	2.3	6.4
N N W	5.6	5.7	1.5	0.6	—	1.9	4.3	2.9	—	—	—	3.2	1.6	2.7
Circulating	1.9	2.5	2.0	5.4	8.4	5.6	9.4	1.4	2.6	0.4	2.8	5.9	5.5	2.6
Variable	3.7	6.4	8.3	8.6	5.1	0.5	1.7	2.9	3.2	0.9	8.5	4.8	3.7	5.4
Calm	0.6	1.3	2.0	1.6	2.2	0.9	—	—	1.3	0.4	1.9	0.5	1.0	1.1

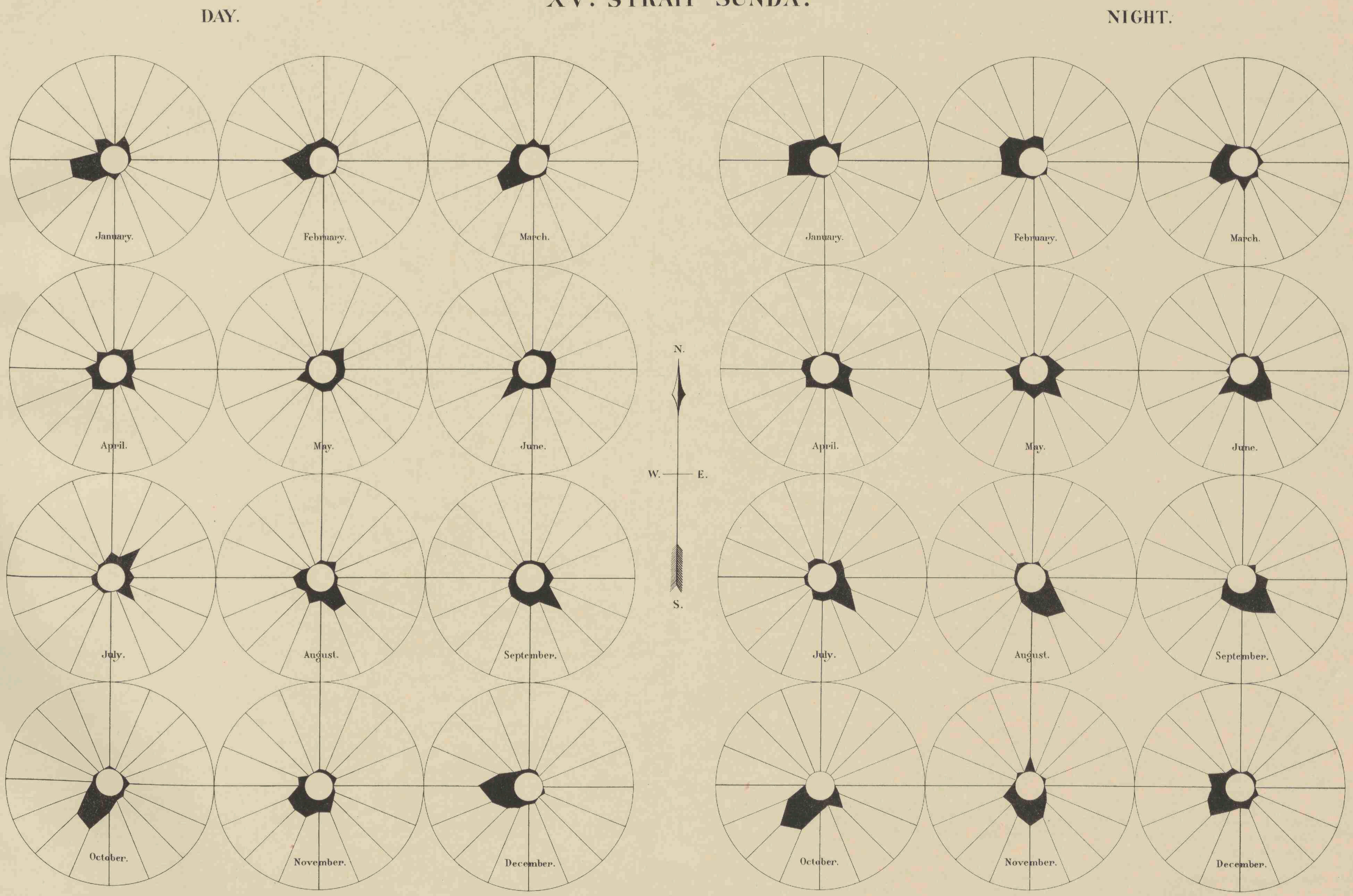
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	4.2	38.4	—	18.8	23.8	29.2	1.7	7.2	17.0	29.4	10.0	35.9	16.3	19.7
High Swell	28.8	1.7	—	—	2.1	—	—	6.3	—	—	—	—	1.4	5.1
Waves	—	—	—	—	—	—	—	—	—	—	10.0	—	—	1.7
Sea	26.8	3.4	—	23.6	6.7	1.1	12.7	40.2	20.8	26.7	—	31.3	17.5	14.7
High Sea	—	—	—	11.8	—	—	—	—	—	—	—	—	2.0	—
Calm	40.4	56.7	100.0	45.9	67.5	69.8	85.7	46.5	62.3	44.0	80.0	32.8	63.0	59.0
Number of Observations	31	54	18	17	44	92	55	15	101	27	11	20	324	161

CONDITION OF THE WEATER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	16.0	23.6	40.2	36.5	43.8	35.8	39.2	36.3	57.3	22.2	29.3	20.2	41.5	25.3
Overcast	50.6	35.8	35.4	36.9	31.9	44.4	31.1	44.3	27.4	54.6	35.6	36.1	36.0	41.4
Showery	7.2	7.4	6.6	5.0	6.2	5.6	6.2	5.9	2.8	9.7	6.8	14.9	5.3	8.8
Rain	19.8	30.8	14.9	14.7	8.7	8.0	7.7	7.1	6.4	8.6	18.3	27.0	8.8	19.9
Squalls	2.4	—	0.5	1.5	0.8	0.4	—	—	—	—	1.4	0.5	0.5	0.8
Thunder	1.2	1.7	1.8	3.7	2.1	1.4	8.4	0.6	—	1.5	2.8	1.5	2.7	1.8
Hazy	2.9	0.9	0.9	2.0	6.7	4.5	7.7	6.0	6.3	3.6	6.1	—	5.5	2.4
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	168	206	229	411	242	288	145	168	217	280	145	208	1471	1236

XV. STRAIT SUNDA.



XVI. INDIAN OCEAN, SOUTH OF JAVA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	24	—37	N 56° W	N W	44 %	2.2	37
February	20	—28	N 86° W	W	34	1.3	43
March	— 3	—13	S 79° W	W S W	13	1.3	80
April	—24	25	S 47° E	S E	35	1.4	48
May	—10	61	S 79° E	E S E	62	1.9	53
June	—56	35	S 31° E	S S E	66	1.7	47
July	— 4	26	S 82° E	E	26	1.4	73
August	—39	1	S 2° E	S	39	1.9	36
September	—47	44	S 43° E	S E	64	1.6	76
October	—36	— 1	S 2° W	S	36	1.6	71
November	—42	— 5	S 6° W	S	42	1.7	41
December	—58	—10	S 10° W	S	59	1.6	17
Year	—23	8	S 19° E	S S E	24	1.63	622

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	25	—64	N 70° W	W N W	69 %	1.6	23
February	—16	—46	S 71° W	W S W	49	1.5	38
March	—21	—20	S 44° W	S W	29	1.4	86
April	—52	4	S 4° E	S	52	1.4	39
May	—29	47	S 57° E	E S E	55	1.6	57
June	—43	22	S 27° E	S S E	48	1.7	46
July	—63	23	S 20° E	S S E	67	1.3	69
August	—68	—20	S 16° W	S S W	71	2.0	34
September	—65	27	S 23° E	S S E	70	1.7	75
October	—63	—10	S 9° W	S	64	1.7	68
November	—70	—26	S 20° W	S S W	75	1.7	39
December	—67	—22	S 19° W	S S W	71	1.5	13
Year	—44	— 7	S 9° W	S	45	1.59	587

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	25	—51	N 64° W	W N W	57 %	1.9	60
February	2	—37	N 87° W	W	37	1.4	81
March	—12	—17	S 55° W	S W	21	1.4	166
April	—38	15	S 22° E	S S E	41	1.4	87
May	—20	54	S 70° E	E S E	58	1.8	110
June	—50	29	S 30° E	S S E	58	1.7	93
July	—34	25	S 36° E	S E	42	1.4	142
August	—54	—10	S 10° W	S	55	2.0	70
September	—56	36	S 33° E	S S E	67	1.7	151
October	—50	— 6	S 7° W	S	50	1.7	139
November	—56	—16	S 16° W	S S W	58	1.7	80
December	—63	—16	S 14° W	S S W	65	1.6	30
April—September	—42	25	S 31° E	S S E	49	1.67	653
October—March	—26	—24	S 43° W	S W	35	1.62	556
Year	—34	1	S 2° E	S	34	1.64	1209

In this part of the *Indian Ocean* the S E trade-winds prevail, as may be seen on consulting Table C, where the results of the observations are set down.

Southerly components almost exclusively appear in this table with the exception only of January, when northerly components are shown with a percentage of 25 %, and the general motion of the air, taken over the whole year, is from the South with a percentage of 34 %.

The S E monsoon sets in in April and lasts till September with pretty persistent winds from the E—S quarter; but the percentages of steadiness are not so great as might be expected and Table D shows, that S W and S S W winds occasionally are experienced during the E monsoon.

When in September the sun has passed the equator, the ascending current of heated air over the main-land of *Australia* causes westerly components to appear and the average direction of the wind veers to the S in October, to the S S W in November and December, and to the W N W in January.

In February the resulting direction assumes a retrograde motion to the westward, and in March S W winds prevail, but N W and S E winds are experienced as well: this unsettled condition of the weather lasts till the latter half of April when the E monsoon may again be depended upon.

Although varying and circulating winds appear in the tables with large percentages, the probability of rain in these regions is, in general, very small, remaining even below that known for any other place in the Archipelago, as is shown in the summarizing table preceeding these pages.

During the E monsoon not more than 8 rainy days in 100 may be expected on an average; during the W monsoon, in January, February and March especially, this percentage increases to about 25 %.

In the E monsoon rain may be expected with varying winds and in light showers; during the W monsoon heavy squalls from the West are met with occasionally. This statement concerning the general conditions of rainfall in the offing does not however apply to the south coast of *Java;* whereas at sea, during the E monsoon at least, the probability of rainfall is reduced to a minimum as compared with other regions, it attains an almost maximum value at some places situated on the south coast.

At *Tjilatjap* the record for June and July is of 379 mm. on an average, and of 50 rainy days in a 100.

On approaching the *Java*-coast both the S E and the S W aircurrents are forced up the very steep slopes of the mountainrange, the ensuing expansion is accompanied by a corresponding decrease of temperature, and condensation takes place, the consequences of which are heavy rainfall on the wet, i. e. the windside of the mountainrange, and dry winds (which have lost most of their vapour) on the leeside of it.

At all places situated on the south coast of *Java*, where steep mountainranges extend along the coast, such *föhn*-like phenomena will be observed, whilst there, where the mountains recede from the coast, as for instance at *Poeger*, dry S E winds are observed during the E monsoon so that, in July, not more than 8 mm. of rain are registered on an average.

Java's south coast, therefore, offers a striking example of the differences which, at many places, exist between rainfall in the offing and at coast-places, the latter depending only partly on the physical properties of the prevailing winds, but principally on local circumstances.

Observations of the condition of the sea are not very numerous and consequently the results not as reliable as might be desired, but still the fact is proved with sufficient certainty, that there is generally a heavy swell rolling in from the ocean and that the sea is frequently turbulent.

The currents flow with an average velocity of about 20 miles per 24 hours and mostly in a south-easterly direction during both seasons: this current may be regarded as a continuation of the perennial south-easterly current, which, running along *Sumatra's* S W coast, compelles the S W strait-*Sunda*-current to bend to the S E ward.

From October to March, therefore, the resulting steadiness of direction at the south coast of *Java* will be small because, in this part of the year, the current along the *Sumatra* coast is weak and also on account of the prevailing S W winds, which encounter the perennial current issuing from strait *Sunda*.

From April to September the percentage of prevailing currents to the S E will, for the same reasons, be higher, at least in the western parts of these regions: in the eastern parts pretty strong currents issue from the *Timor* and *Harafura* seas, which, on meeting the S E currents mentioned above, cause a large eddy, the resulting streams of which set to the eastward on the northside and to the westward on the southside i. e. turn with the hands of a watch.

Observations of tides have been made at *Tjilatjap* during three consecutive years and by means of a self-registering tide-gauge, and a new tidal station has been recently established in the *Wynkoops-bay*: the tide, following the time of the moon's transits is the principal one; consequently a port-establishment exists: at *Tjilatjap* it is high water, full and change, at $8^h\ 25^m$; springs rise 73 cm. and neaps 24 cm.: they occur two or three days after the dates of full and change or first and last quarter resp.

For further details about tides in *Tjilatjap* harbour the reader is referred to the chapter on tides.

In the sailing direction of the Admirality (1893) it is stated, that in the *Wynkoops-bay* the port-establishment is 5^h and at *Patjitan* 3^h: it seems hardly probable that these numbers should be proved to be correct when reliable observations are available because the tide-wave is running in from the westward and consequently the port-establishment ought to increase, as is shown by the charts of cotidal lines given in this work.

Observations of rainfall at stations situated on *Java's* south coast have been made at *Pameungpeuk, Parigi, Tjilatjap, Banjoemas, Patjitan* and *Poeger*; of wind at *Tjilatjap, Nusa Kembangan* and *Patjitan*.

TABLE D. INDIAN OCEAN, SOUTH OF JAVA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	8.9	3.4	4.7	—	5.9	—	2.9	—	4.0	3.4	—	—	2.1	3.4
N N E	—	1.7	7.5	1.5	1.0	—	7.6	2.9	3.2	5.1	1.4	4.0	2.7	3.3
N E	4.4	3.4	1.9	4.5	3.0	—	10.5	—	1.6	—	5.6	—	3.3	2.6
E N E	—	—	2.8	3.0	13.9	2.5	12.4	2.9	3.2	1.7	5.6	—	6.3	1.7
E	4.4	—	2.8	**25.8**	17.8	9.9	7.6	11.4	0.8	2.6	—	4.0	12.2	2.3
E S E	—	—	3.8	4.5	**22.8**	12.3	2.9	1.4	6.5	0.9	1.4	—	8.4	1.0
S E	—	1.7	9.4	7.6	11.9	**30.9**	8.6	18.6	**45.2**	9.4	4.2	—	**20.5**	4.1
S S E	—	12.1	2.8	—	3.0	7.4	—	—	13.7	10.3	2.8	16.0	3.9	7.3
S	6.7	3.4	5.7	1.5	1.0	11.1	**16.2**	1.4	5.6	11.1	**23.9**	**32.0**	6.1	**13.8**
S S W	2.2	1.7	3.8	16.7	4.0	6.2	4.8	12.9	4.8	**14.5**	19.7	16.0	8.2	9.7
S W	4.4	6.9	11.3	7.6	—	8.6	1.0	**25.7**	2.4	9.4	4.2	12.0	7.6	8.0
W S W	—	—	3.8	3.0	—	3.7	4.8	—	—	2.6	5.6	—	1.8	2.0
W	8.9	10.3	8.5	1.5	—	1.2	1.0	2.9	0.8	1.7	—	4.0	1.2	5.6
W N W	15.6	**19.0**	0.9	—	—	—	1.9	—	—	0.9	2.8	—	0.3	6.5
N W	**24.4**	1.7	**15.1**	—	—	—	1.9	2.9	—	1.7	—	—	0.8	7.2
N N W	—	8.6	1.9	—	—	—	2.9	—	1.6	1.7	2.8	8.0	0.8	3.8
Circulating	15.6	12.1	6.6	9.1	8.9	—	8.6	2.9	4.0	10.3	1.4	4.0	5.6	8.3
Variable	4.4	13.8	5.7	12.1	6.9	6.2	4.8	14.3	2.4	11.1	18.3	—	7.8	8.9
Calm	—	—	0.9	1.5	—	—	—	—	—	1.7	—	—	0.3	0.4

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	2.6	—	2.5	—	—	—	1.1	—	—	—	—	—	0.2	0.9
N N E	—	3.5	0.8	—	—	1.3	1.1	—	—	0.9	—	—	0.4	0.9
N E	—	—	4.9	5.3	1.1	1.3	2.2	2.9	—	—	—	—	2.1	0.8
E N E	—	—	2.5	3.5	5.3	—	1.1	—	—	—	—	—	1.7	0.4
E	—	7.0	3.3	8.8	**26.3**	10.5	7.5	1.4	4.9	1.7	—	—	9.9	2.0
E S E	—	—	1.6	3.5	20.0	**28.9**	2.2	2.9	9.0	0.9	—	—	11.1	0.4
S E	—	—	6.6	12.3	12.6	7.9	20.4	14.5	**34.4**	7.7	7.4	—	**17.0**	3.6
S S E	—	5.3	6.6	7.0	1.1	1.3	10.8	7.2	13.1	16.2	5.9	25.0	6.8	9.8
S	10.5	7.0	6.6	5.3	4.2	10.5	**26.9**	7.2	9.8	8.5	22.1	15.0	10.7	11.6
S S W	—	3.5	13.1	17.5	5.3	2.6	15.1	26.1	8.2	**26.5**	**26.5**	5.0	12.5	12.4
S W	2.6	15.8	5.7	**28.1**	4.2	14.5	1.1	**30.4**	12.3	15.4	19.1	**35.0**	15.1	**15.6**
W S W	—	14.0	4.1	—	6.3	10.5	1.1	—	2.5	2.6	5.9	—	3.4	4.4
W	18.4	**15.8**	**17.2**	—	1.1	1.3	—	7.2	—	0.9	1.5	5.0	1.6	9.8
W N W	26.3	15.8	2.5	—	—	—	—	—	—	—	2.9	—	—	7.9
N W	**28.9**	—	6.6	—	—	—	—	—	0.8	—	—	—	0.1	5.9
N N W	—	7.0	1.6	—	—	—	—	—	0.8	0.9	1.5	—	0.1	1.8
Circulating	2.6	3.5	3.3	1.8	9.5	1.3	3.2	—	2.5	6.0	2.9	5.0	3.1	3.9
Variable	2.6	1.8	8.2	5.3	2.1	7.9	3.2	—	1.6	10.3	4.4	10.0	3.4	6.2
Calm	5.2	—	2.5	1.8	1.1	—	3.2	—	—	1.7	—	—	1.0	1.6

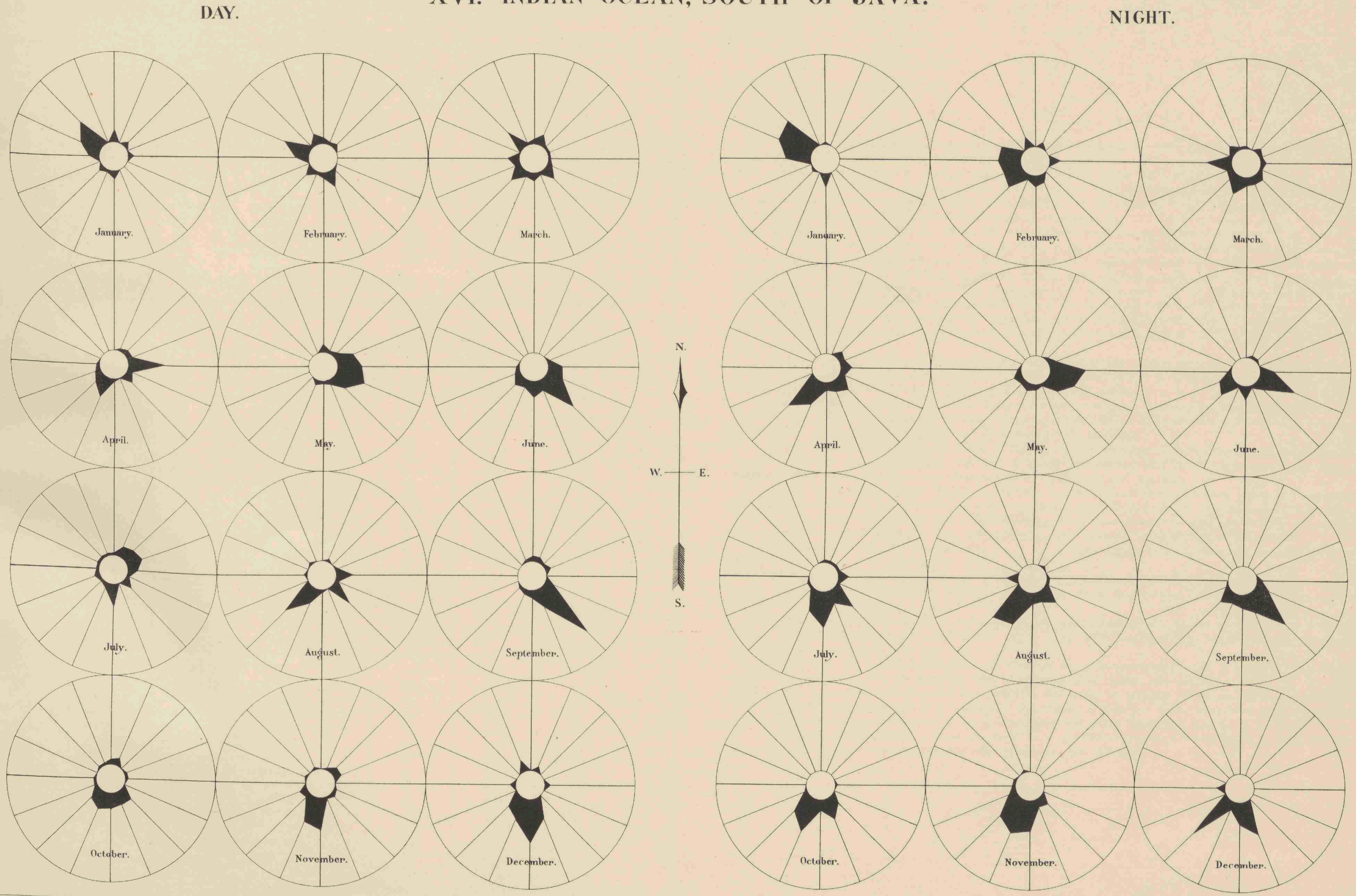
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	—	73.4	20.7	88.9	—	46.5	57.8	31.3	42.9	48.6	8.4	—	53.5	25.2
High Swell	—	—	—	5.6	—	3.6	—	18.8	—	—	—	—	5.6	—
Waves	—	—	—	—	—	3.6	—	—	6.6	—	—	—	2.0	—
Sea	—	—	10.4	5.6	—	12.2	21.1	6.3	16.5	22.9	—	16.7	12.3	8.3
High Sea	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Calm	100.0	26.7	69.0	—	—	34.3	21.1	43.8	34.1	28.5	91.7	83.4	26.6	66.6
Number of Observations	8	8	87	13	—	24	19	12	91	17	9	6	159	135

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	42.4	34.2	44.5	70.6	43.8	48.4	74.5	57.9	46.1	60.9	30.6	46.7	56.9	43.2
Overcast	33.7	37.0	34.1	23.3	37.2	35.5	21.3	33.4	34.9	25.9	53.0	44.6	30.9	38.1
Showery	6.2	6.6	1.8	1.3	4.6	2.2	0.7	7.4	2.6	1.5	6.4	3.0	3.1	4.3
Rain	15.8	18.6	16.6	3.6	10.0	6.5	2.9	1.5	5.9	0.7	7.6	5.9	5.1	10.9
Squalls	1.9	1.2	0.6	—	—	1.1	—	—	—	—	—	—	0.2	0.6
Thunder	—	—	0.6	1.3	1.9	1.1	0.7	—	—	—	—	—	0.8	0.1
Hazy	—	2.5	1.9	—	2.8	5.4	—	—	10.5	11.1	2.5	—	3.1	3.0
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	50	80	167	86	110	93	141	69	152	135	79	30	651	541

XVI. INDIAN OCEAN, SOUTH OF JAVA.



XVII. JAVA-SEA, SUMATRA'S SOUTH-EAST COAST.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	35	—61	N 60° W	W N W	70 %	1.8	157
February	45	—49	N 47° W	N W	67	1.7	195
March	31	—38	N 51° W	N W	49	1.6	385
April	0	1	E	E	1	1.5	468
May	— 9	41	S 79° E	E S E	42	1.4	343
June	— 6	25	S 77° E	E S E	26	1.5	208
July	— 9	37	S 76° E	E S E	38	1.6	183
August	— 9	42	S 77° E	E S E	43	1.6	205
September	— 1	39	S 88° E	E	39	1.5	226
October	— 9	29	S 73° E	E S E	30	1.5	194
November	— 8	27	S 74° E	E S E	28	1.5	229
December	1	—55	N 89° W	W	55	1.7	337
Year	5	3	N 31° E	N N E	6	1.58	3130

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	17	—57	N 73° W	W N W	59 %	1.9	136
February	33	—53	N 57° W	W N W	63	1.7	171
March	13	—45	N 74° W	W N W	47	1.7	360
April	—34	—53	S 9° W	S	63	1.5	423
May	—46	31	S 35° E	S E	55	1.5	307
June	—38	25	S 33° E	S S E	45	1.5	175
July	—32	47	S 55° E	S E	57	1.5	167
August	—32	49	S 56° E	S E	59	1.5	178
September	—46	45	S 44° E	S E	64	1.4	201
October	—41	28	S 35° E	S E	50	1.6	177
November	—37	—39	S 55° W	S E	47	1.6	198
December	—14	—55	S 75° W	W S W	57	1.8	314
Year	—21	— 6	S 16° W	S S W	22	1.60	2807

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	26	—59	N 67° W	W N W	64 %	1.9	293
February	39	—51	N 53° W	N W	64	1.7	366
March	22	—42	N 62° W	W N W	47	1.7	745
April	—17	—26	S 57° W	W S W	31	1.5	891
May	—28	36	S 52° E	S E	46	1.5	650
June	—22	25	S 49° E	S E	33	1.5	383
July	—21	42	S 64° E	E S E	47	1.6	350
August	—24	46	S 66° E	E S E	51	1.6	383
September	—24	42	S 60° E	E S E	48	1.5	427
October	—25	29	S 49° E	S E	38	1.6	371
November	—18	— 6	S 18° W	S S W	19	1.6	427
December	— 7	—55	S 83° W	W	55	1.8	651
May—October	—24	37	S 57° E	E S E	41	1.55	2564
November—April	9	—40	N 78° W	W N W	37	1.70	3373
Year	— 8	— 2	S 14° W	S S W	8	1.63	5937

In this part of the *Java-sea*, bordered by *Sumatra's* S E coast and the 107th degree of eastern Longitude, the E S E monsoon cannot be depended upon before the middle of May. During this monsoon, which lasts till October, there is an equal probability of E, E S E, S E, S S E, S and even N E and E N E winds.

The direction of the wind during daytime will shift to the North as the *Sumatra* coast is approached, because the general direction of the seabreeze is N 19° E; at nighttime, on the contrary, it will veer to the West on account of the S W landbreeze with which the S E monsoonwind combines.

The weather is steady and dry during this monsoon with fresh breezes and hazy skies.

In the early morning-hours the haziness is least; a layer of grayish cumulo-strati seems to rest upon the horizon, whereas in the zenith the sky is evenly covered by a slightly coloured layer of light clouds; about one hour after sunrise cumuli are forming at the eastern horizon, which begin flowing to the westward; at times those cumuli cause some rain or increase of wind on passing by; their passing away has left the horizon free from clouds, but in the mean time the haziness has grown more intense and the *Sumatra* coast is but seldom seen.

The first W winds are experienced in November: during this month winds from all points of the compass may be expected, but especially during the latter half of the month and more from the S W, W S W and W than from any other point.

In December the W monsoon blows with increasing steadiness: in January the general direction veers to the W N W and in February to the N W; after that a retrograde movement sets in, accompanied by a gradual decrease of steadiness; in March W N W winds and in April W S W winds prevail.

Near the *Sumatra* coast the direction of the wind in this monsoon is more from the North at daytime and more from the West at nighthours on account of the sea- and landbreezes, which are observable as far as *Noordwachter*, a small island situated at a distance of about 70 kilometers from the coast.

The fact, therefore, exhibited in Tables A and B, that the percentages of steadiness during the E monsoon are smaller at day- than at nighttime, but that in the W monsoon the wind blows steadier during day- than at nighthours, finds its explanation in this effect of land- and seabreezes near the coast.

In the W monsoon showery weather occurs with somewhat larger percentages than during the E monsoon, and mostly at nighthours; heavy squalls are almost exclusively experienced in the W monsoon and also at nighttime.

A force of the wind greater than 3 has been recorded 23 times during the night and 13 times at daytime, only during the months December to May, and never from other than the western points of the compass.

The haziness of the sky is considerably less in the W than during the E monsoon; but not so much so as might be expected.

As to rainfall the monsoons, or rather the seasons, are well marked and coincide with the monsoons as defined by the prevailing winds: July, August, September and October are the dry months, with a percentage of rainy days less than 15 %.

In November, when S S W winds begin to blow, the rainfall increases and attains its maximum in December, January and February, when the probability of rain is about 30 %; in March the rainfall decreases, remaining stationary again during April, May and June.

The currents are mostly drift-currents and, therefore, the main current during the E monsoon being at right angles to the coast-line, the sea near the coast is most disturbed during this monsoon. Calm sea will occur mostly during the transition months April and November, but in the W monsoon pretty high seas are met with again.

During both monsoons there is a tendency of the currents to flow in a southerly direction along the coast and consequently tidal streams are observed to set for a longer period to the South than they do to the North.

The average velocity of the currents was found to be 9.5 miles in 24 hours during the E monsoon and 13.6 in the W monsoon, the maximum velocities resp. 36 and 46 miles per diem.

TABLE D. JAVA-SEA, SUMATRA'S SOUTH-EAST COAST.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	9.3	15.7	13.3	6.9	2.2	3.8	1.4	3.4	5.6	6.7	6.2	5.9	3.9	9.5
N N E	1.8	0.9	3.7	2.9	3.2	6.3	4.1	3.0	3.2	1.7	1.4	1.8	3.8	1.9
N E	3.6	0.6	5.0	7.2	12.6	10.4	8.5	9.1	**15.0**	10.1	6.7	1.2	10.5	4.5
E N E	0.4	0.6	1.9	4.5	11.0	5.4	**14.3**	9.5	5.3	6.1	2.0	0.9	8.3	2.0
E	0.4	1.2	0.6	8.8	**14.2**	**13.3**	11.2	14.0	13.8	8.8	3.9	0.9	**12.6**	2.6
E S E	—	0.6	0.5	4.0	8.2	4.4	11.2	9.8	7.1	10.1	1.1	0.2	7.5	2.1
S E	1.1	1.5	0.6	5.7	12.6	11.1	11.9	**16.7**	14.7	**18.2**	2.8	1.4	12.1	4.3
S S E	—	—	0.5	4.5	3.6	4.4	4.8	4.9	6.5	4.4	3.1	1.1	4.8	1.5
S	0.4	0.3	3.4	2.9	7.8	7.0	7.8	7.9	5.3	4.0	8.1	2.7	6.5	3.2
S S W	0.7	1.2	1.9	1.6	2.6	3.5	2.4	0.3	0.3	1.7	9.0	3.0	1.8	2.9
S W	3.9	1.5	7.4	8.5	5.4	5.1	3.1	3.7	2.6	3.4	**12.6**	15.8	4.7	7.3
W S W	11.0	6.9	6.1	7.9	2.2	2.5	3.1	2.4	2.1	6.4	8.1	13.7	3.4	8.7
W	17.8	11.7	11.5	6.9	1.6	4.7	4.1	0.6	2.9	3.7	11.0	14.7	3.5	11.7
W N W	16.7	10.8	8.1	4.0	0.2	3.2	2.0	1.2	1.8	0.7	5.6	9.4	2.1	8.6
N W	**23.8**	**27.4**	**16.8**	3.7	3.0	1.3	2.7	4.3	1.5	3.0	8.7	**15.8**	2.8	**15.9**
N N W	7.5	12.0	10.0	2.4	1.0	0.9	2.4	3.0	3.2	2.4	1.7	1.6	2.2	5.9
Circulating	0.4	2.1	3.1	6.3	2.6	6.0	0.7	3.0	5.6	2.4	2.5	4.1	4.0	2.4
Variable	1.4	4.5	3.9	**9.5**	5.2	6.0	3.7	2.1	2.3	5.4	4.2	5.5	4.8	4.2
Calm	—	0.3	1.5	1.9	0.6	0.6	0.7	0.9	1.2	1.0	1.1	0.5	1.0	0.7

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	10.6	12.0	10.1	2.0	1.1	1.9	0.4	2.2	0.4	0.4	2.9	3.4	1.3	6.6
N N E	2.7	1.0	2.9	0.8	0.8	1.1	—	—	0.7	0.4	1.6	0.7	0.6	1.6
N E	4.7	—	1.3	4.9	2.8	2.7	8.8	5.1	4.6	6.1	1.6	1.2	4.8	2.5
E N E	—	0.3	0.5	1.4	2.5	3.8	4.8	8.7	3.6	7.2	1.0	0.9	4.1	1.7
E	0.4	0.7	0.5	4.9	10.2	13.5	15.5	11.3	12.1	9.0	1.9	1.1	11.3	2.3
E S E	—	—	0.7	5.6	10.8	8.1	13.5	16.4	9.3	10.0	—	0.5	10.6	1.9
S E	1.6	2.3	3.7	11.4	**22.7**	**15.4**	**20.7**	**25.1**	**22.8**	**19.4**	8.3	2.0	**19.7**	6.2
S S E	—	0.3	1.8	8.2	8.3	7.7	7.2	6.2	16.0	6.1	1.0	1.2	8.9	1.7
S	2.7	1.0	3.5	9.4	13.1	11.1	9.2	6.5	16.0	13.3	6.4	5.5	10.9	5.4
S S W	3.5	2.0	3.2	6.3	5.3	9.2	4.4	1.8	2.5	2.5	8.3	5.3	4.9	4.1
S W	5.1	6.6	9.9	**12.8**	5.5	6.9	2.0	6.2	1.1	12.6	**21.5**	**18.8**	5.8	12.4
W S W	18.0	10.0	9.7	8.7	4.4	2.3	1.6	1.1	—	3.6	11.9	15.8	3.0	11.5
W	**21.2**	10.3	**14.6**	7.4	1.9	3.1	1.6	1.1	1.4	2.9	11.5	14.5	2.8	12.5
W N W	7.5	8.3	7.9	2.0	0.2	0.7	2.8	0.4	0.7	0.4	4.8	9.4	1.1	6.4
N W	16.9	**27.6**	14.1	3.8	0.6	0.7	—	1.8	1.1	0.4	6.7	10.3	1.3	**12.7**
N N W	4.3	11.6	8.4	0.9	0.4	1.5	0.4	—	—	—	1.0	2.8	0.5	4.7
Circulating	—	2.0	3.4	3.8	2.5	5.4	4.8	3.3	2.5	2.2	3.8	2.0	3.7	2.2
Variable	0.4	3.3	3.5	4.9	4.2	2.7	1.6	2.2	2.1	2.9	4.2	3.9	3.0	3.0
Calm	0.4	0.7	0.3	1.1	2.5	1.9	0.8	0.7	3.2	0.7	1.6	0.7	1.7	0.7

CONDITION OF THE SEA, PERCENTAGE.

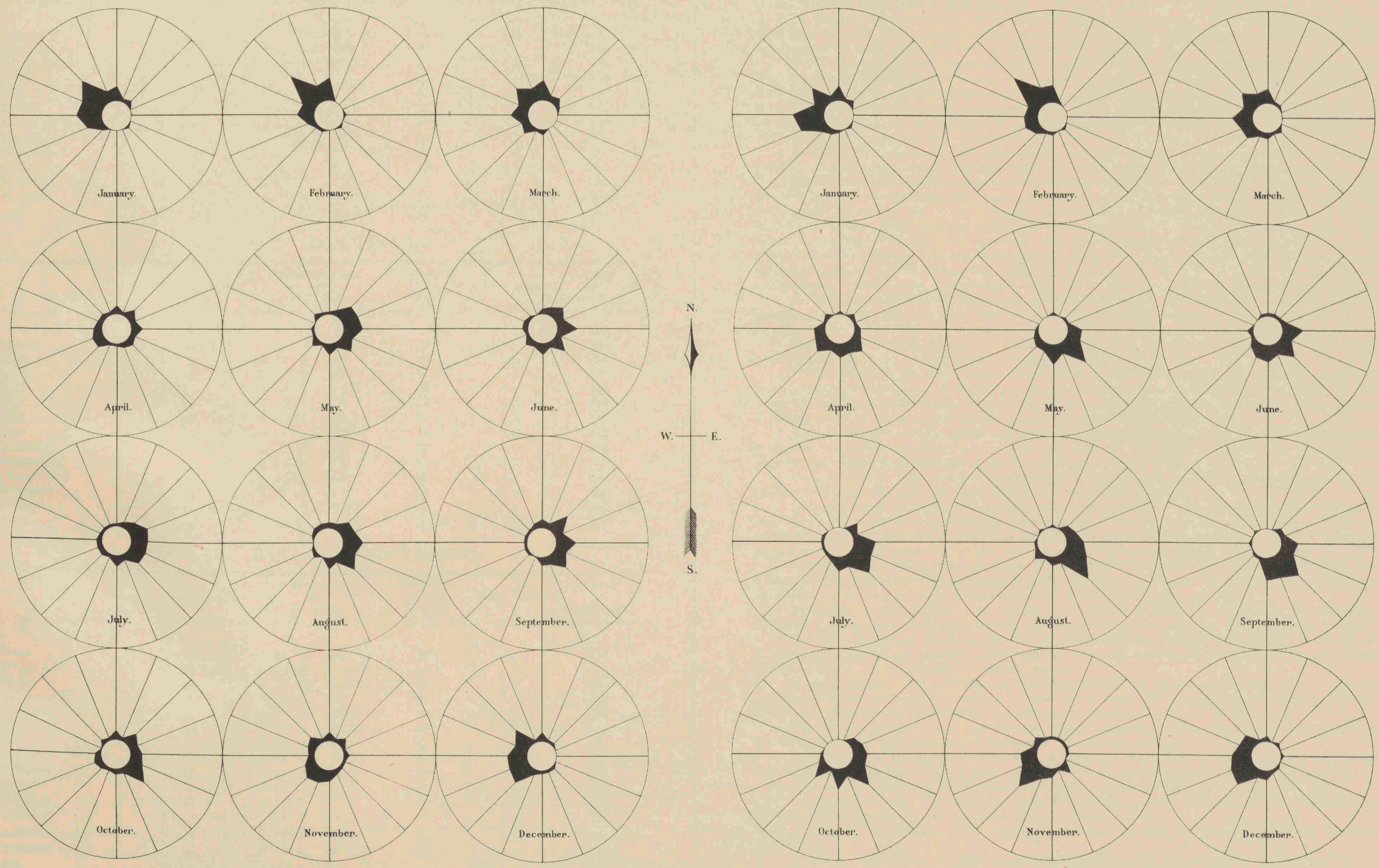
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	12.8	6.4	11.0	3.7	16.9	23.7	17.4	21.2	15.1	21.6	7.1	13.0	16.3	12.0
High Swell	2.4	5.6	—	0.5	—	—	1.4	1.9	0.9	—	—	—	0.5	1.3
Waves	1.8	—	0.6	1.1	0.4	—	—	—	—	—	1.0	0.9	0.3	0.7
Sea	15.2	14.5	16.6	4.3	5.6	15.5	9.8	18.1	5.2	10.7	10.0	25.7	9.8	15.5
High Sea	0.9	3.3	—	1.1	0.4	1.6	0.7	1.9	—	—	—	—	1.0	0.7
Calm	67.1	70.2	72.0	89.6	76.9	59.3	70.8	57.1	78.9	67.8	82.0	60.4	72.1	69.9
Number of Observations	126	157	201	198	271	197	123	166	241	169	191	222	1196	1066

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	29.5	29.0	30.0	39.4	43.3	47.6	49.7	45.9	58.9	46.3	42.1	22.5	47.5	33.2
Overcast	42.6	38.8	38.8	37.5	37.5	30.0	31.2	33.7	26.3	34.3	33.4	43.5	32.7	38.6
Showery	4.1	9.0	7.0	6.2	5.9	5.2	6.3	5.4	3.0	4.3	5.7	9.2	5.3	6.6
Rain	19.5	19.3	19.3	10.8	10.1	12.3	8.1	8.0	6.9	8.5	13.8	20.2	9.4	16.8
Squalls	1.8	1.7	0.7	1.1	0.3	—	—	0.8	—	0.6	0.5	1.6	0.4	1.2
Thunder	0.7	1.5	2.5	3.0	1.5	0.3	0.6	0.9	0.7	1.4	1.4	1.7	1.2	1.5
Hazy	2.0	0.9	1.9	2.3	1.7	4.8	4.2	5.6	4.3	4.8	3.1	1.6	3.8	2.4
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	292	366	740	902	647	377	348	373	425	376	421	657	3072	2852

XVII. JAVA SEA, S.E. COAST SUMATRA.

DAY. NIGHT.



XVIII. JAVA-SEA, WESTERN PARTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	32	—74	N 68° W	W N W	81 %	1.8	232
February	36	—68	N 61° W	W N W	77	1.7	163
March	26	—32	N 51° W	N W	41	1.5	402
April	0	20	E	E	20	1.5	451
May	— 6	57	S 87° E	E	57	1.6	750
June	—17	70	S 76° E	E S E	72	1.7	582
July	—12	66	S 80° E	E	67	1.6	467
August	—16	64	S 76° E	E S E	66	1.7	294
September	— 6	57	S 84° E	E	57	1.6	230
October	— 5	40	S 82° E	E	40	1.5	391
November	2	4	N 63° E	E N E	4	1.4	553
December	24	—47	N 63° W	W N W	53	1.6	400
Year	5	13	N 69° E	E N E	14	1.60	4915

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	1	—69	W	W	69 %	1.7	227
February	7	—62	N 84° W	W	62	1.5	151
March	— 6	—33	S 80° W	W	34	1.4	381
April	—27	12	S 24° E	S S E	30	1.4	418
May	—38	45	S 49° E	S E	59	1.5	727
June	—38	60	S 58° E	E S E	71	1.7	566
July	—41	51	S 51° E	S E	65	1.7	447
August	—38	48	S 52° E	S E	61	1.7	292
September	—37	51	S 54° E	S E	63	1.7	234
October	—39	33	S 40° E	S E	51	1.5	385
November	—31	— 3	S 6° W	S	31	1.5	535
December	—12	—52	S 77° W	W S W	53	1.6	398
Year	—25	7	S 16° E	S S E	26	1.58	4761

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	32	—72	N 66° W	W N W	79 %	1.8	459
February	22	—65	N 72° W	W N W	69	1.6	314
March	10	—33	N 74° W	W N W	34	1.5	783
April	—14	16	S 49° E	S E	21	1.5	869
May	—22	51	S 67° E	E S E	56	1.6	1477
June	—28	65	S 66° E	E S E	71	1.7	1148
July	—27	59	S 66° E	E S E	65	1.7	914
August	—27	56	S 64° E	E S E	62	1.7	586
September	—22	54	S 68° E	E S E	58	1.7	464
October	—22	37	S 60° E	E S E	43	1.5	776
November	—15	1	S 4° E	S	15	1.5	1088
December	6	—50	N 83° W	W	50	1.6	798
April—November	—22	42	S 62° E	E S E	47	1.61	7322
December—March	13	—55	N 77° W	W N W	57	1.63	2354
Year	— 9	10	S 48° E	S E	13	1.62	9676

A glance at Table C will disclose the remarkable fact, that northerly as well as westerly components occur only during the four months December to March, and that the eight remaining months must be regarded as belonging to the period of the S E monsoon.

In April feeble winds are experienced, near the *Java*-coast mostly land- and seabreezes, but S E winds may be said to prevail, though with a small percentage.

In May the E monsoon blows steadily from the E S E and this condition of the weather lasts till November when again S winds prevail, though they are not regular enough to be relied upon, feeble winds from all quarters being experienced in the offing, and land- and seabreezes near the coast.

The W monsoon sets in in December, reaches a maximum of strength and steadiness in January and February, when the wind blows from the N W N ward, and abates again in March; even then this is still the prevailing wind, but it cannot longer be absolutely depended upon as during the first months of the year.

During the E monsoon the sky is generally overcast at nighthours; at sunrise light-coloured, faint, filmy clouds are observed, stationary in the zenith, whilst the clouds are denser towards the horizon (an effect of perspective), where a typical cumulo-stratus form is observable.

By and by after sunrise, the veil breaks up very slowly, sometimes so as to assume cirruslike appearances at places, a peculiarity which may be again observed in the evening when, towards sunset, the wind ceases.

These loose cirruslike cumuli however are evidently floating in strata much lower than those occupied by true cirri and last only a short time. Some time after sunrise the sky generally clears up; in the beginning few and small cumuli are seen to flow to the West, but gradually their number and size increase till, at noon, the whole sky is more or less densely sprinkled with them: the enormous height to which the top of these typical, tropical cumuli may rise above their base can be observed when they move along the horizon: they are of a dazzling white, which considerably intensifies the light diffused in the atmosphere. Here, as everywhere in the Archipelago, when S E winds, conveying particles of dust, blow during the E monsoon, the sky is generally very hazy and even in the near proximity of the coast the mountainranges of mid-*Java* remain unseen, whilst bright, starry nights seldom occur.

In November this lack of clearness makes itself felt at daytime in the whitish colour of the blue sky and at nighthours in the fact, that only stars of the first and second magnitude are seen, and this dimly, surrounded by a hazy corona: this haze is densest with southerly winds on account of the dust-particles they convey.

During the W monsoon the colour of the unclouded part of the sky is clearer, though the cloudiness is much greater, amounting, on the average, to 7 or 8 tenths of the whole surface.

In this season, in the East at early morning and in the West about sunset, fine cirrostrati and cirrocumuli, intensely illuminated by the rays of the rising or setting sun may be seen, and altocumuli appear about this time in the zenith; sometimes the latter cloud-forms are likewise seen at nighthours, whenever there is a calm and the clouds are lighted up by the moon; at daytime the cumulus and nimbus forms prevail.

When cleared by a heavy rainfall the nights are sometimes bright and starry in the W monsoon, but this is especially the case in March and April, a time when the air is kept free of dust-particles by occasional showers, while the dark skies and pouring rains of the W monsoon have drifted away.

Owing to various local circumstances the rainfall at land-stations is, in general, considerably greater than at stations on isles near the coast, and there again greater than in the offing.

This thesis holds good for the W monsoon when condensation takes place on the ascending of the moist air along the slopes of the *Java* mountainrange, but not in the E monsoon, when the S E winds, in passing over the mountains of mid-*Java*, lose their moistness and descend on the northern coast-places as dry winds; at sea occasional showers are experienced, which are not met with at places on and near the shores.

Consequently in Table D we find records of light showers throughout the whole year, and during the full E monsoon, from July to October, percentages of rainfall amounting to 13 % and even heavy squalls are occasionally experienced, though in a less degree than during the W monsoon, especially in January.

On account of the influence of the *China-sea* the conditition of the sea in these parts is, on the whole, not favourable: a pretty heavy swell from the North and large percentages of „sea" and „high sea" being recorded.

The latter are probably due to the fact that the currents, though principally drift-currents, are not as steady as sometimes is believed and, therefore, it will frequently occur that a steady monsoonwind is blowing in a direction opposite to that of the currents and thus disturbs the sea.

In March and April, and in October and November, therefore, the percentages of „calm sea" are highest. The average velocity of the currents is about 11.5 miles in 24 hours; for maximum-values 54 miles to the E and W S W have been found in the W monsoon, and 114 miles per diem to the S in the E monsoon.

The tides are practically diurnal and the tidal streams consequently change their direction once in the 24 hours and do not follow the time of the moon's transit, but rather that of the stars.

As is shown by the charts of *cotidal lines* the tides vary considerably for different parts of the *Java-sea* so that it is nearly impossible to give a verbal description of these phenomena holding good for the whole north-coast of *Java* and even of a part of it and the reader is, therefore, referred for details to the chapter on tides.

Observations of rainfall have been made at the following stations near the coast: *Serang*, *Tangerang*, *Batavia*, *Edam*, *Indramayoo*, *Cheribon*, *Tegal*, *Pekalongan*, *Kendal*, *Semarang* and *Pati*,

of winds at: *Isle of Edam*, *Batavia*, *Boompjes-eiland*, *Semarang*, *Pulu Mandelike*, *Duizend-Eilanden* and *Karimon Djawa Isles*,

of tides at: *Duizend-Eilanden*, *Edam*, *Tandjong-Priok*, *Boompjes-eiland*, *Semarang* and *Karimon Djawa Isles*.

TABLE D. JAVA-SEA, WESTERN PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	3.4	4.7	5.5	1.6	2.5	0.9	1.2	2.2	4.0	2.9	3.5	5.1	2.1	4.2
N N E	—	2.2	2.9	1.8	2.9	2.1	1.3	1.6	3.2	3.5	3.2	2.5	2.2	2.4
N E	—	2.5	5.9	10.8	8.1	4.9	8.1	7.6	12.2	10.1	7.4	2.2	8.6	4.7
E N E	—	—	4.2	6.3	12.4	9.3	12.6	10.5	7.7	11.1	8.1	1.9	9.8	4.2
E	0.5	0.4	4.2	**15.6**	**21.9**	**27.2**	**24.0**	18.1	**18.3**	12.7	6.8	2.2	**20.9**	4.5
E S E	—	—	2.1	9.7	15.5	20.1	17.3	**20.1**	14.6	8.6	5.1	2.0	16.2	3.0
S E	0.2	—	2.9	10.2	11.3	18.2	15.9	17.7	16.9	**18.2**	6.6	1.5	15.0	4.9
S S E	—	0.4	0.8	2.7	4.0	4.7	4.6	7.6	5.8	4.7	3.8	0.8	4.9	1.8
S	0.7	0.7	2.7	1.5	3.0	2.1	3.2	2.2	4.0	2.7	4.3	0.8	2.7	2.0
S S W	0.7	0.7	0.3	2.1	0.8	0.4	1.1	0.4	—	1.5	2.5	1.7	0.8	1.2
S W	2.9	2.2	3.7	4.0	1.4	0.8	0.9	1.4	1.1	2.7	5.1	4.7	1.6	3.6
W S W	7.0	2.2	4.5	2.7	1.3	0.1	0.5	—	0.5	1.9	5.2	5.6	0.9	4.4
W	20.7	23.9	14.6	11.4	2.1	0.3	0.9	0.2	1.1	4.2	**8.6**	19.1	2.7	15.2
W N W	26.5	**28.3**	14.1	3.6	0.8	0.6	0.5	0.4	0.3	2.4	4.7	13.9	1.0	15.0
N W	**27.5**	23.2	**20.7**	6.9	0.8	0.8	1.8	0.2	2.4	2.7	5.8	**19.5**	2.2	**16.6**
N N W	5.1	4.7	3.2	1.6	0.8	0.2	0.4	1.8	1.9	1.5	3.7	5.9	1.1	4.0
Circulating	1.0	1.4	3.0	1.5	5.5	2.3	2.8	2.2	2.4	2.4	6.3	5.1	2.8	3.2
Variable	2.9	1.4	3.7	4.3	3.9	4.2	2.0	3.8	3.2	5.6	7.3	4.4	3.6	4.2
Calm	1.0	1.1	1.0	1.5	1.3	0.7	0.8	1.8	0.8	0.5	1.9	1.0	1.2	1.1

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	2.1	1.3	2.0	1.3	0.4	1.1	0.5	1.0	1.3	1.1	2.3	1.1	0.9	1.7
N N E	0.5	0.9	2.4	0.5	0.2	0.6	0.4	0.2	0.8	1.1	0.4	0.8	0.5	1.0
N E	0.3	0.9	2.6	4.1	2.0	1.6	2.2	3.6	4.6	3.3	2.7	0.8	3.0	1.8
E N E	0.8	—	2.7	3.6	4.4	4.5	4.6	3.2	3.0	3.7	1.2	0.2	3.9	1.4
E	0.3	1.3	3.1	9.5	17.4	20.7	16.8	13.1	16.7	10.9	7.2	0.9	15.7	4.0
E S E	—	—	2.6	9.5	12.0	19.5	16.3	16.7	17.0	13.0	6.4	2.5	15.2	4.1
S E	2.4	2.2	5.1	**14.8**	**18.2**	**21.1**	**22.4**	**29.1**	**18.5**	**19.6**	**11.3**	3.3	**20.7**	7.3
S S E	—	1.7	1.1	6.2	12.6	11.4	7.2	9.8	9.6	8.6	6.6	3.6	9.5	3.6
S	1.8	6.1	4.9	7.0	8.7	7.5	10.4	11.2	10.4	10.4	10.0	4.6	9.2	6.3
S S W	3.7	3.1	5.5	2.6	4.0	1.3	4.2	2.4	5.3	5.8	6.6	2.8	3.3	4.6
S W	9.4	6.6	9.0	7.7	2.8	1.1	2.4	1.4	0.3	4.6	9.7	13.2	2.6	8.8
W S W	13.4	4.8	10.4	4.6	0.9	0.7	1.2	0.4	—	2.3	6.7	9.4	1.3	7.8
W	**29.1**	**27.1**	**13.9**	10.5	1.1	0.3	0.5	—	1.3	3.5	7.0	**22.4**	2.3	**17.2**
W N W	14.9	17.0	8.8	2.5	0.4	0.4	0.4	—	—	0.9	3.7	12.7	0.6	9.7
N W	13.4	18.8	10.6	2.3	1.1	0.2	—	0.4	0.8	0.5	4.7	8.8	0.8	9.5
N N W	1.0	2.6	2.0	0.2	—	0.2	0.1	—	0.3	0.4	0.9	1.3	0.1	1.4
Circulating	1.6	1.3	5.9	3.8	5.2	2.2	2.9	3.8	4.1	4.9	5.0	4.7	3.7	3.9
Variable	4.5	3.9	6.4	7.0	7.3	5.3	6.8	3.8	5.8	4.2	6.0	5.3	6.0	5.1
Calm	1.0	0.4	0.9	2.3	1.2	0.4	0.7	—	0.5	1.4	1.7	1.6	0.9	1.2

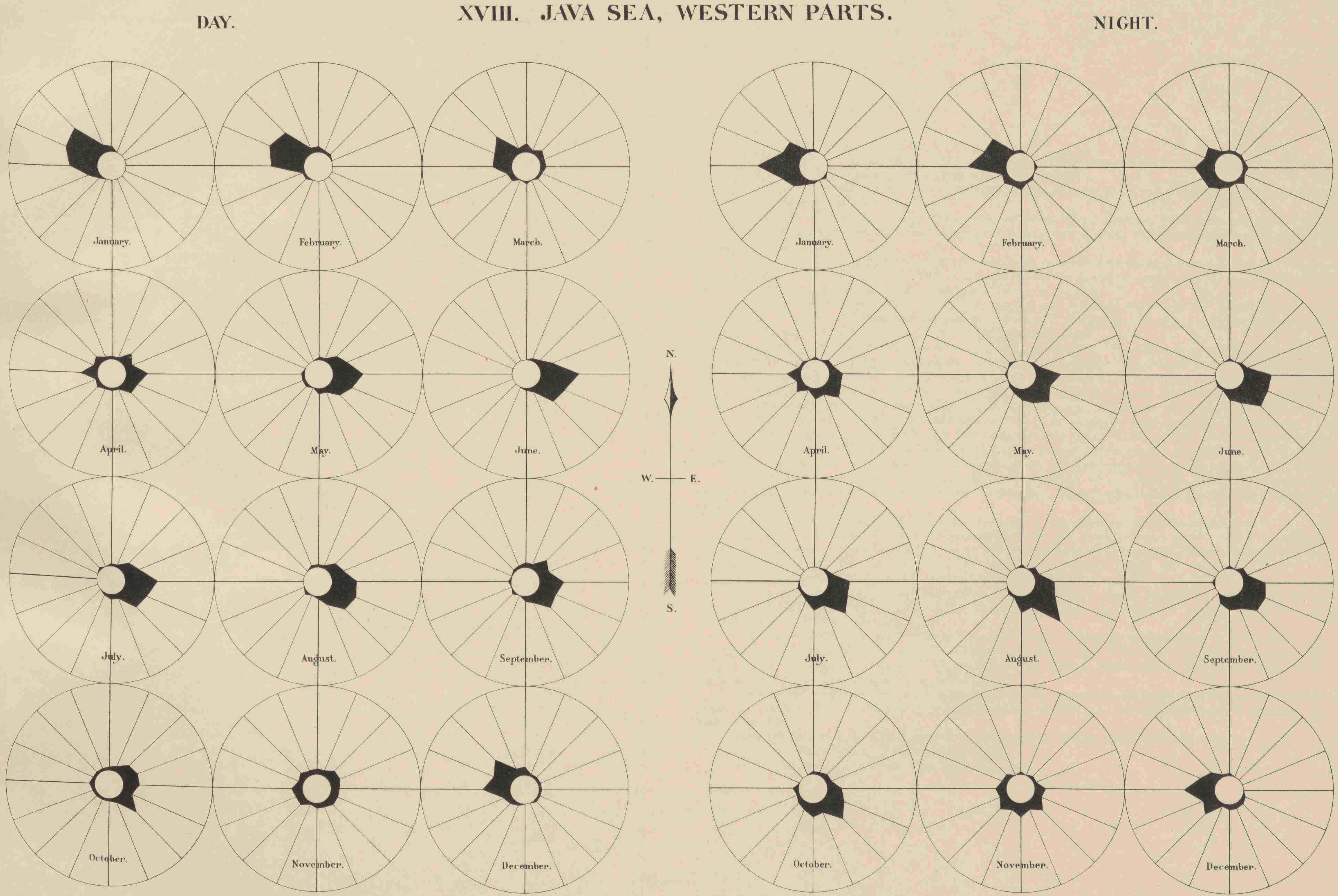
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	29.9	19.8	6.3	7.8	22.7	20.9	27.2	20.9	24.2	9.7	11.1	20.1	20.6	16.2
High Swell	0.5	2.5	1.1	3.7	—	1.5	0.4	—	—	1.3	0.3	0.8	0.9	1.1
Waves	4.8	2.4	0.4	0.3	2.7	—	2.1	—	2.8	0.9	1.6	0.8	1.3	1.8
Sea	21.3	24.3	9.7	3.5	18.7	27.4	20.3	28.7	7.6	13.4	7.3	28.6	17.7	17.4
High Sea	1.4	0.6	0.7	1.8	—	6.2	1.7	3.2	6.7	0.5	0.3	1.1	3.3	0.8
Calm	42.2	50.5	82.0	83.0	56.0	44.4	48.5	47.3	58.8	74.5	79.5	48.8	56.3	62.9
Number of Observations	211	167	289	340	336	278	291	197	182	239	318	269	1624	1493

CONDITION OF THE WEATER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	18.6	41.8	31.3	41.5	44.5	44.3	46.9	56.1	52.3	40.5	34.4	20.8	47.6	31.2
Overcast	48.5	34.5	40.8	34.3	33.0	32.7	32.7	25.8	23.3	31.0	38.0	45.5	30.3	39.7
Showery	7.7	7.5	8.4	6.2	6.4	4.5	4.7	3.3	5.0	2.7	5.7	8.2	5.0	6.7
Rain	21.1	15.9	15.0	14.0	9.3	12.0	8.4	6.7	5.2	8.4	14.3	19.2	9.3	15.7
Squalls	3.1	—	1.2	0.4	0.5	0.5	0.3	0.2	—	0.3	0.4	0.4	0.3	0.9
Thunder	0.5	—	1.9	1.5	3.1	1.1	1.6	0.7	1.1	2.0	2.8	4.2	1.5	1.9
Hazy	0.7	0.3	1.6	2.4	3.2	5.0	5.4	7.3	13.3	14.7	4.6	1.9	6.1	4.0
Mist	—	—	—	—	0.1	0.1	—	—	—	0.4	—	—	0.0	0.1
Number of Observations	456	312	771	856	1456	1143	893	584	462	742	742	774	5394	3797

XVIII. JAVA SEA, WESTERN PARTS.



XIX. JAVA-SEA, MIDDLE PARTS.

TABLE A. DAY-HOURS.

	Components. N	Components. E	Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
January	18	—69	N 76° W	W N W	71 %	1.7	240
February	25	—67	N 66° W	W N W	72	1.8	279
March	14	—24	N 60° W	W N W	28	1.5	371
April	— 9	11	S 51° E	S E	14	1.3	370
May	—13	60	S 79° E	E S E	61	1.6	383
June	—23	61	S 70° E	E S E	65	1.7	479
July	—30	65	S 61° E	E S E	72	1.7	582
August	—32	61	S 62° E	E S E	69	1.7	301
September	—30	56	S 62° E	E S E	64	1.5	384
October	—22	43	S 62° E	E S E	48	1.6	558
November	— 8	2	S 17° E	S S E	8	1.3	408
December	5	—39	N 83° W	W	39	1.5	416
Year	— 9	13	S 55° E	S E	16	1.58	4771

TABLE B. NIGHT-HOURS.

	Components. N	Components. E	Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
January	— 1	—70	W	W	70 %	1.7	235
February	10	—78	N 83° W	W	79	1.9	254
March	—13	—27	S 63° W	W S W	30	1.4	356
April	—26	9	S 19° E	S S E	28	1.3	350
May	—31	62	S 64° E	E S E	69	1.7	354
June	—31	61	S 63° E	E S E	68	1.7	461
July	—41	65	S 58° E	E S E	77	1.7	566
August	—48	62	S 52° E	S E	78	1.7	266
September	—43	54	S 51° E	S E	69	1.6	361
October	—40	35	S 43° E	S E	53	1.6	538
November	—23	— 1	S 2° W	S	23	1.4	370
December	—13	—47	S 75° W	W S W	49	1.5	392
Year	—25	10	S 22° E	S S E	27	1.60	4503

TABLE C. DAY AND NIGHT-HOURS.

	Components. N	Components. E	Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
January	9	—70	N 83° W	W	71 %	1.7	475
February	18	—73	N 76° W	W N W	75	1.9	533
March	1	—26	N 88° W	W	26	1.5	727
April	—18	10	S 29° E	S S E	21	1.3	720
May	—22	61	S 70° E	E S E	65	1.7	737
June	—27	61	S 66° E	E S E	67	1.7	940
July	—36	65	S 61° E	E S E	74	1.7	1148
August	—40	62	S 57° E	E S E	74	1.7	567
September	—37	55	S 56° E	S E	66	1.6	745
October	—31	39	S 52° E	S E	50	1.6	1096
November	—16	1	S 4° E	S	16	1.4	778
December	— 4	—43	S 85° W	W	43	1.5	808
April—November	—28	44	S 58° E	E S E	52	1.59	6731
December—March	6	—53	N 84° W	W	53	1.65	2543
Year	—17	12	S 35° E	S E	21	1.61	9274

In the middle part of the *Java-sea*, from the 111^{th} to the 115^{th} degree of longitude, the monsoons are distinctly marked; there is no compensation of either time or direction, however.

The E monsoon blows during seven or eight months and from the E S E, the W monsoon during five or four months only and from the West.

March and April are the months of transition, the former with a prevailing tendency to westerly, the latter to S S E winds: in these months the force of the wind is least, variable winds alternate with calms, and the monsoon cannot be depended upon.

In May the full E monsoon has set in and blows with increasing force and steadiness till August; in September and October the E monsoon gradually abates in force and steadiness, and in November there are again equal chances of winds from any point of the compass, whilst their force is very small.

The W monsoon blows with full vigour in January and February, when force and persistency are both very great: in December the monsoon has not yet come to full development, the wind drifting between southerly and westerly directions and the average value of the force being feeble.

On comparing the weather in these parts with that experienced in the adjacent parts of this sea, we find the percentages of „bright sky" to be considerably increased, and cloudiness correspondingly decreased; the rainfall is about the same as that recorded in the western parts of the *Java-sea*, and greater than in more easterly regions. Showers occur during all seasons, but mostly during the W monsoon when heavy squalls also are, at times, experienced.

Thunderstorms appear to be less frequent than in the western parts, probably on account of the shelter afforded by the Isle *Borneo* against the influence of the *China-sea*, where thunderstorms reach a maximum of frequency.

During the E monsoon the sky is very hazy, especially from June to October, when distant objects are seldom visible and the cloudless sky has a whitish blue tint; about noontide however bright cumuli flow to the westward almost without exception, and the percentages of cloudiness are not much below those recorded during the W monsoon.

The dry months are July, August and September; in October and November the rainfall increases, but not before the W monsoon fully has set in, namely in December, January and February, may the rainy monsoon be said to prevail.

From a maximum rainfall in February the frequency of rainy days steadily decreases until July.

As to the general aspect of clouds, the reader is referred to „*Java-sea*, western parts" where a description is given; near the coast, for a distance of about 15 miles, land- and seabreezes prevail, especially in the E monsoon, the westerly winds blowing with a force too great to allow the landbreezes to come off.

The condition of the sea is at its best when the monsoons turn i. e. in March, April and November; during the W monsoon a pretty heavy swell is experienced from the West; in the E monsoon the swell is less, but the sea is rather disturbed, which is exhibited in Table D by the great percentages of „sea" and „high sea", the latter for June amounting even to 9.2 %.

This is due to the interruption of the regular drift-currents by irregular streams, which, when they are stronger and steadier, often cause the water to run in a direction opposite to that of the wind: thus it is, that these parts, together with the *Indian Ocean* south of the *Sunda isles* and the more eastern parts of the *Java-sea*, belong to the most turbulent of the different seas of the Archipelago.

Tides in these regions are diurnal, i. e. high water occurs only once in 24 hours: near *Bawean* it is high water about 21^{st} June at 9^h 42^m a. m. and about 21^{st} December at 9^h 42^m p. m.; for details the reader is referred to the chapter on tides.

Observations of tides have been made at *Bawean*, *Arisbaya*, *Oedjong Pangka* and *Pulu Sapudi*;
of rain at *Pati*, *Rembang*, *Tuban* and *Banjermasin*;
of wind at *Bawean*, *Pulu Sapudi* and *Banjermasin*.

TABLE D. JAVA-SEA, MIDDLE PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	2.4	2.9	3.6	3.4	4.2	2.4	0.7	1.6	1.6	4.7	4.5	5.7	2.3	4.0
N N E	1.0	2.1	1.3	1.0	1.1	0.5	1.1	1.2	1.0	4.5	2.0	1.3	1.0	2.0
N E	0.7	2.1	7.9	4.2	5.0	4.2	4.1	6.8	9.9	8.1	7.5	2.2	5.7	4.8
E N E	—	—	2.9	5.0	8.3	6.9	8.5	6.8	6.1	5.9	6.1	1.3	6.9	2.7
E	1.0	1.1	5.2	**12.6**	**27.2**	**24.6**	19.5	15.1	15.6	11.9	5.7	4.0	19.1	4.8
E S E	—	—	3.2	8.4	17.5	19.1	18.9	10.6	11.5	9.5	4.8	1.6	14.3	3.2
S E	1.7	0.4	4.3	12.0	13.8	17.9	**22.8**	**32.6**	**23.6**	**20.1**	**10.2**	1.7	**20.5**	6.4
S S E	—	—	2.7	2.4	3.6	5.7	8.3	11.6	7.4	6.8	3.0	0.3	6.5	2.1
S	2.2	1.5	2.9	5.8	3.9	5.5	6.3	5.4	13.1	12.5	10.0	6.8	6.7	6.0
S S W	0.7	1.1	1.1	3.2	1.1	0.6	0.4	—	1.1	1.8	3.2	3.7	1.1	1.9
S W	9.6	6.3	6.9	4.0	2.3	1.9	0.7	0.6	1.0	3.2	7.0	10.8	1.8	7.3
W S W	4.8	5.5	2.7	4.4	0.5	0.1	0.4	—	0.2	0.5	3.8	4.6	0.9	3.7
W	**28.6**	23.0	16.1	8.4	1.3	1.3	—	0.8	0.7	2.2	8.2	**14.9**	2.1	**15.5**
W N W	14.7	22.1	8.7	4.2	0.3	1.0	0.3	—	—	1.1	3.6	11.6	1.0	10.3
N W	23.8	**23.6**	**16.2**	7.0	2.1	1.3	0.3	1.2	0.5	0.8	7.9	12.9	2.1	14.2
N N W	4.8	3.2	4.5	2.6	0.5	0.2	0.3	0.4	0.2	0.9	2.1	4.3	0.7	3.3
Circulating	0.5	1.3	3.2	2.6	3.1	1.0	2.4	1.0	1.1	1.6	5.2	4.8	1.9	2.8
Variable	1.7	1.7	4.5	3.8	2.8	3.6	3.3	2.5	3.1	2.0	2.9	3.8	3.2	2.8
Calm	1.9	2.1	2.0	4.8	1.6	2.5	1.7	2.1	2.3	1.8	2.3	3.7	2.5	2.3

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	1.0	2.4	2.3	2.9	1.0	1.8	0.3	1.5	1.7	1.6	5.6	2.4	1.5	2.6
N N E	1.0	1.9	1.0	0.2	2.2	1.0	—	0.2	0.3	—	0.8	0.5	0.3	0.9
N E	2.2	0.8	4.6	2.5	5.1	2.4	0.9	2.0	3.2	3.0	4.3	0.5	2.7	2.6
E N E	0.7	—	1.7	2.0	1.7	2.2	3.1	0.9	3.1	2.8	1.5	0.3	2.2	1.2
E	0.5	0.5	4.8	10.9	22.2	21.2	25.5	17.1	17.3	13.3	6.4	2.6	19.0	4.7
E S E	0.5	—	4.0	9.0	19.2	**26.0**	18.0	16.8	12.6	11.6	4.5	1.0	16.9	3.6
S E	0.2	0.5	6.1	**13.9**	**23.2**	19.8	**25.8**	**35.4**	**28.2**	**23.3**	**12.2**	3.4	**24.4**	7.6
S S E	1.2	0.2	2.1	4.7	7.9	6.7	10.0	12.7	9.9	7.8	4.0	3.6	8.7	3.2
S	1.9	1.1	5.9	9.0	6.1	5.9	6.1	6.1	12.5	11.1	11.7	5.0	7.6	6.1
S S W	2.9	0.2	6.9	4.1	2.0	1.1	2.2	1.3	2.2	3.0	5.1	5.4	2.2	3.9
S W	13.5	6.5	11.6	6.6	1.0	1.7	1.4	2.2	1.9	6.3	7.9	16.0	2.5	10.3
W S W	7.5	9.8	5.1	4.7	—	0.2	0.2	—	—	1.3	5.6	8.1	0.9	6.2
W	**37.1**	**47.5**	**16.8**	8.0	0.7	0.6	0.3	0.4	0.7	3.6	8.7	**16.0**	1.8	**21.6**
W N W	13.7	10.3	7.6	3.5	0.3	—	—	—	0.2	0.8	1.1	10.6	0.7	7.4
N W	10.8	14.1	8.0	4.3	0.5	1.9	0.4	0.2	1.0	1.2	5.1	12.1	1.4	8.6
N N W	0.7	2.2	1.3	0.6	0.5	1.1	—	—	—	0.9	1.1	1.3	0.4	1.3
Circulating	1.4	0.3	3.6	3.5	1.8	1.8	1.1	0.4	0.3	3.3	3.6	2.9	1.5	2.5
Variable	1.9	0.6	3.4	3.1	3.1	1.8	3.0	1.3	2.1	2.3	5.1	2.9	2.4	2.7
Calm	1.2	1.1	3.2	6.6	1.5	2.7	1.6	1.3	2.7	2.9	5.3	5.4	2.7	3.4

CONDITION OF THE SEA, PERCENTAGE.

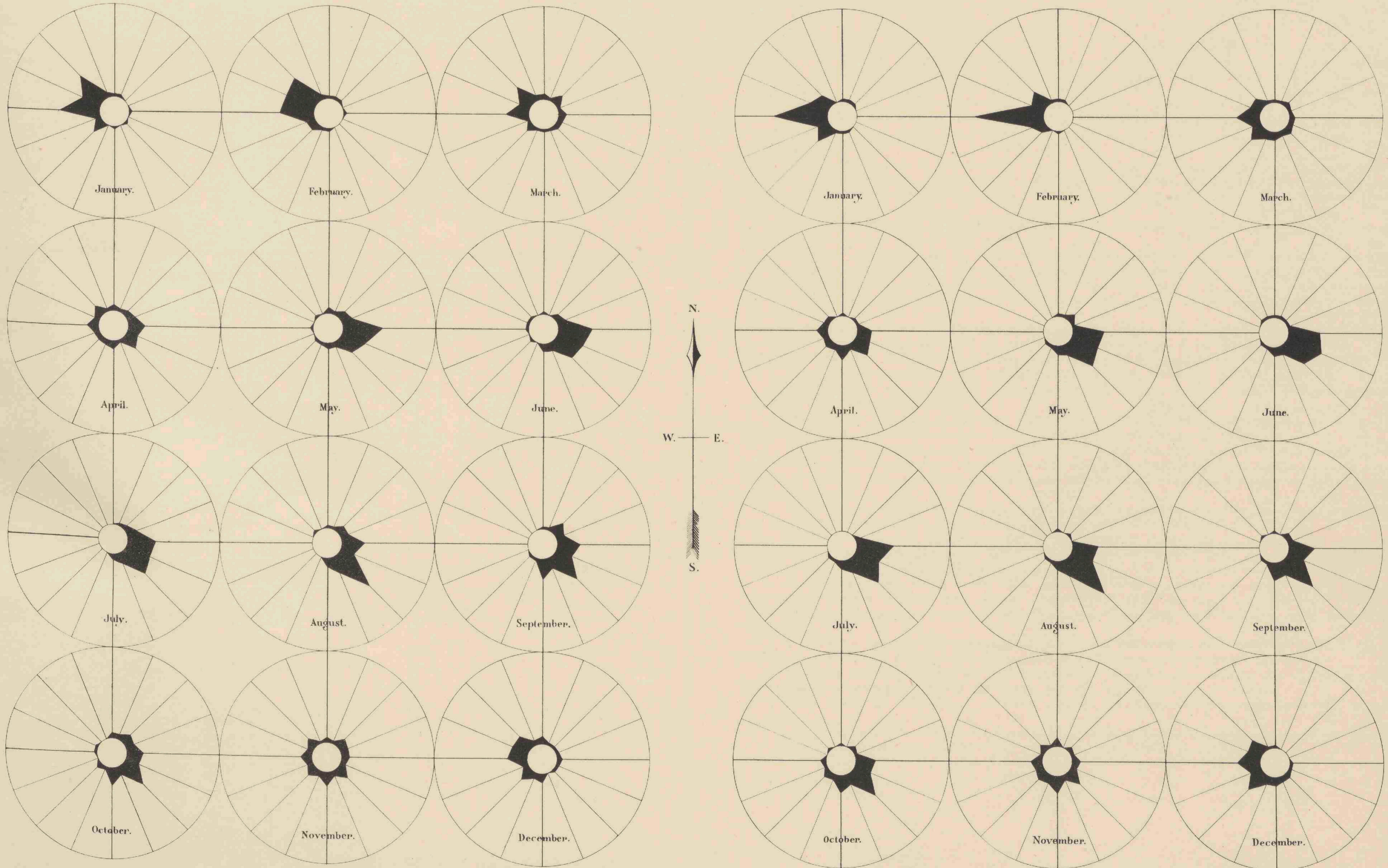
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	26.4	24.3	12.6	3.8	22.3	15.0	17.1	18.4	13.6	10.4	10.5	20.6	15.0	17.5
High Swell	1.4	3.4	0.4	0.4	1.9	0.3	—	—	0.3	0.2	—	—	0.5	0.9
Waves	1.0	2.1	—	—	1.9	0.2	0.7	4.6	1.5	0.4	—	0.3	1.5	0.6
Sea	20.3	21.9	14.3	7.7	10.0	21.7	31.7	32.9	14.6	26.9	4.9	15.4	19.8	17.3
High Sea	2.6	4.3	0.7	0.4	—	9.2	0.5	0.3	0.5	—	—	2.1	1.8	1.6
Calm	48.2	44.2	72.1	87.9	64.1	53.8	50.2	43.9	69.7	62.2	84.6	61.7	61.6	62.2
Number of Observations	298	336	287	288	326	444	344	434	421	585	402	332	2257	2240

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	34.2	29.4	44.0	38.2	49.3	49.4	57.7	59.0	61.3	49.9	40.0	30.2	52.5	38.0
Overcast	31.2	38.7	32.8	37.4	32.3	29.0	27.8	25.2	21.8	23.6	31.4	35.2	28.9	30.8
Showery	9.0	8.7	6.8	4.7	7.1	5.7	3.6	2.5	1.2	2.7	6.0	6.9	4.1	6.7
Rain	23.1	25.1	11.2	15.8	9.6	10.9	8.4	4.3	6.3	7.6	16.2	22.1	9.2	17.6
Squalls	1.7	2.5	1.4	0.7	0.3	0.1	0.3	0.2	0.2	0.4	0.4	1.6	0.3	1.3
Thunder	0.4	0.6	1.3	0.9	0.6	0.4	—	—	0.2	1.6	2.1	2.5	0.4	1.4
Hazy	0.2	2.7	2.5	1.2	1.0	4.6	2.4	8.5	8.2	10.6	3.8	1.0	4.3	3.5
Mist	0.2	0.4	0.2	1.3	—	0.1	—	0.4	1.0	3.7	0.3	0.8	0.5	0.9
Number of Observations	468	527	720	712	737	929	1120	558	731	1061	770	795	4787	4341

XIX. JAVA SEA, MIDDLE PARTS.

DAY. NIGHT.



XX. JAVA-SEA, EASTERN PARTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	26	—53	N 63° W	W N W	59 %	1.7	132
February	37	—59	N 57° W	W N W	70	1.9	117
March	19	—40	N 66° W	W N W	44	1.6	179
April	—10	5	S 27° E	S S E	11	1.4	223
May	—31	55	S 61° E	E S E	63	1.7	163
June	—32	60	S 62° E	E S E	68	1.6	289
July	—40	63	S 58° E	E S E	75	1.7	196
August	—46	63	S 54° E	S E	78	1.9	137
September	—41	47	S 47° E	S E	62	1.7	300
October	—37	52	S 54° E	S E	64	1.6	288
November	—28	14	S 30° E	S S E	31	1.4	170
December	— 1	—42	W	W	42	1.6	235
Year	—18	17	S 43° E	S E	25	1.65	2429

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	15	—64	N 78° W	W N W	66 %	1.7	133
February	23	—67	N 71° W	W N W	71	1.8	114
March	7	—45	N 82° W	W	46	1.5	178
April	—24	— 3	S 7° W	S	24	1.4	221
May	—44	50	S 49° E	S E	67	1.7	168
June	—46	53	S 51° E	S E	70	1.8	264
July	—49	62	S 54° E	S E	79	1.8	189
August	—58	51	S 41° E	S E	77	1.9	134
September	—60	43	S 36° E	S E	74	1.8	302
October	—58	37	S 33° E	S S E	69	1.7	299
November	—55	4	S 5° E	S	55	1.5	175
December	—13	—40	S 71° W	W S W	42	1.6	237
Year	—30	7	S 13° E	S S E	31	1.68	2414

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	22	—59	N 70° W	W N W	63 %	1.7	265
February	30	—63	N 65° W	W N W	70	1.9	231
March	13	—43	N 73° W	W N W	45	1.6	357
April	—17	1	S 3° E	S	17	1.4	444
May	—38	53	S 55° E	S E	65	1.7	331
June	—39	57	S 56° E	S E	69	1.7	553
July	—45	63	S 54° E	S E	77	1.8	385
August	—52	57	S 42° E	S E	77	1.9	271
September	—51	45	S 41° E	S E	68	1.8	602
October	—48	45	S 43° E	S E	66	1.7	587
November	—42	9	S 12° E	S S E	43	1.5	345
December	— 7	—41	S 81° W	W	42	1.6	472
April—November	—42	41	S 45° E	S E	59	1.69	3518
December—March	15	—52	N 74° W	W N W	54	1.70	1325
Year	—23	10	S 23° E	S S E	25	1.69	4843

The W monsoon, which in the western parts of the *Java-sea* blows from the W N W on account of the influence of the *China-sea*, and which blows from the West in the sheltered middle parts south of *Borneo*, here again assumes a W N W direction, owing to the northern components originating in *Makasser*-strait.

The S E monsoon however exhibits the same S E direction in all three regions with a steadiness that increases as we proceed eastward.

At the same time the W monsoon abates in steadiness, as well as in force, the latter being equal here to that in the E monsoon, whereas in the western and middle parts it is considerably stronger in the W than in the E monsoon.

The E monsoon is at its full height in July and August with percentages amounting to 77 % and maxima of average forces 1.8 and 1.9; it practically blows during seven months, namely from May to November with great steadiness; in April southerly winds still prevail, but winds from all points of the compass may be expected and theu the force attains a minimum value.

The W monsoon sets in in December and lasts till about the middle of March, when easterly and southerly winds begin to appear; it is at its height in February.

From this preponderance of the E over the W monsoon, which still increases as we proceed eastward, it follows that the displacement of the air in a direction from South to North — taken over the whole year — equally increases as we proceed eastward: for the western parts we find a percentage of 13 %, for the middle parts of 21 %, for the eastern parts 25 %, facts which are shown in the chart exhibiting the general motion of the air during a whole year.

If we look at the summarizing table in the introduction, we see that, in conformity with these results, the brightness of the sky increases as we go eastward, that the cloudiness of the sky is less here than in the western parts, and that the rainfall remains considerably under that experienced in the western and middle parts.

A force of the wind greater than 3 has been recorded 83 times, 38 at day- and 45 at nighthours.

Showery weather may be expected during all seasons, but especially in the W monsoon, whereas heavy squalls exclusively occur with western winds.

Owing to the prevalence of S E winds conveying dust-particles from the Australian deserts, the sky is very hazy during the E monsoon, and the more so, the longer the period of drought has lasted.

Consequently the haze is densest about September and October when, as a rule, distant objects are but dimly seen.

Forms of clouds other than bright cumuli about midday are seldom observed; at daytime the colour of the sky is of a whitish blue, and bright, starry nights are experienced only when the atmosphere has been cleared by occasional showers.

During the W monsoon, and especially when in April the rainfall decreases, the atmosphere is transparent, the sky, when not overcast, of a darker blue and at times bright, starry nights are experienced.

When the W monsoon, in December, January and February is at its height, the rainfall at sea is about the same as in the more western parts, about one rainy day occurring in three; but in the E monsoon, especially after June and up to October, the percentage of rainy days is very small in these eastern parts of the *Java-sea*.

The condition of the sea is, on the whole, unfavourable owing to a pretty heavy swell, which is caused by the vicinity of strait *Makasser*, with frequent occurrences of „sea" and „high sea", the latter reaching a percentage higher than anywhere else in the Archipelago, with the exception only of the *Indian Ocean*, south of the *Sunda* isles.

This must be regarded as a consequence of the fact that the prevailing drift-currents are interfered with by streams to the southward from strait *Makasser*, and by others to the westward from the *Sunda-sea*.

In neither monsoon, therefore, can the direction of the currents be depended upon, and whenever the wind blows in a direction opposite to that of the currents, high and turbulent seas may be expected.

As is natural the probability of „calm sea" is highest in April and November, when the force of the wind is small.

The strongest currents on record are 51 miles per 24 hours in the E and 40 miles per diëm in the W monsoon.

Observations of tides and wind have been made at the reef „*de Bril*" by the lightkeeper.

TABLE D. JAVA-SEA, EASTERN PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	7.7	7.0	7.7	1.6	0.7	1.1	—	—	1.7	1.3	2.5	2.5	0.9	4.8
N N E	2.3	1.8	5.2	3.3	2.6	0.9	—	0.8	0.8	0.7	2.9	1.3	1.4	2.4
N E.	1.8	1.3	0.3	6.2	1.5	4.8	0.9	1.1	1.1	0.9	5.8	2.0	2.6	2.0
E N E.	1.4	—	1.0	5.2	4.4	5.2	6.2	3.1	5.0	6.7	2.1	0.3	4.9	1.9
E	3.2	4.0	5.6	7.8	20.0	17.3	19.8	17.9	8.8	14.5	4.6	1.5	15.3	5.6
E S E.	1.8	—	2.8	2.3	19.6	18.8	19.5	14.1	15.3	14.7	11.6	2.3	14.9	5.5
S E	1.4	—	2.4	**11.4**	**23.7**	**27.3**	**29.2**	**39.7**	**28.3**	**25.2**	**11.6**	5.8	**26.6**	7.7
S S E.	1.4	—	1.4	7.2	8.1	7.8	6.2	10.3	13.6	10.2	11.6	2.3	8.9	4.5
S	1.4	—	1.7	4.2	4.1	4.8	7.4	5.0	6.1	6.7	8.3	3.8	5.3	3.7
S S W	0.5	0.9	3.5	4.2	3.0	0.6	1.8	1.1	2.3	3.6	4.6	4.5	2.2	2.9
S W	3.2	4.0	3.5	7.5	1.5	2.2	1.2	1.5	2.7	1.1	5.0	7.1	2.8	4.0
W S W.	0.5	3.5	5.6	4.2	1.9	0.4	0.3	—	0.6	—	5.8	5.8	1.2	3.5
W	**31.8**	16.3	**18.5**	4.9	1.5	1.3	0.6	1.1	1.1	1.1	6.2	**22.0**	1.8	**16.0**
W N W	16.4	22.9	17.8	3.6	—	—	0.3	—	1.1	0.7	2.1	9.8	0.8	11.6
N W	16.4	**28.6**	12.9	8.5	3.7	1.5	0.3	1.1	1.3	1.1	2.9	11.1	2.7	12.2
N N W.	4.1	4.0	3.5	2.3	1.1	0.4	0.6	0.8	1.1	0.4	1.2	5.3	1.1	3.1
Circulating	1.4	—	2.4	4.2	0.7	1.7	3.5	—	3.4	6.2	4.1	6.3	2.3	3.4
Variable	3.2	4.4	3.5	9.8	1.9	2.6	2.1	1.9	5.0	4.7	3.7	3.8	3.9	3.9
Calm	0.5	1.3	0.7	1.3	—	1.3	0.3	0.4	0.6	0.2	3.3	2.5	0.7	1.4

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	4.7	4.2	5.4	2.2	1.4	0.2	—	—	0.4	0.4	—	1.5	0.7	2.7
N N E	2.2	1.4	2.9	—	1.0	0.2	—	—	—	—	0.4	0.5	0.2	1.2
N E.	0.9	1.9	1.1	2.5	1.0	0.6	—	—	1.3	1.4	1.1	1.0	0.9	1.2
E N E	—	—	—	2.8	2.4	4.4	1.5	0.8	0.4	1.0	1.8	0.5	2.1	0.6
E	1.7	0.5	4.0	6.4	13.7	15.0	25.6	13.5	8.6	7.2	4.0	2.0	13.8	3.2
E S E.	1.7	0.5	2.9	3.8	**22.3**	16.7	15.2	11.6	8.6	9.9	11.7	2.0	13.0	4.8
S E	2.6		4.3	10.3	18.8	**27.3**	**28.6**	**39.4**	**32.3**	**28.4**	10.3	7.6	**26.1**	8.9
S S E.	1.3	—	1.4	8.8	16.8	12.0	12.2	8.4	18.7	14.1	4.8	6.3	12.8	4.7
S	0.9	0.9	2.5	9.7	8.6	8.8	7.1	12.7	13.8	14.5	**21.6**	4.5	10.1	7.5
S S W	0.4	—	3.2	3.4	3.1	2.4	3.6	6.8	2.9	7.4	13.6	3.0	3.7	4.6
S W	4.7	2.8	7.2	**13.4**	2.1	2.4	2.7	—	3.5	2.9	8.8	9.1	4.0	5.9
W S W.	7.8	8.5	7.6	2.8	—	0.4	—	0.4	0.2	0.4	3.3	10.6	0.6	6.4
W	**34.5**	25.0	**22.6**	3.8	2.1	1.5	—	0.8	0.4	0.6	7.0	**17.9**	1.4	7.9
W N W	19.4	**28.3**	10.8	4.1	—	—	—	1.2	0.4	0.4	—	10.6	1.0	**11.6**
N W	9.5	12.3	15.9	7.8	2.1	1.1	—	—	—	—	—	11.8	1.8	8.3
N N W.	4.7	3.3	1.4	4.4	0.7	0.2	—	—	—	—	0.4	1.0	0.9	1.8
Circulating	0.9	2.8	2.9	4.4	0.3	2.8	2.4	0.8	2.8	5.8	6.2	3.0	2.3	3.6
Variable	1.3	5.2	2.9	5.9	3.8	3.2	0.6	2.4	5.0	5.4	2.2	5.5	3.5	3.8
Calm	0.9	2.4	0.7	3.8	—	0.9	0.6	1.2	0.9	0.4	2.9	1.5	1.2	1.5

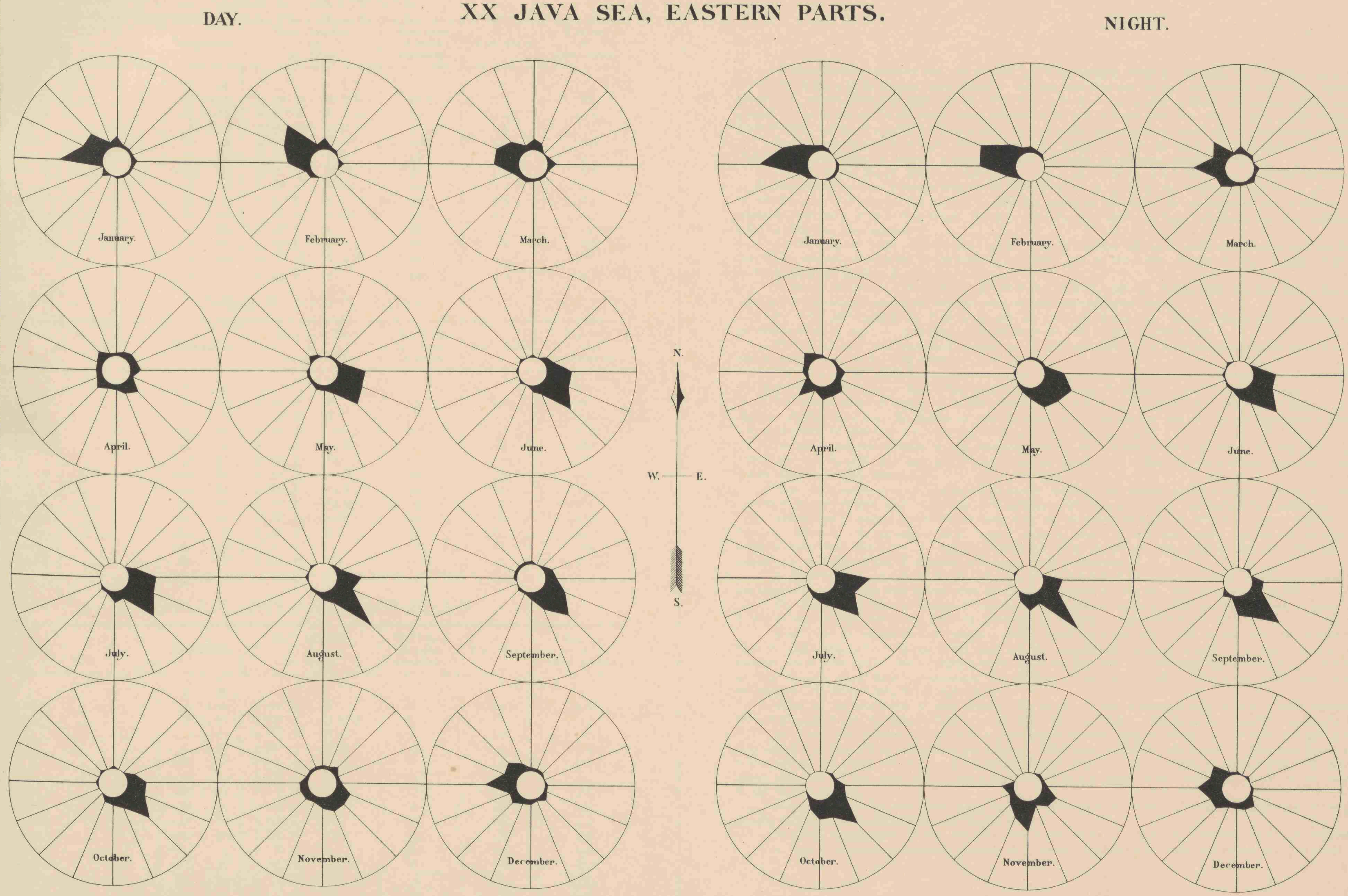
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	25.2	23.5	12.7	6.3	19.6	17.9	32.7	33.8	28.6	27.6	19.9	18.9	23.2	21.3
High Swell.	1.5	2.5	—	—	—	4.9	3.6	0.9	1.0	—	0.9	0.5	1.7	0.9
Waves	0.8	—	1.0	6.3	—	1.2	1.4	1.0	1.8	0.5	—	1.0	2.0	0.6
Sea	25.2	11.2	18.5	7.1	18.8	19.3	31.3	34.4	26.8	24.7	5.2	15.9	23.0	16.8
High Sea.	5.4	6.2	4.8	—	—	4.3	3.6	1.8	3.2	1.8	0.9	5.1	2.2	4.0
Calm	42.0	56.8	63.2	80.5	61.7	52.6	27.6	28.2	39.0	45.5	73.3	58.7	48.3	56.6
Number of Observations .	131	81	103	128	133	166	141	110	221	218	116	196	989	845

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	25.7	30.2	45.7	48.1	62.7	55.0	63.5	68.3	62.1	60.4	43.3	34.2	60.0	39.9
Overcast	41.7	32.4	32.4	31.2	21.6	30.0	24.4	23.1	24.2	24.3	35.0	30.2	25.8	32.7
Showery	11.0	8.6	7.6	7.9	1.8	4.6	4.5	1.5	2.5	1.8	5.5	10.1	3.8	7.4
Rain	17.8	23.7	9.9	8.4	8.2	5.8	2.1	2.7	2.4	2.6	9.5	21.1	4.9	14.1
Squalls	1.2	2.2	1.4	1.4	0.6	—	—	—	0.5	0.4	0.3	1.1	0.4	1.1
Thunder	0.8	—	1.4	1.2	0.9	0.2	—	0.4	—	0.7	1.8	0.9	0.5	0.9
Hazy	1.9	3.0	1.7	2.1	4.3	4.6	5.5	4.1	8.4	10.0	4.7	2.6	4.8	4.0
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations .	264	232	355	443	329	545	379	265	596	581	344	474	2557	2250

XX JAVA SEA, EASTERN PARTS.



XXI. STRAIT MADURA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	23	—60	N 70° W	W N W	64 %	1.6	166
February	29	—63	N 66° W	W N W	69	1.6	178
March	6	—13	N 65° W	W N W	14	1.6	298
April	6	39	N 81° E	E	39	1.4	289
May	— 7	66	S 84° E	E	66	1.6	306
June	—27	64	S 67° E	E S E	69	1.6	280
July	—17	48	S 70° E	E S E	51	1.7	297
August	—18	51	S 81° E	E	54	1.8	268
September	—20	56	S 71° E	E S E	59	1.7	252
October	— 6	36	S 81° E	E	36	1.5	485
November	— 3	17	S 80° E	E	17	1.4	308
December	6	—24	N 77° W	W N W	25	1.5	236
Year	— 2	18	S 84° E	E	18	1.58	3363

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—11	—68	S 81° W	W	69 %	1.6	147
February	11	—70	N 81° W	W	71	1.6	159
March	—22	—24	S 47° W	S W	33	1.5	273
April	—32	20	S 31° E	S S E	38	1.4	253
May	—39	47	S 50° E	S E	61	1.6	291
June	—59	27	S 26° E	S S E	65	1.6	260
July	—68	26	S 20° E	S S E	73	1.6	278
August	—62	17	S 16° E	S S E	64	1.7	263
September	—64	21	S 18° E	S S E	67	1.8	219
October	—62	2	S 89° E	E	62	1.7	448
November	—51	—10	S 11° W	S	52	1.4	285
December	—34	—44	S 52° W	S W	56	1.6	227
Year	—41	— 5	S 7° W	S	41	1.59	3103

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	6	—64	N 85° W	W	64 %	1.6	313
February	20	—67	N 72° W	W N W	70	1.6	337
March	— 8	—19	S 67° W	W S W	21	1.6	571
April	—13	30	S 67° E	E S E	33	1.4	542
May	—23	57	S 69° E	E S E	61	1.6	597
June	—43	46	S 47° E	S E	63	1.6	540
July	—43	37	S 41° E	S E	57	1.7	575
August	—40	34	S 40° E	S E	52	1.8	531
September	—42	39	S 43° E	S E	57	1.8	471
October	—34	19	S 29° E	S S E	39	1.6	933
November	—27	4	S 8° E	S	27	1.4	593
December	—14	—34	S 68° W	W S W	37	1.6	463
April—November	—33	33	S 45° E	S E	47	1.61	4782
December—March	1	—46	W	W	46	1.60	1684
Year	—22	7	S 18° E	S S E	23	1.61	6466

In strait *Madura*, sheltered from the westerly and north-westerly winds by the large isle of *Madura*, the action of the W monsoon is, to a great extent, impeded; January and February are the only months when this monsoon blows with reliable steadiness from the W, W N W and N W; in December southerly and south-westerly winds prevail, but north-westerly winds are at times experienced as well, and the same may be said of March, when westerly, north-westerly and south-westerly winds dominate, but practically winds from all points of the compass are met with.

The E monsoon sets in in April, with prevailing E S E winds, reaches its full development in May, and remains stationary till September; in October it begins to abate, decreasing at the same time in steadiness.

On the whole, though both monsoons may be said to be but feebly developed in this strait, the E monsoon is the stronger of the two; although open on the eastside to the E monsoon, the strait is too narrow to give scope to the full action of the easterly winds; besides the mainlands of *Madura* on the northside and of *Java* on the southside constitute a surface of land large enough to give rise to a system of land- and seabreezes, which materially interfere with the monsoonwinds.

In the southern parts of the strait, therefore, the E monsoon will be steadiest during nighthours and from the S S E, whereas at daytime the direction of the wind will be less steady on account of the opposition of the northerly seabreeze to the S E monsoonwind.

In the W monsoon, on the contrary, the W N W and N W winds are steadier under the *Java*-coast at daytime than during nighthours when calms alternate with variable and circulating winds.

Near the *Madura*-coast the E monsoon can mostly be depended upon during daytime, when seabreeze and monsoonwind set in together; at nighthours winds are feeble and variable in this season.

The W monsoon is strongest and steadiest in the northern parts of the strait during nighthours, when monsoon and landbreeze blow in the same direction.

The force of the wind is considerably greater during the E than in the W monsoon and is least in April and November; a force greater than 3 has been recorded 60 times, 31 at daytime and 29 at nighthours.

The results given in Tables A, B and D have been calculated from all available observations made in strait *Madura*, whether made near the *Madura* or near the *Java* coast; consequently they do not give more than a general idea of the state of affairs and by no means the actual state near the coasts.

On calculating the influence of land- and seabreezes by the average values of A and B, we find 23.5 % and N N E for the strength and direction of the landbreeze, which proves that the observations have been made mostly near the *Madura* coast.

Table C, however, may be considered to exhibit reliable data concerning the monsoons because, by taking conjointly the observations made at daytime and nighthours, the influence of land- and seabreezes is eliminated.

Rainfall, as is shown in the summarizing table of the introduction, is not abundant: only in January and February, when the W monsoon is at its height, about one rainy day in 3 days occurs; July till October are the driest months, when practically no rain is experienced; heavy squalls are very seldom met with, but showers occasionally occur during the W monsoon with pretty great percentages.

A cloudless, but very hazy sky is a characteristic feature of the weather during the E monsoon; altogether the haziness is denser here than in any other part of the Archipelago, the *Timor*-sea only being excepted.

The condition of the sea, though favourable on the whole on account of the small percentages of swell, yet is not so calm as might have been expected, much less so f. i. than in strait *Banka*.

From June to September and October a pretty heavy swell from the E rolls in, and when the E monsoon is at its height, from July to October, heavy seas are often experienced: these are caused by the pretty strong tidal currents which give rise to short chopping waves whenever they flow in a direction opposite to that of the wind, as they do with rising water; consequently the condition of the sea is best in March and April, good in the W monsoon and worst during the E monsoon.

Owing to the prevalence of tidal streams, the velocity of the currents, as deduced from a ship's calculated and actual positions, do not tally with the velocities found when the strength of the current is measured by means of a log.

Tides and tidal streams are very intricate phenomena in these parts on account of the equal strength of the semi-diurnal and mono-diurnal constituents; consequently tides may be equally well defined as being semi-diurnal and largely affected by diurnal influence, or as being diurnal and affected by large semi-diurnal partial tides: this state of affairs gives rise to tidal phenomena which cannot be described in words so that the reader is referred, for details, to the chapter on tides.

Observations of tides have been made at *Sembilangan, Surabaya, Gading, Karang Kleta, Pasuruan, Zwaantjes-droogte, Pulu Sapudi, Meinderts-droogte* and *Banjuwangi*,

of rainfall at *Bangkallan, Grissee, Surabaya, Pamekasan, Sumenep, Probolinggo, Kraksaän, Besuki* and *Situbondo*,

of wind at *Sembilangan, Surabaya, Sumenep, Pulu Sapudi, Zwaantjes-droogte, Meinderts-droogte* and *Duiven-eiland*.

TABLE D. STRAIT MADURA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	2.2	2.4	4.0	5.4	0.6	0.9	2.8	2.3	3.3	3.2	4.0	7.4	2.6	3.9
N N E	1.9	0.7	2.8	2.0	2.6	0.4	1.4	2.1	2.1	4.0	3.8	1.9	1.8	2.5
N E	1.5	1.4	5.7	11.5	10.5	5.6	6.7	8.1	7.5	6.4	9.5	4.4	8.3	4.8
E N E	—	—	2.5	5.9	10.1	3.4	6.3	8.9	5.9	9.1	5.8	2.5	6.8	3.3
E	0.7	2.4	5.1	**20.3**	**25.8**	**25.3**	**20.6**	15.1	19.7	**12.3**	7.8	6.3	**21.1**	5.8
E S E	0.7	0.3	4.7	10.3	17.7	18.2	9.0	12.8	13.1	10.4	6.0	1.6	13.5	4.0
S E	2.2	—	5.9	7.8	12.9	22.0	18.1	**18.5**	**20.6**	11.4	8.9	1.4	16.7	5.0
S S E	0.4	—	4.4	3.2	4.0	6.3	7.5	6.2	6.3	6.1	2.9	2.2	5.6	2.7
S	0.7	0.7	3.0	2.2	1.6	4.3	2.8	4.9	5.2	4.8	2.7	3.5	3.5	2.6
S S W	1.1	0.7	1.9	1.2	0.2	0.9	2.9	1.1	1.6	2.5	4.3	7.9	1.3	3.1
S W	2.6	6.5	5.9	1.0	1.4	0.7	2.9	3.0	2.8	2.9	6.7	6.8	2.0	5.2
W S W	6.0	2.4	3.0	2.2	0.4	0.4	0.6	1.3	—	2.5	2.7	4.1	0.8	3.5
W	23.9	23.1	11.2	3.2	0.8	0.7	1.4	0.4	—	1.3	3.8	13.9	1.1	12.9
W N W	17.2	15.0	8.1	1.0	1.2	0.2	1.2	0.4	—	1.7	1.6	4.1	0.7	8.0
N W	**25.0**	**31.6**	**12.3**	4.4	0.8	0.7	1.2	0.6	1.9	1.7	3.1	**14.2**	1.6	**14.7**
N N W	1.5	3.7	2.8	2.0	—	—	0.8	0.6	0.2	1.5	1.3	1.6	0.6	2.1
Circulating	3.4	3.1	7.6	5.4	2.6	3.6	5.1	3.6	2.3	7.6	**11.3**	6.0	3.8	6.5
Variable	8.2	5.1	8.3	9.5	6.0	6.3	6.7	9.8	7.0	7.1	11.3	7.9	7.6	8.0
Calm	0.7	1.0	0.8	1.7	0.8	0.2	2.2	0.2	0.5	3.2	2.7	2.5	0.9	1.8

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	—	1.1	1.2	1.4	1.3	—	—	—	0.3	—	1.4	1.1	0.5	0.8
N N E	—	—	0.5	—	—	—	—	—	—	0.4	—	—	—	0.2
N E	—	0.4	2.4	1.9	3.9	1.2	0.7	2.7	1.8	0.3	1.7	0.5	2.0	0.9
E N E	0.4	0.8	1.9	1.1	2.0	2.4	—	0.4	0.3	1.9	2.1	0.8	1.0	1.3
E	1.6	0.4	2.9	**14.4**	16.7	6.9	12.9	5.3	10.8	3.7	2.8	0.8	11.2	2.0
E S E	1.6	—	3.6	10.5	18.0	14.8	9.2	8.0	6.2	5.7	3.8	1.3	11.0	2.7
S E	1.6	1.5	5.8	13.9	**20.8**	15.5	15.5	14.2	15.5	11.6	7.6	3.5	**15.9**	5.3
S S E	0.4	—	9.1	6.4	7.2	14.1	12.0	14.4	14.4	11.6	6.4	5.6	11.4	5.5
S	2.0	2.3	9.4	10.8	9.2	**16.2**	**22.9**	**23.1**	**22.4**	16.3	16.1	9.9	17.4	9.3
S S W	3.3	1.1	3.4	6.6	4.2	8.4	8.7	10.0	11.6	**17.8**	**16.5**	8.6	8.3	8.5
S W	13.9	6.1	8.9	5.3	3.9	9.3	7.8	7.8	8.5	13.5	16.5	**25.2**	7.1	14.0
W S W	14.8	6.5	8.6	3.0	0.7	1.7	1.7	2.0	2.1	3.6	3.8	4.6	1.9	7.0
W	**28.7**	**30.0**	**12.9**	1.7	2.6	1.0	0.7	1.3	—	1.2	3.1	15.8	1.2	**15.3**
W N W	16.8	25.1	8.4	4.4	0.4	—	—	0.2	—	0.7	0.7	3.8	0.8	9.3
N W	7.0	11.0	6.2	5.5	0.2	—	0.4	0.4	1.0	0.7	2.6	9.7	1.3	6.2
N N W	—	3.4	2.4	0.6	—	—	—	—	—	0.1	—	1.1	0.1	1.2
Circulating	3.3	4.9	5.0	4.4	2.9	2.9	1.3	3.8	1.0	4.5	6.9	2.7	2.7	4.6
Variable	2.5	4.6	6.2	7.2	5.0	5.0	5.0	5.8	3.4	5.3	5.7	3.5	5.2	4.6
Calm	2.0	0.8	1.2	0.8	0.9	0.7	1.3	0.7	0.8	1.2	2.4	1.6	0.9	1.5

CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	14.9	13.5	3.4	4.9	16.5	20.1	19.3	25.0	18.1	12.5	8.8	6.3	17.3	9.9
High Swell	2.1	0.6	0.7	0.6	0.6	0.8	1.0	1.3	—	0.5	0.7	—	0.7	0.8
Waves	0.7	—	0.7	3.7	5.6	3.9	1.5	1.3	3.3	1.0	—	—	3.2	0.4
Sea	12.1	10.0	7.5	3.2	5.9	7.7	12.8	19.2	16.1	17.6	1.9	15.8	10.8	10.8
High Sea	0.9	3.9	3.5	—	—	—	0.5	—	—	—	0.7	2.7	0.1	2.0
Calm	69.5	72.2	84.3	87.7	71.5	67.6	65.1	53.3	62.6	68.6	88.1	75.3	68.0	76.3
Number of Observations	129	150	159	190	185	130	197	152	197	220	160	223	1051	1041

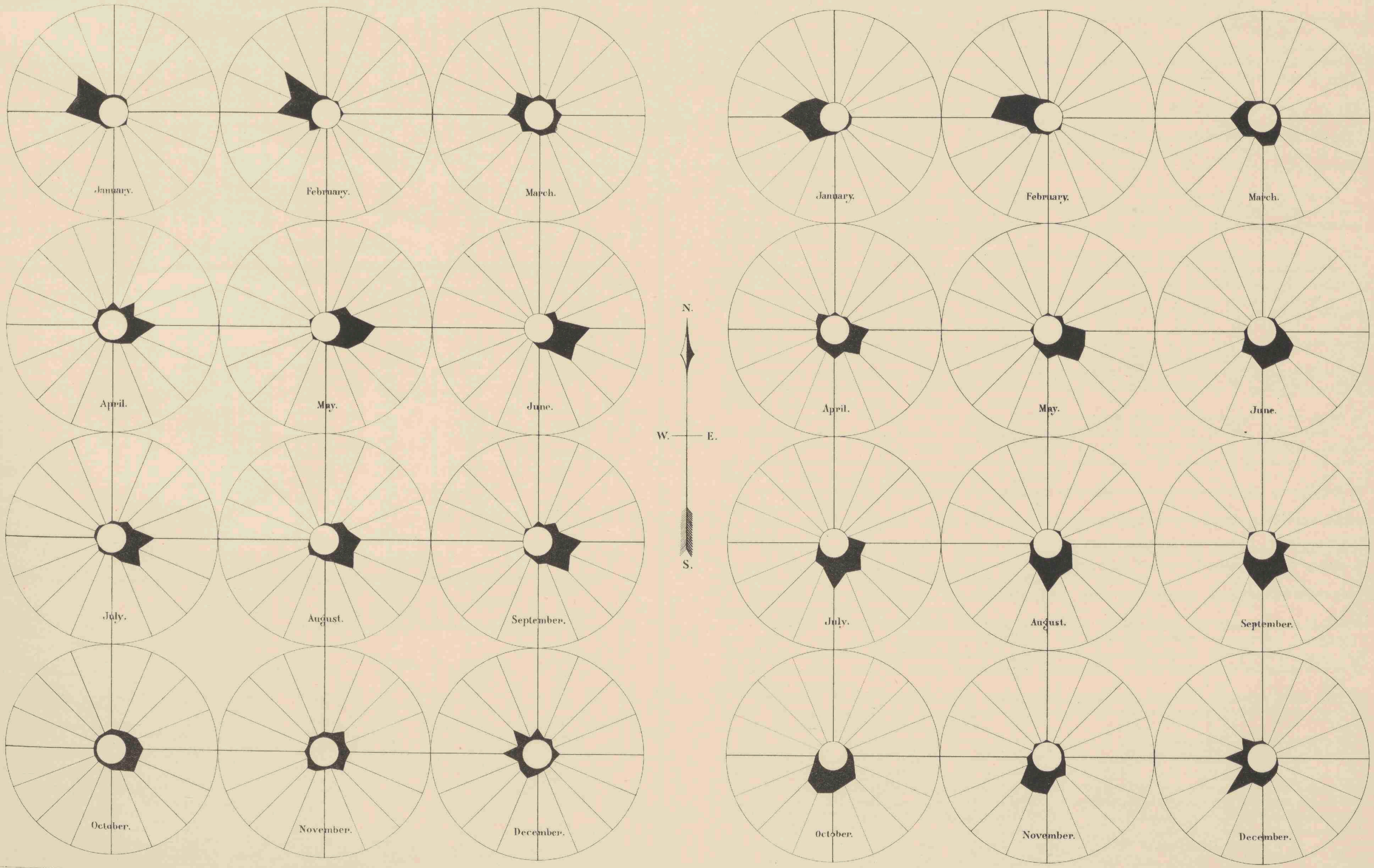
CONDITION OF THE WEATER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	32.9	29.5	35.7	49.0	63.9	58.1	64.8	64.6	72.6	56.6	41.4	44.4	62.2	40.1
Overcast	35.4	34.9	39.0	31.2	19.9	25.8	24.4	22.7	13.4	28.1	33.6	30.6	22.9	33.6
Showery	8.0	8.0	5.7	5.8	3.4	4.3	2.1	1.6	0.9	2.4	7.0	6.8	3.0	6.3
Rain	21.7	24.3	13.6	10.4	9.9	5.9	3.0	2.2	0.2	1.5	10.6	12.7	5.3	14.1
Squalls	0.4	0.3	1.1	—	0.2	—	—	—	0.3	—	—	0.7	0.1	0.4
Thunder	0.4	1.0	1.6	1.4	0.7	0.2	0.2	—	—	0.3	2.1	1.8	0.4	1.2
Hazy	1.4	2.1	3.5	2.3	2.2	5.9	5.6	9.0	12.7	11.1	5.5	3.1	6.3	4.5
Mist	—	—	—	—	—	—	—	0.2	—	0.3	—	—	0.0	0.1
Number of Observations	311	335	568	530	592	529	571	525	465	920	587	455	3212	3176

DAY.

XXI. STRAIT MADURA.

NIGHT.



XXII. SPERMONDE ARCHIPELAGO.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	19	—49	N 70° W	W N W	53 %	1.6	115
February	36	—35	N 43° W	N W	50	1.5	115
March	23	—36	N 56° W	N W	43	1.6	209
April	— 1	—17	S 86° W	W	17	1.5	115
May	—22	40	S 62° E	E S E	46	1.6	154
June	—38	28	S 36° E	S E	47	1.6	130
July	—41	28	S 34° E	S S E	50	1.7	149
August	—40	35	S 41° E	S E	53	1.8	183
September	—57	14	S 16° E	S S E	59	1.8	186
October	—44	— 1	S	S	44	1.7	179
November	2	—21	N 85° W	W	21	1.5	196
December	28	—43	N 58° W	W N W	51	1.6	159
Year	—11	— 5	S 24° W	S S W	12	1.62	1890

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	22	—11	N 27° W	N N W	25 %	1.5	107
February	50	—39	N 37° W	N W	63	1.6	97
March	42	—11	N 15° W	N N W	43	1.5	168
April	10	22	N 66° E	E N E	24	1.3	98
May	—16	75	S 76° E	E S E	77	1.6	133
June	—26	62	S 67° E	E S E	67	1.6	109
July	—27	77	S 71° E	E S E	82	1.7	130
August	—32	72	S 66° E	E S E	79	1.7	153
September	—48	60	S 51° E	S E	77	1.6	169
October	—22	48	S 65° E	E S E	53	1.4	166
November	14	10	N 36° E	N E	17	1.4	168
December	26	—18	N 35° W	N W	32	1.6	150
Year	— 1	29	S 88° E	E	29	1.54	1648

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	21	—30	N 55° W	N W	37 %	1.6	222
February	43	—37	N 41° W	N W	57	1.6	212
March	33	—24	N 36° W	N W	41	1.6	377
April	5	3	N 31° E	N N W	6	1.4	213
May	—19	58	S 72° E	E S E	61	1.6	287
June	—32	45	S 55° E	S E	55	1.6	239
July	—34	53	S 58° E	E S E	63	1.7	279
August	—36	54	S 56° E	S E	65	1.8	336
September	—53	37	S 35° E	S E	65	1.7	355
October	—33	24	S 36° E	S E	41	1.6	345
November	8	— 6	N 37° W	N W	10	1.5	364
December	27	—31	N 49° W	N W	41	1.6	309
April—October	—29	39	S 54° E	S E	49	1.63	2054
November—March	26	—26	N 45° W	N W	37	1.58	1484
Year	— 6	12	S 63° E	E S E	13	1.61	3538

The E monsoon sets in during the latter half of April, attains its full height in May and continues till September or the first half of October, its steadiness remaining stationary and its strength increasing.

The direction during these six months is almost invariably from the S E, but, as might have been expected, the percentages of steadiness are considerably greater at nighthours, when the landbreeze and monsoonwind blow in the same direction, than at daytime, when the direction is more to the S and the steadiness less.

At night, therefore, the E monsoon may be said to veer to the E and to increase in steadiness, whilst during dayhours a tendency to the S is observable and a decrease of steadiness.

In October S W, W S W and S winds begin to appear, especially in daytime, and N E winds at nighthours; the probability of rain slightly increases, but the characteristic E winds still prevail, though somewhat abated in force.

In November no prevailing winds are experienced, either at night or during dayhours; winds from all points of the compass may be expected, and circulating winds frequently occur.

December, January, February and March are the W monsoon months, but both the average force of the wind and the steadiness of direction are considerably smaller than in the E monsoon.

At night, when the landbreeze blows in a direction opposite to that of the monsoon, the prevailing directions are N W and N N W, but winds from all other points are also experienced: at daytime the monsoon may be more relied upon though variable and circulating winds, the inevitable concomitants of the W monsoon, still occur with pretty large percentages.

In February the W monsoon is at its height and may be depended upon both at night- and at dayhours.

In March the monsoon begins to abate and its direction to be modified by gradually increasing land- and seabreezes, so that by April the prevailing directions have ceased to exist and the state of the weather becomes very unsettled whilst varying winds are mostly on record.

The force of the wind is greater at daytime than at night, strongest in August and September during the day, when it attains an average value of 1.8, and weakest in April, October and November, especially during the night; but, though the *average* force is pretty strong when the E monsoon is at its height, forces greater than 3 have been very seldom recorded, not more than 30 times in the 3538: a force of 5 only once, and never of 6.

Though the W monsoon is so feebly developed in those parts, the dry and wet seasons are strongly marked, stronger perhaps than anywhere else.

Owing to the influence of the mountainrange which runs from north to south through the south-westerly neck of land of *Celebes*, the E monsoon is very dry and the W monsoon extraordinarily wet.

The S E and E aircurrents of the E monsoon, having lost their moistness in passing the hills, come off the slopes on the west-coast as a dry „föhn", whilst, on the contrary, the aircurrents from the W cause a heavy rainfall on the western shores as well as at sea not far from the coast.

At *Makasser* not less than 25 rainy days in the 31 occur on the average in January and a mean rainfall of 704 mm. is experienced in that month; at *Pangkadjene* even 835 mm. in January and 752 mm. in December.

As is exhibited in Table D, the amount of rainy days at sea is less than at *Makasser*, but December, January and February appear with percentages of rainy days nearly approaching to 50 %, whereas in the *Java-sea* not more than 30 % of rainy days are recorded during the W monsoon.

In March the rainfall is considerably less, and from April to October the probability of rain is very small, in September practically nihil.

Heavy squalls seldom occur, but whenever westerly and variable winds are blowing, light showers accompanied by thunder are frequent.

During the W monsoon the sky is generally overcast, but in the E monsoon the percentages of „bright sky" are pretty high, as shown in Table D, though not so much so as might have been expected from the explanation given above concerning the origin of the wet and dry seasons.

In the E monsoon clouds hardly ever are entirely absent, and at the same time the atmosphere is very hazy, especially in August, September and October.

This seems to prove that a great part of the aircurrents in the E monsoon enter the strait from the S and blow along the coast or pass through the mountainrange without having ascended the slopes and, consequently, without having deposed the suspended dust-particles together with the aqueous vapour. It is possible, however, that the air, on descending along the western slopes becomes charged again with dust-particles, to which the haziness of the sky may be ascribed.

The marine currents in the *Spermonde Archipelago* are pretty strong and during all seasons setting to the S or S W; consequently they are not to be regarded as drift-currents but rather as a branching off from the perennial current to the southward in strait *Makasser*.

In the S E monsoon their general direction suffers a deviation to the S W owing to the influence of the currents to the W in the *Sunda-sea*: in July, August and September the sea is disturbed as is shown in Table D and in October and November high percentages of „calm sea" are recorded.

In the W monsoon, when the perennial and drift-currents flow together, the currents are strong and running along the coast, but, owing to the fact that the wind generally blows in about the same directions, the sea is less turbulent than when the E monsoon is at its height: in March, April, May and June „calm seas" again are mostly met with.

Observations of tides have been made at *Makasser*; they prove that a proper port-establishment does not exist and, consequently, that the time of high water does not follow that of the moon's transit.

For further details the reader is referred to the chapter on tides.

Rainfall has been observed at *Segeri*, *Pangkadjene*, *Tjamba* and *Makasser*; wind at *Makasser*.

TABLE D. SPERMONDE ARCHIPELAGO.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	6.5	5.0	5.7	4.8	1.7	1.0	0.8	0.3	1.5	2.3	4.3	7.3	1.7	5.2
N N E	0.5	2.2	3.0	3.0	—	1.0	0.4	0.6	—	0.7	0.3	0.8	0.8	1.3
N E	2.2	3.4	3.3	1.8	3.3	2.4	4.0	0.6	—	1.0	3.3	1.5	2.0	2.5
E N E	—	2.2	0.9	4.8	3.7	4.8	2.8	1.2	0.6	1.3	1.0	—	3.0	0.9
E	1.6	3.9	2.1	6.5	16.9	7.7	7.3	8.0	1.2	1.6	5.0	0.4	7.8	2.4
E S E	0.5	—	2.4	0.6	**21.9**	9.6	13.8	18.2	7.5	7.9	2.7	1.5	11.9	2.5
S E	2.7	2.8	2.7	5.4	12.4	**24.9**	**18.6**	**25.6**	**26.2**	**15.4**	4.7	0.8	**18.9**	4.9
S S E	—	0.6	0.9	3.0	5.0	12.9	13.4	10.8	16.6	8.9	4.7	0.8	10.3	2.7
S	3.8	3.4	4.2	7.1	3.3	4.8	6.5	7.1	9.6	13.1	2.3	1.9	6.4	4.8
S S W	1.6	—	2.1	3.6	2.1	1.0	6.1	0.3	6.3	3.3	3.3	0.4	3.2	1.8
S W	7.6	1.7	7.4	**11.3**	4.1	7.7	6.1	3.4	9.6	13.1	11.3	3.1	7.0	7.4
W S W	2.2	1.1	3.9	1.8	2.5	3.8	1.6	3.4	4.8	7.9	4.3	4.2	3.0	3.9
W	**23.9**	7.8	9.8	11.3	1.7	5.3	4.9	3.4	3.9	4.9	7.7	10.0	5.1	10.7
W N W	7.6	13.4	11.0	5.4	3.3	2.4	1.6	2.8	1.2	3.0	3.3	13.1	2.8	8.6
N W	17.9	**29.1**	**18.7**	8.3	3.7	1.4	1.6	1.2	1.8	1.0	**14.0**	**24.6**	3.0	**17.6**
N N W	9.2	8.9	12.2	6.5	—	—	—	2.2	—	0.7	7.7	5.4	1.5	7.4
Circulating	4.3	4.5	2.1	2.4	7.0	3.8	5.3	5.9	1.2	6.2	10.0	10.4	4.3	6.3
Variable	6.5	8.9	6.8	10.7	7.4	3.8	4.9	4.9	7.2	7.5	8.7	10.8	6.5	8.2
Calm	1.1	1.1	1.2	1.8	—	1.9	0.4	—	0.6	0.3	1.3	3.1	0.8	1.4

NIGHT.

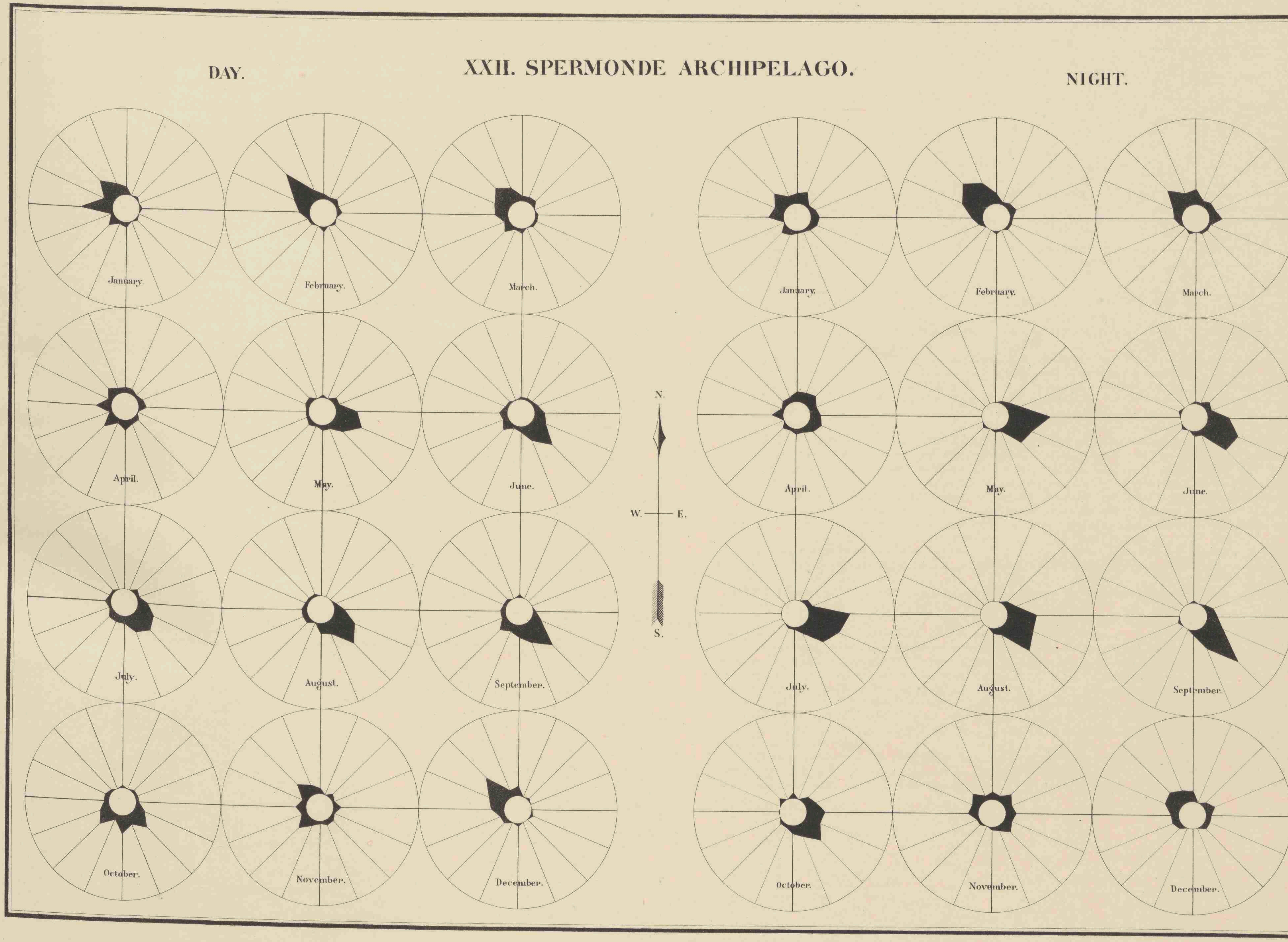
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	7.4	7.0	11.7	8.3	0.9	2.0	0.4	0.7	1.1	4.3	6.5	7.8	2.2	7.5
N N E	9.3	1.9	3.6	7.5	2.8	2.0	—	—	—	0.4	4.8	0.8	2.1	3.5
N E	2.5	3.8	6.9	9.8	4.6	5.9	3.6	3.3	2.1	5.6	**9.5**	3.7	4.9	5.3
E N E	3.7	5.7	6.0	5.3	10.6	4.6	4.4	7.0	6.0	8.5	6.1	7.8	6.3	6.3
E	6.8	1.3	9.3	8.3	**31.0**	15.7	**32.0**	22.7	8.5	14.5	7.4	4.5	19.7	7.3
E S E	6.2	1.3	1.6	**9.8**	20.8	**26.1**	25.8	21.2	14.9	12.4	5.2	3.3	19.8	5.0
S E	3.7	1.9	1.2	8.3	18.5	23.5	20.0	**28.2**	**38.8**	**20.1**	9.1	3.7	**22.9**	6.6
S S E	2.5	—	1.6	3.0	2.8	4.6	5.8	5.9	16.7	9.0	4.8	0.8	6.5	3.1
S	1.2	1.3	—	3.8	1.9	3.9	1.8	3.7	4.6	6.0	1.3	0.8	3.3	1.8
S S W	3.7	—	1.2	2.3	0.9	—	1.3	—	—	1.7	0.9	—	0.8	1.3
S W	5.6	—	0.8	3.0	1.4	2.6	0.4	0.7	0.4	2.6	2.6	3.7	1.4	2.6
W S W	—	3.8	2.8	—	—	0.7	—	—	1.1	0.9	1.7	6.6	0.3	2.6
W	11.1	7.6	6.9	7.5	0.5	0.7	—	—	0.7	0.9	7.8	6.6	1.6	6.8
W N W	8.0	17.1	8.1	2.3	—	2.0	—	—	—	—	5.2	11.1	0.7	8.4
N W	**13.6**	**25.9**	**19.0**	3.8	0.9	—	0.4	—	—	3.4	9.1	**14.0**	0.9	**14.2**
N N W	6.8	17.7	9.7	3.0	—	—	0.9	—	0.4	0.4	3.5	9.5	0.7	7.9
Circulating	3.1	0.6	2.0	3.0	0.5	—	0.9	2.2	0.4	3.4	8.2	6.2	1.2	3.9
Variable	3.1	1.9	6.0	9.8	1.4	3.9	—	2.2	3.2	4.7	4.3	6.6	3.4	4.4
Calm	1.9	1.3	1.6	1.5	0.5	2.0	2.2	2.2	1.1	1.3	2.2	2.5	1.6	1.8

CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	32.5	19.6	4.7	13.6	11.6	7.8	17.9	21.7	17.6	6.5	8.1	21.6	15.0	15.5
High Swell	1.0	3.6	—	—	—	—	0.8	—	—	—	—	—	0.1	0.8
Waves	—	—	—	2.5	—	—	—	2.3	0.6	—	—	—	0.9	—
Sea	20.3	8.1	8.6	4.0	4.7	15.5	21.5	25.6	33.3	8.9	2.0	14.3	17.4	10.4
High Sea	1.3	3.1	4.5	—	—	—	—	—	—	—	1.3	1.2	—	1.9
Calm	45.0	65.8	82.3	79.9	83.7	76.8	59.8	50.6	48.6	84.7	88.7	63.0	66.6	71.6
Number of Observations	89	61	110	53	69	80	117	128	169	112	126	83	616	581

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	25.7	25.7	38.0	53.0	62.3	62.5	62.5	59.4	66.1	55.0	48.8	20.2	61.0	35.6
Overcast	34.7	40.5	34.7	31.2	28.6	26.0	27.0	23.3	25.5	29.5	26.3	33.9	26.9	33.3
Showery	7.2	7.4	5.6	2.4	2.8	2.6	1.2	1.5	0.6	0.3	7.3	8.3	1.9	6.0
Rain	30.6	23.8	17.8	11.0	3.8	5.0	4.8	2.2	0.9	6.8	13.2	36.2	4.6	21.4
Squalls	0.5	1.0	0.8	—	0.3	1.3	—	—	—	—	—	0.7	0.3	0.5
Thunder	0.9	0.5	1.4	0.5	—	0.9	0.4	—	0.6	2.0	2.2	0.7	0.4	1.3
Hazy	0.5	1.3	1.9	2.0	2.2	2.0	4.4	13.7	6.5	6.2	2.3	0.3	5.1	2.1
Mist	—	—	—	—	—	—	—	—	—	0.3	—	—	—	0.1
Number of Observations	222	210	379	211	289	238	270	329	353	340	363	310	1690	1824


DAY.
XXII. SPERMONDE ARCHIPELAGO.
NIGHT.
January.
February.
March.
April.
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October.
November.
December.
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XXIII. STRAIT MAKASSER, SOUTHERN PARTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	27	—34	N 53° W	N W	44 %	1.5	110
February	44	2	N 3° E	N	44	1.6	74
March	25	—22	N 42° W	N W	33	1.4	99
April	4	24	N 81° E	E	25	1.2	58
May	— 4	17	S 78° E	E S E	17	1.3	81
June	—44	10	S 13° E	S S E	45	1.4	76
July	—31	15	S 25° E	S S E	34	1.5	61
August	—34	20	S 31° E	S S E	39	1.5	122
September	—46	14	S 17° E	S S E	48	1.3	119
October	—23	2	S 4° E	S	23	1.2	149
November	— 2	—25	S 86° W	W	25	1.2	82
December	14	—33	N 66° W	W N W	36	1.6	111
Year	— 6	— 1	S 10° W	S	6	1.39	1142

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	37	—31	N 40° W	N W	48 %	1.6	107
February	43	— 5	N 7° W	N	43	1.5	79
March	22	— 8	N 20° W	N N W	23	1.2	104
April	— 3	27	S 83° E	E	28	1.2	38
May	—11	12	S 47° E	S E	16	1.4	76
June	—27	26	S 43° E	S E	38	1.4	81
July	—22	30	S 54° E	S E	37	1.7	53
August	—31	39	S 51° E	S E	50	1.5	101
September	—22	48	S 65° E	E S E	53	1.5	92
October	— 1	31	S 87° E	E	31	1.2	130
November	11	—19	N 61° W	W N W	22	1.2	74
December	14	—44	N 72° W	W N W	45	1.6	90
Year	1	9	N 86° E	E	9	1.41	1025

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	32	—33	N 46° W	N W	46 %	1.6	217
February	43	— 2	N 2° W	N	43	1.6	153
March	23	—15	N 33° W	N N W	28	1.3	203
April	0	26	N 89° E	E	26	1.2	91
May	— 7	14	S 63° E	E S E	16	1.4	157
June	—36	18	S 27° E	S S E	40	1.4	157
July	—26	22	S 40° E	S E	34	1.6	114
August	—32	29	S 42° E	S E	44	1.5	223
September	—34	31	S 42° E	S E	46	1.4	211
October	—12	16	S 53° E	S E	21	1.2	279
November	5	—22	N 79° W	W	23	1.2	156
December	14	—38	N 70° W	W N W	41	1.6	201
April—October	—21	22	S 46° E	S E	30	1.39	1232
November—March	23	—22	N 44° W	N W	32	1.46	930
Year	— 3	4	S 53° E	E S E	5	1.42	2162

In strait *Makasser* the monsoons are much less marked than in the *Java-sea* or even in the *Spermonde Archipelago*: the percentages of steadiness, as exhibited in Table D, clearly show that though the directions of the monsoonwinds are remarkably constant, especially during the E monsoon, winds from all points of the compass may at times be expected during either monsoon.

In April the E monsoon sets in with prevailing N E, E S E and S E winds, but N W and S W winds occur as well and this unsettled weather lasts from May to June, when the wind begins to blow with some regularity from the S E quarter of the compass; S W winds however occasionally are experienced as well: in October N W winds begin to appear, together with E and S E winds; in November the prevailing directions are S W, W, N W and N, and in December the W monsoon may be said to prevail with winds veering from S W to N W; it is not steady enough to be relied on however.

In January the W monsoon is at its height, begins to abate in February, and in March N E and E winds occur as well as winds from the N and N W.

The force of the wind in the strait is, on the average small, smaller than in the *Java-sea* and *Spermonde Archipelago* and about the same as in *Malakka*-strait; in April, October and November the mean force does not exceed the value of 1.2, a minimum when compared with other regions; the greatest value, 1.6, is recorded in the three months of the W monsoon and during the height of the E monsoon.

A force greater than 3 has been recorded only 14 times: 10 at nighthours and 4 at daytime; a force of 5 only once from the W.

The state of the weather is in conformity with these unsettled conditions of the monsoons: taken over the whole year the rainfall is somewhat greater than in the *Spermonde Archipelago*, but the way in which the rain is distributed over the various months is entirely different, the dry and wet monsoons being much less marked.

The probability of rain is far less in the W monsoon and much greater in the E monsoon than near the southern entrance of the strait; the rainy season may be said to last from December to March with, on the average, about 25 rainy days in the 100; in April, May and June this percentage decreases to about 15 % and in July, August and September (the dry months) to about 10 %; in October and November table D shows a steady increase to 17 % and 20 %; in December the rainfall is heaviest.

Showery weather is experienced in all months, but least from June to October; heavy squalls also occur with varying and circulating winds in all months except from August to November; they are mostly accompanied by thunderstorms.

The haziness of the atmosphere is less than in the *Spermonde Archipelago*, but, especially towards the end of the E monsoon, the records show pretty large percentages.

The percentages of cloudiness are about the same during both seasons and the brightness of the sky is less than either in the northern parts of the strait or in the *Spermonde Archipelago*.

The condition of the sea is on the whole favourable and more so in the W monsoon than in the E monsoon: southerly and south-easterly winds not only cause a swell from the south, which occasionally becomes heavy, but also a chopping sea because the general direction of the currents is to the southward.

In this respect however the condition of the sea is much better here than in the *Spermonde Archipelago* or in the *Java-* and *Sunda-seas*; „high sea" has been recorded only once in September.

The marine-currents, running to the S W in the E monsoon and to the S E ward during the W monsoon, are rather strong, the average value of the velocity being about 17 miles per 24 hours: the greatest velocities on record are 56 and 58 miles.

Observations of tides have been made at *Makasser* and at *Kotta-Baroe* on *Pulu Laut* near the south-western entrance of the strait; at the latter place tides are totally different from those at *Makasser*, the principal constituents being semi-diurnal whilst at *Makasser* diurnal tides prevail; for details the reader is referred to the chapter on tides.

TABLE D. STRAIT MAKASSER, SOUTHERN PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**18.5**	**19.7**	**14.9**	3.7	5.5	3.7	9.3	4.7	2.4	4.5	7.5	9.9	4.9	12.5
NNE	3.6	8.5	3.0	7.4	0.9	5.5	—	1.6	1.2	1.0	0.9	2.8	2.8	3.3
NE	1.8	16.2	10.4	6.2	10.0	2.8	4.1	1.6	3.0	3.5	1.9	0.6	4.6	5.7
ENE	1.2	3.4	3.0	4.9	0.9	—	—	1.6	1.2	1.0	—	—	1.4	1.4
E	1.8	2.6	—	2.5	12.7	11.0	9.3	8.2	5.4	7.6	5.6	1.7	8.2	3.2
ESE	1.2	—	—	8.6	1.8	1.8	6.2	10.9	3.0	2.5	0.9	1.1	5.4	1.0
SE	4.2	5.1	2.2	**16.0**	**14.5**	13.8	**18.6**	18.1	9.6	11.1	5.6	1.7	**15.1**	5.0
SSE	1.8	2.6	0.7	—	2.7	6.4	13.4	12.4	4.8	2.5	3.7	—	6.6	1.9
S	3.0	3.4	1.5	7.4	5.5	**23.9**	12.4	11.9	**23.5**	**15.2**	9.3	3.3	14.1	6.0
SSW	2.4	1.7	5.2	2.5	3.6	4.6	6.2	5.2	7.2	7.6	0.9	0.6	4.9	3.1
SW	5.4	5.1	7.5	6.2	3.6	13.8	11.3	11.9	7.8	7.1	13.1	15.5	9.1	9.0
WSW	1.2	—	3.7	9.9	1.8	3.7	—	1.6	1.2	1.5	5.6	12.7	3.0	4.1
W	14.3	4.3	10.4	—	4.5	2.8	2.1	1.6	1.8	6.6	9.3	9.9	2.1	9.1
WNW	14.3	3.4	4.5	—	2.7	—	1.0	0.5	1.2	2.0	—	8.3	0.9	5.4
NW	15.4	11.1	11.2	12.3	7.3	1.8	2.1	2.1	2.4	9.6	**17.8**	**19.3**	4.7	**14.1**
NNW	1.8	9.4	6.0	3.7	0.9	—	2.1	2.1	3.0	1.0	6.5	0.6	2.0	4.2
Circulating	1.2	1.7	3.0	4.9	11.8	2.8	—	1.0	7.8	6.6	1.9	2.8	4.6	2.9
Variable	3.6	—	11.9	1.2	8.2	—	—	1.6	9.0	6.1	2.8	8.8	3.3	5.5
Calm	3.6	1.7	0.7	2.5	0.9	1.8	2.1	1.6	4.2	3.0	6.5	0.6	2.2	2.7

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	14.0	**20.3**	12.5	4.4	11.4	3.3	4.5	2.6	1.4	8.3	7.4	6.8	4.6	11.6
NNE	2.2	6.5	4.7	2.2	1.9	2.5	—	1.3	—	0.6	5.3	2.7	1.3	3.7
NE	3.9	8.9	7.8	**17.8**	6.7	4.1	7.9	9.2	5.8	9.5	3.2	4.7	8.6	6.3
ENE	1.1	4.9	2.3	—	—	5.0	—	2.6	12.2	4.8	1.1	1.4	3.3	2.6
E	1.1	5.7	4.7	8.9	7.6	**15.7**	**21.3**	15.0	**21.6**	**15.5**	8.4	1.4	15.0	6.1
ESE	1.7	—	2.3	13.3	6.7	9.9	11.2	11.8	5.8	3.6	—	—	9.8	1.3
SE	2.2	2.4	3.9	13.3	**14.3**	13.2	18.0	**17.6**	16.5	13.7	4.2	2.7	**15.5**	4.7
SSE	0.6	—	3.9	2.2	4.8	2.5	9.0	5.9	6.5	1.8	—	0.7	5.2	1.2
S	2.2	1.6	1.6	2.2	7.6	9.9	10.1	11.8	8.6	8.3	8.4	5.4	8.4	4.6
SSW	0.6	—	4.7	2.2	1.9	7.4	6.7	1.3	2.2	2.4	—	4.1	3.6	2.0
SW	—	8.1	7.0	11.1	11.4	9.9	6.7	11.8	5.8	1.2	10.5	5.4	9.5	5.4
WSW	3.9	—	2.3	—	1.9	2.5	1.1	—	—	—	2.1	10.1	0.9	3.1
W	6.7	6.5	3.9	2.2	2.9	4.1	1.1	1.3	1.4	2.4	10.5	13.5	2.2	7.3
WNW	16.2	—	1.6	—	—	—	—	—	1.4	—	4.2	12.2	0.2	5.7
NW	**17.3**	15.4	**17.2**	8.9	7.6	0.8	2.2	1.3	0.7	6.5	**16.8**	**18.2**	3.6	**15.2**
NNW	6.7	7.3	5.5	—	1.0	1.7	—	—	0.7	0.6	2.1	3.4	0.6	4.3
Circulating	10.6	3.3	2.3	2.2	7.6	3.3	—	—	2.9	7.7	5.3	1.4	2.7	5.1
Variable	5.6	3.3	7.8	6.7	4.8	—	—	2.6	3.6	4.2	3.2	5.4	2.8	4.9
Calm	3.4	5.7	3.9	2.2	—	4.1	—	3.9	2.9	8.9	7.4	0.7	2.2	5.0

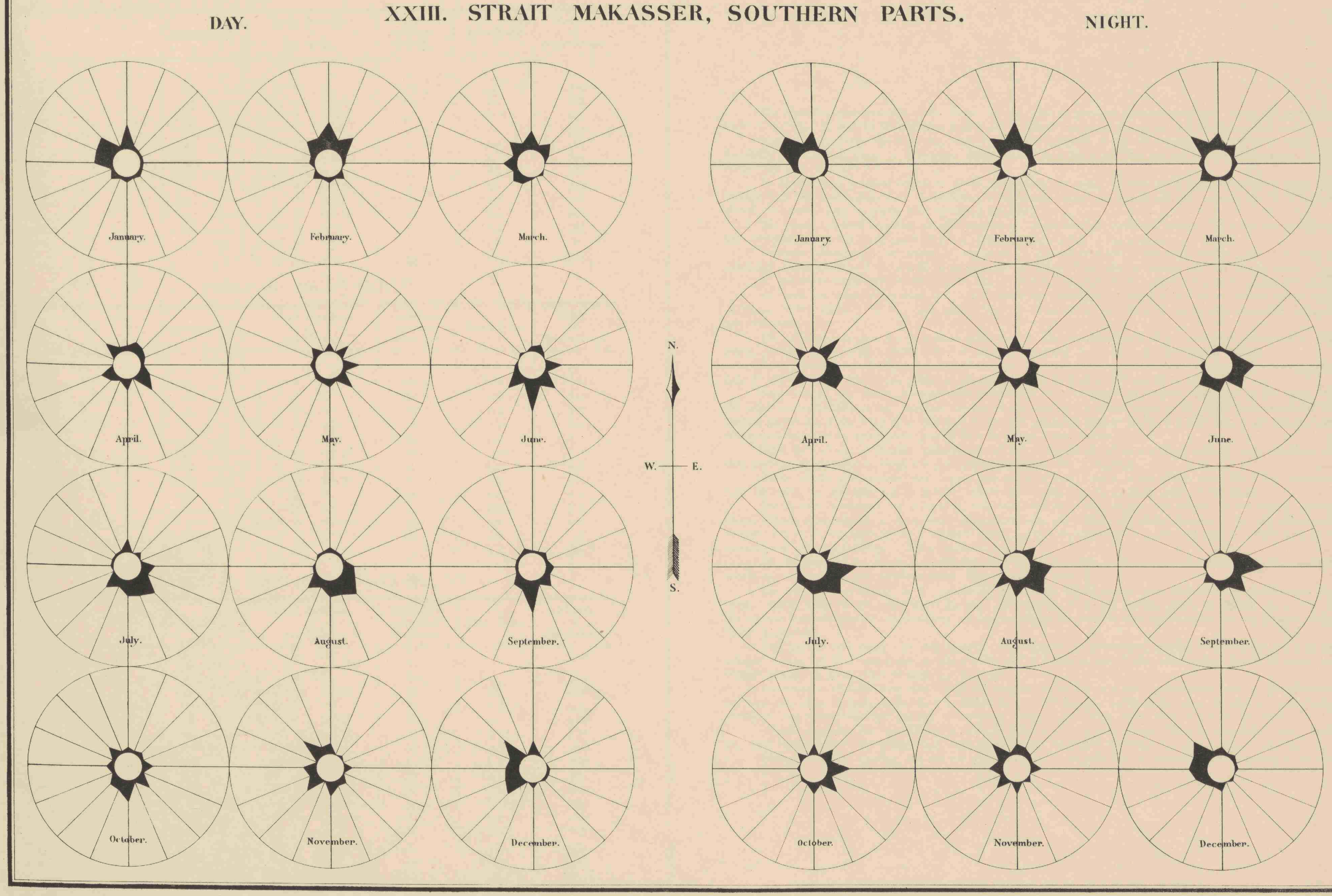
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	19.4	12.9	12.5	13.9	17.8	36.1	31.4	29.2	40.8	21.3	0.8	15.1	28.2	13.7
High Swell	—	—	1.0	—	0.8	—	1.9	—	2.7	—	—	—	0.9	0.2
Waves	—	—	—	1.4	—	5.5	1.9	3.0	—	—	—	—	2.0	—
Sea	7.6	10.8	—	4.2	11.4	9.8	18.7	19.7	11.4	3.5	2.6	12.3	12.5	6.1
High Sea	—	—	—	—	—	—	—	—	0.7	—	—	—	0.1	—
Calm	73.2	76.9	86.5	80.6	70.1	48.8	46.3	48.2	44.6	75.4	96.7	72.7	56.4	80.2
Number of Observations	120	117	103	72	124	111	108	137	126	190	127	99	678	756

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	38.1	43.0	35.9	41.4	42.3	41.1	45.9	51.5	59.2	88.0	51.0	23.0	46.9	38.2
Overcast	37.2	29.5	37.6	35.8	35.0	40.7	35.0	30.8	23.2	37.7	22.8	37.5	33.4	33.7
Showery	4.6	6.6	5.4	3.5	5.5	1.9	2.5	3.4	0.5	2.1	6.0	8.6	2.9	5.6
Rain	19.3	18.3	18.8	12.3	12.9	12.0	8.3	10.1	7.4	14.5	13.6	25.9	10.5	18.4
Squalls	0.5	0.7	1.0	0.9	1.2	0.6	1.7	—	—	—	—	1.9	0.7	0.7
Thunder	—	—	—	1.8	2.5	0.6	—	1.7	2.3	1.4	1.4	2.8	1.5	0.9
Hazy	0.5	2.0	1.0	4.4	0.6	3.2	6.7	2.5	7.6	6.5	4.1	0.5	4.2	2.4
Mist	—	—	0.5	—	—	—	—	—	—	—	1.3	—	—	0.3
Number of Observations	218	152	206	115	163	159	120	237	221	292	153	221	1015	1242

XXIII. STRAIT MAKASSER, SOUTHERN PARTS.



XXIV. STRAIT MAKASSER, NORTHERN PARTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	34	— 5	N 8° W	N	34 %	1.5	143
February	58	33	N 29° E	N N E	67	1.4	167
March	26	7	N 15° E	N N E	27	1.3	221
April	13	11	N 41° E	N E	17	1.2	169
May	—32	— 4	S 7° W	S	32	1.4	182
June	—34	—24	S 35° W	S W	42	1.3	198
July	—31	—27	S 41° W	S W	41	1.4	149
August	—56	—17	S 32° W	S S W	58	1.6	193
September	—28	—27	S 44° W	S W	39	1.6	205
October	—22	—12	S 27° W	S S W	25	1.4	204
November	—13	—18	S 54° W	S W	22	1.2	167
December	1	—11	N 85° W	W	11	1.3	92
Year	— 7	— 8	S 49° W	S W	10	1.38	2090

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	38	4	N 6° E	N	39 %	1.3	126
February	60	8	N 8° E	N	60	1.6	141
March	26	— 1	N 2° W	N	26	1.3	230
April	11	11	N 45° E	N E	16	1.2	144
May	—18	—18	S 44° W	S W	25	1.3	141
June	—43	—10	S 13° W	S S W	44	1.2	176
July	—45	— 4	S 5° W	S	45	1.4	131
August	—45	—14	S 17° W	S S W	47	1.4	154
September	—49	6	S 7° E	S	49	1.4	179
October	—30	— 1	S 1° W	S	30	1.3	185
November	— 7	—18	S 70° W	W S W	19	1.2	144
December	22	—24	N 48° W	N W	33	1.5	80
Year	— 7	— 5	S 36° W	S W	9	1.34	1831

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	36	— 1	N 5° W	N	36 %	1.4	269
February	59	21	N 20° E	N N E	63	1.5	308
March	26	3	N 7° E	N	26	1.3	451
April	12	11	N 43° E	N E	16	1.2	313
May	—25	—11	S 24° W	S S W	27	1.4	323
June	—39	—17	S 24° W	S S W	43	1.3	374
July	—38	—16	S 23° W	S S W	41	1.5	280
August	—51	—16	S 18° W	S S W	53	1.5	347
September	—39	—11	S 16° W	S S W	41	1.5	384
October	—26	— 7	S 15° W	S S W	27	1.4	389
November	—10	—18	S 61° W	W S W	21	1.2	311
December	12	—18	N 56° W	N W	22	1.4	172
May—November	—33	—14	S 23° W	S S W	36	1.40	2408
December—April	29	3	N 6° E	N	29	1.36	1513
Year	— 7	— 7	S 45° W	S W	10	1.38	3921

The prevailing characteristics of the climate in the northern parts of *Makasser*-strait are: a but inconsiderable force of the wind, N and S S W monsoons instead of W and E monsoons, much rain and feebly marked seasons.

The S S W monsoon sets in in May with prevailing S and S W winds, but northerly and westerly winds also frequently occur; from June to September this monsoon is at its height, but the percentages of steadiness never attain very high values.

In October the monsoon begins to abate, N E winds at times are met with, and, at the same time, the average force decreases: this force is minimum in November when the general direction is from the W S W, but N and N E winds begin to appear with increasing frequency.

The same unsettled condition of the weather is experienced in December, when N W winds are prevalent, but, practically, there are equal probabilities of winds from any point of the compass.

Northerly winds begin to prevail in the latter half of January and in February N N E winds blow with a steadiness surpassing that of the S S W monsoon; then the force of the wind is highest with an average value of 1.5.

In March the force decreases to 1.4, the general direction is from the N, but N E and N W winds also occur.

In April the force of the wind, viz. 1.2, is minimum, calms prevail, and the N E monsoonwind, though still prevalent, is too unsteady to be relied upon. Near the coasts these directions of the wind are modified by land- and seabreezes.

The brightness of the sky is greater here than in the southern parts of the strait and, consequently, the degree of cloudiness less; the rainfall is heavier and the rainy and wet seasons are not sharply marked.

From November to March may be called the wet season, with a probability of rainy days of about 25 %, from July to September the dry season, when, at sea, about 15 rainy days in 100 are to be expected.

Near and on the coasts, however, this state of the weather differs considerably from that in the offing: on the whole the probability of rain increases the nearer the track of the vessel keeps to the coasts and generally as we proceed northward in the strait from *Makasser* to the first degree of latitude north, and near and at the *Borneo*-coast the rainfall seems to be considerably greater than along the *Celebes* shores.

Light showers are occasionally experienced, but not often, during all seasons; very seldom heavy squalls occur, their percentage of frequency being less than anywhere else in the Archipelago.

Forces of the wind greater than 3 have been recorded only 4 times in the 3921; when the S S W monsoon is at its height the atmosphere is often hazy, but far less so than in the southern parts of the strait.

The farther northward we proceed in the strait, therefore, the greater the increase of the rainfall, whilst steady rainfall is experienced in all seasons: showers decrease and squalls practically disappear; the sky clears and becomes less hazy, consequently of a brighter blue; thunder becomes less frequent and mist — otherwise a rare phenomenon in the Archipelago — often occurs.

The condition of the sea is, in conformity with this state of the weather, very favourable: Table D does not exhibit any considerable percentages of either „high swell" or „high sea".

The currents are mostly to the southward, but, as the winds are but weak and unsteady and, besides, the steady rainfall tends to keep the water smooth, the condition of the sea remains good; for general smoothness of the sea the northern parts of *Malakka*-strait are comparable to the *Malakka*- and *Banka*-straits and the passages of the *Riouw Archipelago*.

The currents are mostly *not* driftcurrents, but perennial marinecurrents, running to the southward with an average velocity of 15.4 miles per 24 hours in the S S W monsoon and of 20.0 miles during the N monsoon, the highest velocity on record was 56 miles per 24 hours.

Observations of tides have been made at *Donggala* in the bay of *Palos*: semi-diurnal tides are predominant, but still the times of high water do not follow those of the moon's transit in the same manner as at European shores, because the semi-diurnal tide due to the sun's influence is as large as the tide evoked by the moon.

Whilst, generally, the moon's tide is twice as large as the sun's tide, here the latter amounts to more than the value of the former; for details about these peculiar tides the reader is referred to the chapter on this subject.

Rainfall has been observed, but not for a long period, at *Donggala* and at *Bulungan*, near the coast of *Borneo*.

TABLE D. STRAIT MAKASSER, NORTHERN PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**21.9**	19.1	10.1	4.5	4.6	4.0	2.7	1.6	4.3	2.7	7.7	18.4	3.6	13.3
N N E	5.6	9.3	4.0	5.9	1.2	0.7	—	—	—	1.4	2.3	1.6	1.3	4.0
N E	14.9	**24.2**	**17.8**	**21.4**	2.7	4.4	4.9	1.3	2.8	4.1	6.3	14.4	6.3	**13.6**
E N E	1.4	2.1	4.7	5.9	1.3	1.1	0.4	1.3	0.3	0.3	1.4	—	1.7	1.7
E	7.0	7.2	11.1	5.5	8.1	2.6	4.9	3.8	2.8	4.8	1.4	1.6	4.6	5.5
E S E	2.8	0.8	5.1	1.8	0.8	1.5	0.9	0.3	1.9	4.1	1.4	3.2	1.2	2.9
S E	2.8	3.0	0.7	3.6	11.2	5.5	11.9	8.2	4.3	5.8	8.1	0.8	7.5	3.5
S S E	—	—	0.7	1.8	4.2	2.6	0.9	5.6	4.3	4.5	1.4	4.0	3.2	1.8
S	4.7	1.3	3.0	6.8	**14.6**	12.1	13.7	**28.5**	14.8	12.0	11.8	9.6	15.1	7.1
S S W	1.4	—	0.7	1.4	11.2	14.7	6.2	11.3	9.6	5.2	3.2	4.8	9.1	2.6
S W	5.1	4.7	8.1	11.8	12.3	**20.2**	**27.0**	14.1	**24.1**	**14.8**	**17.6**	**18.4**	**18.3**	11.5
W S W	1.4	0.4	1.0	0.5	1.2	2.6	3.1	6.6	6.8	3.4	0.9	1.6	3.5	1.5
W	9.8	3.4	5.4	5.0	7.3	9.2	8.8	6.9	4.9	4.8	11.8	7.2	7.0	7.1
W N W	3.3	0.8	1.7	1.4	1.3	1.8	1.3	1.3	1.5	3.8	1.4	1.6	1.4	2.1
N W	11.2	8.9	8.1	7.3	3.5	5.1	4.4	3.4	6.8	6.9	7.7	4.8	5.1	7.9
N N W	—	6.8	5.4	1.4	1.2	0.7	0.9	0.3	1.9	2.7	1.4	—	1.2	2.7
Circulating	4.7	2.1	2.4	3.2	3.8	4.0	2.7	1.9	5.9	7.9	2.7	0.8	3.6	3.4
Variable	—	1.7	7.7	3.2	5.0	2.6	1.8	1.9	1.9	6.5	2.3	1.6	2.9	3.3
Calm	2.3	4.2	2.4	7.7	4.2	4.4	3.5	1.9	1.2	4.1	9.5	5.6	3.8	4.7

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**25.7**	**32.6**	13.1	6.3	9.7	2.1	2.1	0.9	0.4	1.9	9.3	**13.4**	3.6	**16.0**
N N E	5.7	11.6	2.8	6.8	1.0	0.9	0.5	0.4	0.7	1.1	1.1	10.1	1.7	5.4
N E	16.6	15.6	**17.2**	**13.2**	2.6	5.1	7.4	3.4	3.3	7.5	8.2	10.1	5.9	12.5
E N E	2.3	1.8	3.4	5.8	2.0	1.3	1.6	2.6	1.8	3.0	1.1	—	2.5	1.9
E	5.7	6.3	4.4	11.6	1.5	2.6	2.6	6.0	8.1	4.5	5.5	—	5.4	4.4
E S E	0.6	0.4	1.9	1.1	1.0	3.0	2.1	2.6	2.9	6.0	—	—	2.1	1.5
S E	4.0	1.3	3.1	6.3	10.2	9.8	12.1	5.2	13.9	7.5	2.2	2.5	9.6	3.4
S S E	0.6	0.9	0.9	—	5.6	4.7	5.8	4.3	6.2	3.8	2.7	2.5	4.4	1.9
S	2.9	1.3	2.8	8.9	6.6	12.4	16.3	16.7	**19.0**	10.6	11.5	6.7	13.3	6.0
S S W	2.9	—	1.9	—	5.1	**15.8**	7.4	12.0	13.6	7.9	2.2	1.7	9.0	2.8
S W	4.0	3.6	4.4	8.9	**17.3**	15.0	**24.7**	**18.0**	11.7	**17.0**	**15.3**	7.6	**15.9**	8.7
W S W	1.1	2.7	3.4	2.6	3.6	4.3	0.5	7.3	2.2	3.8	2.7	6.7	3.4	3.4
W	8.6	1.3	5.0	5.3	9.2	6.8	3.7	6.4	1.1	3.4	11.5	12.6	5.4	7.1
W N W	1.7	2.2	1.6	1.1	2.6	0.4	—	—	1.8	1.5	4.4	5.0	1.0	2.7
N W	8.0	9.4	14.4	11.1	6.1	1.7	2.1	3.0	4.4	3.4	4.9	10.9	4.7	8.5
N N W	1.1	4.9	6.3	1.1	0.5	—	0.5	—	—	0.4	1.1	3.4	0.4	2.9
Circulating	2.9	0.9	3.1	3.2	5.1	3.0	2.1	3.0	2.9	5.7	7.1	4.2	3.2	4.0
Variable	2.3	2.7	6.6	1.1	4.1	1.7	1.6	3.9	0.7	4.5	1.1	—	2.2	2.9
Calm	3.4	0.4	3.8	5.8	6.1	9.4	6.8	4.3	5.1	6.4	8.2	2.5	6.3	4.1

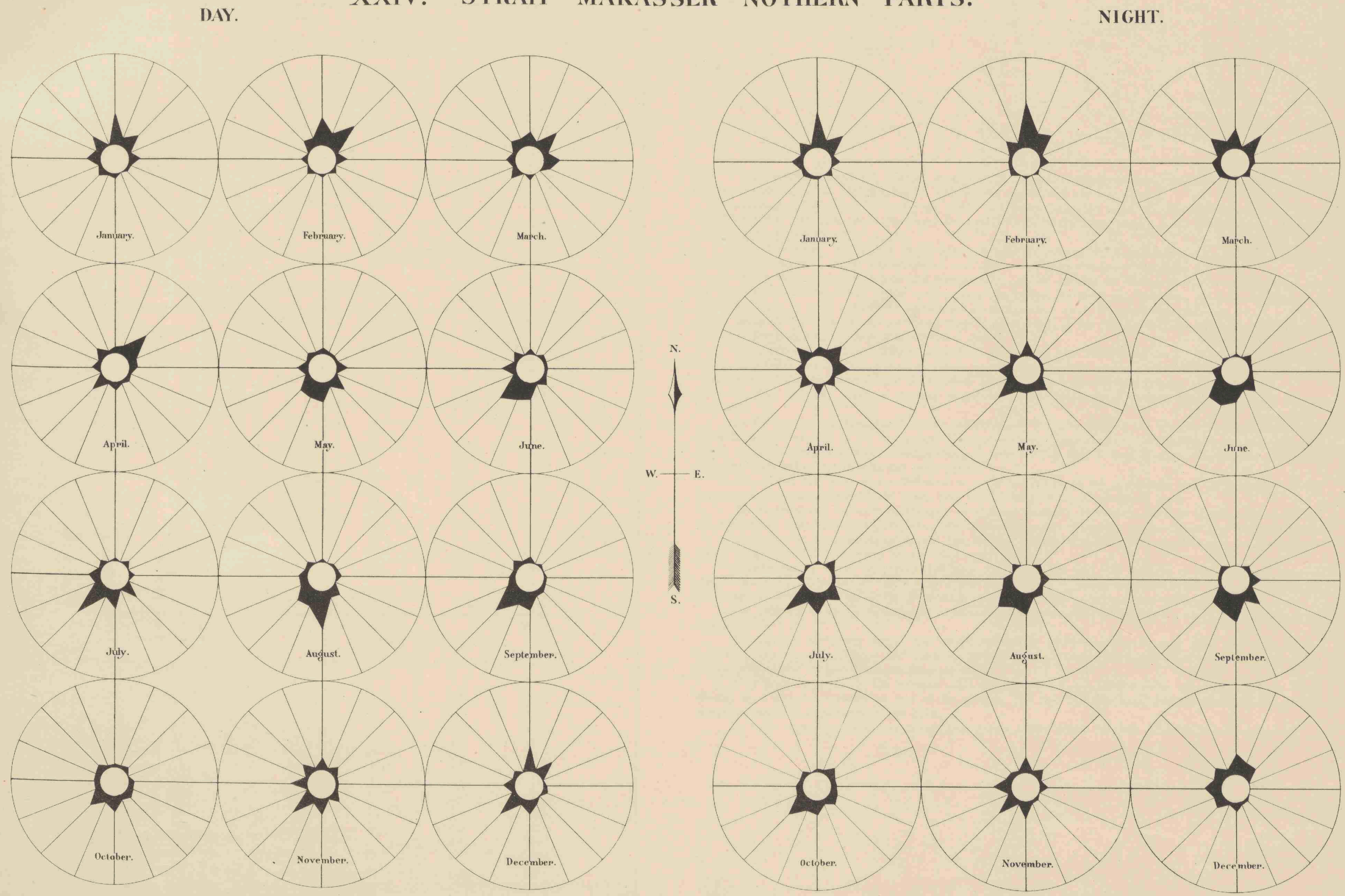
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	11.4	15.7	7.8	4.6	7.6	17.3	9.1	14.7	19.0	8.3	9.2	11.8	12.1	10.7
High Swell	0.4	—	—	—	1.0	—	—	—	0.4	—	—	—	0.2	0.1
Waves	0.4	0.5	—	—	1.3	3.2	0.9	—	3.1	—	—	—	1.4	0.2
Sea	7.1	11.0	8.3	6.8	1.7	8.3	11.2	12.5	8.6	5.7	4.4	4.7	8.2	6.9
High Sea	0.4	0.8	—	—	—	—	—	—	—	—	—	—	—	0.2
Calm	80.4	72.1	84.0	88.7	88.6	71.2	78.9	72.9	69.0	86.1	86.5	83.6	78.2	82.1
Number of Observations	238	262	197	260	237	281	227	243	235	269	262	206	1483	1434

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	46.3	38.0	42.7	55.1	50.1	44.2	51.5	46.8	44.6	44.3	51.0	41.9	48.7	44.0
Overcast	29.1	37.8	33.4	25.7	27.2	34.0	29.4	33.3	33.3	31.3	21.9	31.9	30.5	30.9
Showery	2.9	4.6	3.6	1.6	3.5	1.7	3.3	1.8	4.9	4.3	2.6	4.3	2.8	3.7
Rain	20.7	19.2	16.9	13.6	16.5	18.6	11.9	14.3	11.2	15.2	21.4	20.9	14.4	19.1
Squalls	—	—	0.2	0.7	—	—	0.4	—	0.3	—	—	—	0.2	0.0
Thunder	—	—	0.9	0.4	0.3	0.3	—	1.0	0.3	1.1	0.4	—	0.4	0.4
Hazy	1.2	0.3	1.4	2.0	2.7	1.1	3.6	2.6	5.3	2.9	2.7	0.7	2.9	1.5
Mist	—	0.3	0.9	1.0	—	0.3	—	0.3	0.3	1.1	—	0.6	0.3	0.5
Number of Observations	279	305	443	306	324	367	278	332	386	383	307	171	1993	1888

XXIV. STRAIT MAKASSER NOTHERN PARTS.



XXV. NORTH-EAST COAST OF BORNEO.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	40	1	N 2° E	N	40%	1.4	280
February	20	11	N 29° E	N N E	22	1.3	315
March	29	21	N 35° E	N E	36	1.3	339
April	15	33	N 65° E	E N E	36	1.2	287
May	7	8	N 49° E	N E	11	1.0	224
June	0	7	N 87° E	E	7	1.2	310
July	—30	8	S 14° E	S S E	31	1.3	261
August	—25	19	S 37° E	S E	32	1.2	211
September	—23	—12	S 27° W	S S W	26	1.4	221
October	— 7	— 1	S 10° W	S	7	1.2	201
November	1	3	N 74° E	E N E	3	1.1	310
December	19	0	N	N	19	1.2	269
Year	4	9	N 66° E	E N E	10	1.23	3228

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	45	1	N 2° E	N	45%	1.4	255
February	49	— 4	N 5° W	N	49	1.3	302
March	43	— 3	N 4° W	N	43	1.3	329
April	20	17	N 40° E	N E	26	1.2	267
May	11	4	N 18° E	N N E	11	1.1	210
June	9	—14	N 33° W	N N W	16	1.2	284
July	—24	—15	S 32° W	S S W	28	1.2	245
August	—21	— 7	S 18° W	S S W	22	1.2	194
September	—32	—19	S 32° W	S S W	37	1.4	208
October	— 8	— 8	S 46° W	S W	11	1.2	186
November	6	—18	N 71° W	W N W	19	1.1	284
December	31	—14	N 23° W	N N W	34	1.3	244
Year	11	— 7	N 32° W	N N W	13	1.25	3008

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	43	1	N 18° E	N N E	43%	1.4	535
February	34	3	N 5° E	N	35	1.3	617
March	36	9	N 14° E	N N E	37	1.3	668
April	17	25	N 55° E	N E	30	1.2	554
May	9	6	N 33° E	N N E	11	1.1	434
June	5	— 3	N 33° W	N N W	6	1.2	594
July	—27	— 4	S 8° W	S	27	1.3	506
August	—23	6	S 15° E	S S E	24	1.2	405
September	—28	—16	S 30° W	S S W	32	1.4	429
October	— 7	— 5	S 38° W	S S W	9	1.2	387
November	3	— 7	N 65° W	W N W	8	1.1	594
December	25	— 7	N 15° W	N N W	26	1.3	513
July—October	—21	— 5	S 13° W	S S W	22	1.28	1727
November—June	22	3	N 8° E	N	22	1.24	4509
Year	7	1	N 8° E	N	7	1.25	6236

The characteristics of the weather in this region are: but slightly developed monsoons, very low forces of the wind, and heavy and perennial rainfall without well marked dry and wet seasons.

Contrary to the general rule in the *Indian Archipelago*, northern winds are predominant here, when taken over the whole year and, as is shown by the annual means of the components in table C, the general motion of the air is to the southward.

The S monsoon, which may be considered to take the place of the E monsoon in other regions, lasts three months only viz. July, August and September, and even then the percentages of steadiness are small.

Owing to the influence of land- and seabreezes the general direction at daytime is more to the eastward and at night to the westward but, as the monsoonwind blows along the shore and, moreover, the land- and seabreezes are rather feeble in these regions, the percentages of steadiness are about the same night and day.

In October and November very feeble winds from all points of the compass may be expected as well as calms; the latter are more frequent here than anywhere else.

From December to April northerly components prevail and N E, N N E, N and also N N W winds are experienced.

In January the N monsoon is at its height and the average force attains a maximum value, which, however, does not exceed 1.4; the steadiness of the monsoon in this month is still far from reliable.

In May and June again, no monsoon is perceptible and winds from all quarters and frequent calms may be expected.

In the four months May, June, October and November the mean force of the wind shows a minimum value, lower than anywhere else in the Archipelago: the general mean value too, taken over the whole year, is exceptionally small; in this respect this region is comparable only with the N E and W coast of *Atjeh*; the recorded percentages of „calms" are larger here than in any other region.

For rainfall this part of the *Celebes-sea* is one of the rainiest of the *Archipelago*, but, the probability of rain being about the same throughout the whole year, the rainfall is never extraordinary heavy.

The southern and the northern entrances of *Makasser*-strait are outstanding contrasts in this respect: wet and dry seasons are more marked than anywhere else in the *Spermonde Archipelago*, and least so at the N E coast of *Borneo*.

Light showers occur during all months, but, as they are only occasional, these regions must be considered to belong to the most favoured, heavy squalls being rarely met with.

Thunder seldom occurs and, notwithstanding the vicinity of land, the haziness is but slight and observed almost exclusively in September and October when there is a S S W wind; consequently the sky is bright and the percentage of cloudiness on the whole pretty small; a northerly wind at times causes mists.

The condition of the sea is, as might be expected, very favourable; neither „heavy swell" nor „high sea" are experienced.

The currents are pretty strong and almost exclusively marine-currents, running along the coast to the southward; tho average velocity is 18.8 miles per 24 hours during October—March and 15.8 miles in April—September; the greatest velocity on record was 58 miles per diem.

It is probably owing to the incessant rains that the sea remains pretty smooth, even with southerly winds blowing in a direction contrary to that of the current; the fact that the force of those winds is weak and the steadiness small also contributes to this result.

By order of the Government of *British North-Borneo* a tidal station has been established in *Sandakan-bay.*

TABLE D. NORTH-EAST COAST OF BORNEO.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**20.4**	9.1	**16.8**	7.7	8.5	7.5	1.7	3.0	5.0	9.6	9.3	**14.7**	5.6	**13.3**
N N E	5.3	3.3	3.8	4.1	1.1	1.5	0.9	1.1	1.2	1.6	2.8	5.2	1.7	3.7
N E	15.3	10.7	14.5	**19.1**	**14.0**	10.0	5.5	6.4	2.5	9.6	8.8	14.7	9.6	12.3
E N E	1.0	2.7	4.1	4.1	1.8	2.7	6.4	1.5	3.1	0.4	2.1	0.9	3.3	1.9
E	7.5	10.9	13.6	16.6	11.4	10.7	9.6	9.3	4.7	7.6	**12.4**	5.5	10.4	9.6
E S E	1.8	5.8	5.1	4.4	2.6	2.7	2.9	5.6	3.7	4.0	1.6	1.7	3.7	3.3
S E	6.3	12.0	8.1	11.6	7.4	10.7	13.1	**21.6**	10.9	7.6	9.0	7.8	**12.6**	8.5
S S E	1.0	1.6	0.2	1.1	0.4	3.7	3.8	6.3	2.5	4.4	1.8	0.9	3.0	1.7
S	1.8	1.8	0.6	5.8	7.0	5.7	**17.4**	11.9	10.0	9.6	7.8	4.9	9.6	4.6
S S W	0.5	0.7	0.4	0.8	0.4	2.7	4.1	3.0	5.0	3.2	3.6	4.3	2.7	2.1
S W	5.0	2.0	3.0	1.7	9.6	9.2	12.2	3.7	**19.9**	**10.0**	7.5	7.2	9.4	5.8
W S W	0.3	1.1	0.9	0.3	1.1	0.2	1.2	2.2	0.9	4.4	2.8	1.4	1.0	1.8
W	7.8	9.6	5.8	4.1	6.6	7.0	7.8	7.5	8.1	8.0	10.6	8.6	6.9	8.4
W N W	1.3	1.6	4.7	1.4	0.7	1.7	2.0	—	3.1	0.8	0.8	1.2	1.5	1.7
N W	16.8	**13.6**	7.0	9.9	10.3	**11.2**	4.9	7.8	7.2	8.0	8.0	10.7	8.6	10.7
N N W	4.0	5.8	1.9	0.6	1.1	1.7	0.6	1.5	1.6	1.6	2.3	2.9	1.2	3.1
Circulating	2.0	0.4	2.6	1.1	2.2	1.7	0.9	1.1	2.2	2.4	0.5	3.2	1.5	1.9
Variable	—	1.3	2.3	—	—	1.0	—	—	4.4	1.2	—	—	0.9	0.8
Calm	2.0	6.0	4.5	5.5	13.7	8.0	4.9	6.0	4.0	6.0	8.3	4.3	7.0	5.2

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**24.1**	**17.4**	16.7	7.1	**12.9**	10.1	5.4	1.6	4.1	5.3	10.0	**16.5**	6.9	15.0
N N E	6.7	8.0	6.3	5.3	2.4	2.1	1.8	1.9	0.3	1.2	5.3	6.0	2.3	5.6
N E	16.9	13.8	9.1	**19.4**	12.1	7.4	4.8	3.9	4.1	7.3	5.8	12.0	8.6	10.8
E N E	2.1	3.5	4.8	6.5	4.0	0.3	0.9	—	0.3	1.6	1.4	1.5	2.0	2.5
E	4.6	4.0	8.0	9.1	8.9	5.3	4.5	6.6	4.1	5.7	6.7	3.0	6.6	5.3
E S E	0.3	1.4	2.8	2.4	1.2	0.3	0.9	3.1	1.3	1.2	0.8	1.5	1.5	1.3
S E	3.5	1.4	4.3	5.9	5.2	7.4	7.8	**15.6**	6.9	9.7	2.2	1.8	8.1	3.8
S S E	1.3	—	0.2	0.9	0.8	3.4	1.5	4.3	4.1	4.5	2.5	1.2	2.5	1.6
S	4.0	0.9	0.4	5.0	6.9	7.7	**20.1**	8.9	11.7	10.5	8.9	3.0	10.1	4.6
S S W	0.8	0.2	0.9	1.5	2.0	1.6	0.6	2.7	8.2	2.4	1.4	1.5	2.8	1.2
S W	5.1	2.8	2.8	5.0	12.9	9.5	18.9	12.8	**19.9**	10.9	**13.9**	7.8	**13.2**	7.2
W S W	1.6	1.6	0.9	0.6	—	0.8	1.4	0.4	2.8	0.4	1.4	3.0	1.0	1.5
W	4.6	6.6	6.7	8.5	6.5	8.2	9.6	11.3	10.1	10.5	11.7	8.7	9.0	8.1
W N W	1.1	3.1	5.6	1.5	—	2.5	1.4	1.6	0.6	0.8	2.5	2.7	1.3	2.6
N W	15.0	15.5	**19.9**	7.9	9.3	**17.2**	7.5	12.8	4.1	**13.4**	13.1	15.3	9.8	**15.4**
N N W	3.8	7.3	2.6	1.8	1.6	3.4	1.2	—	1.3	2.4	1.1	3.0	1.6	3.4
Circulating	1.1	2.3	0.9	1.2	2.4	2.5	1.8	2.3	3.2	3.2	—	3.9	2.2	1.9
Variable	0.3	1.9	0.2	2.6	0.4	1.6	0.9	1.2	7.3	—	—	0.9	2.3	0.6
Calm	3.2	8.2	6.9	7.9	10.5	8.5	8.7	8.9	5.7	8.9	11.4	6.6	8.4	7.5

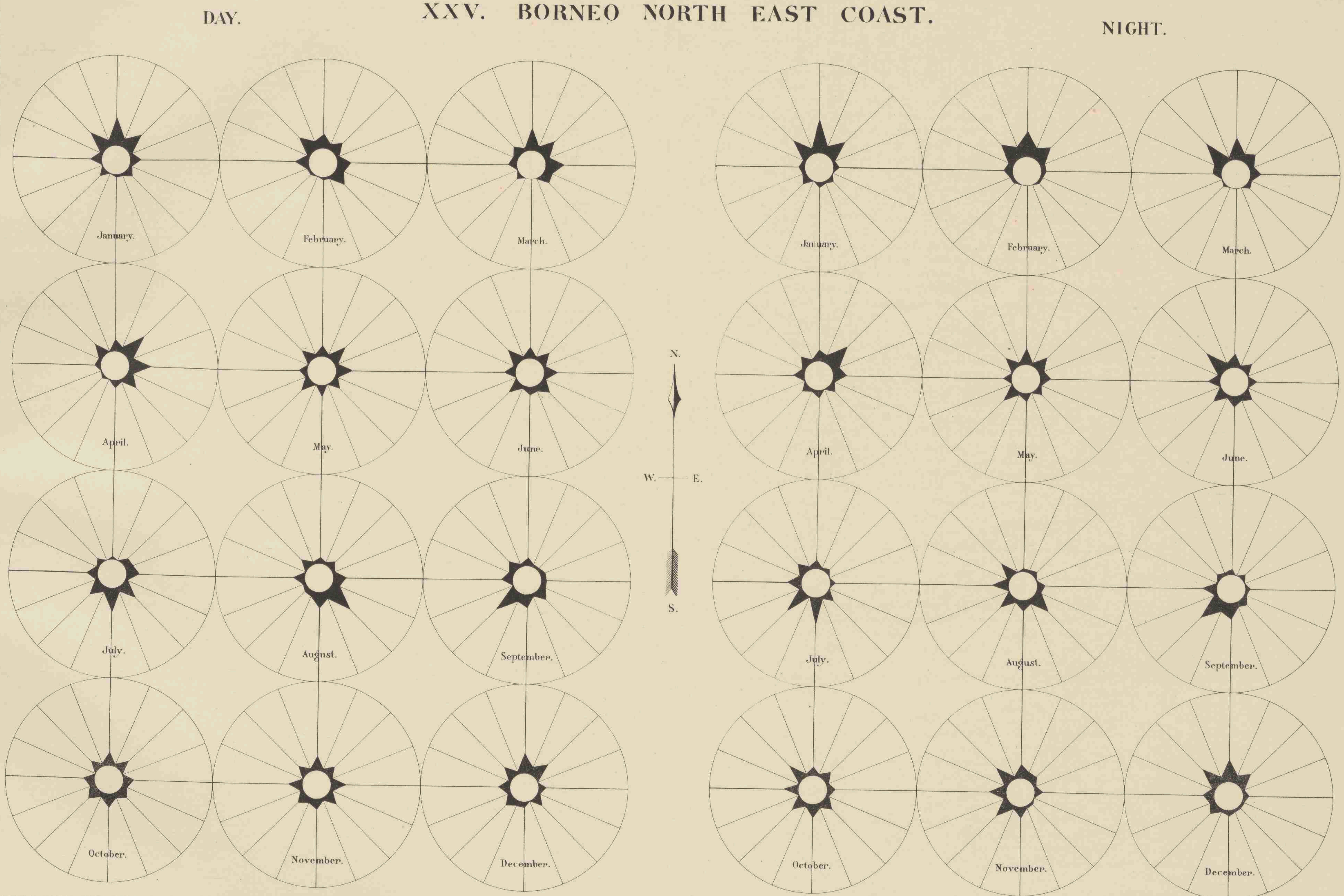
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	21.2	19.2	14.5	15.2	10.5	15.1	15.9	8.6	15.3	4.9	4.4	16.6	13.4	13.5
High Swell	0.2	—	—	—	—	—	0.2	—	—	—	—	0.2	—	0.1
Waves	—	—	—	0.2	0.5	1.7	0.2	0.3	1.0	0.3	—	—	0.7	0.1
Sea	14.1	5.7	6.8	4.8	2.8	5.9	7.7	3.6	9.5	5.4	8.9	8.2	5.7	8.2
High Sea	—	0.2	—	—	—	0.2	—	—	—	—	—	—	—	—
Calm	64.6	75.1	78.9	79.9	86.4	77.3	76.1	87.6	74.2	89.5	86.7	75.1	80.3	78.3
Number of Observations	519	585	639	545	414	547	486	398	306	353	582	505	2696	3181

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	44.1	42.7	47.0	45.1	46.2	48.8	53.5	52.2	43.7	47.7	47.3	48.8	48.3	46.3
Overcast	30.6	34.4	30.8	28.6	32.1	28.5	30.2	24.6	31.7	29.5	28.1	26.2	29.3	29.9
Showery	2.3	2.4	1.8	3.5	2.8	2.9	2.2	4.2	4.3	3.5	4.4	2.9	3.3	2.9
Rain	21.9	18.1	19.0	20.8	18.2	18.6	12.9	17.5	15.3	14.7	17.6	20.0	17.2	18.6
Squalls	—	0.2	0.3	0.2	—	0.5	—	—	—	0.3	0.7	1.0	0.1	0.4
Thunder	0.2	0.5	—	0.2	0.3	0.4	0.8	0.3	0.8	0.6	0.4	0.6	0.5	0.4
Hazy	0.8	1.2	1.2	0.9	0.5	0.2	0.6	1.3	4.3	4.0	1.4	0.4	1.3	1.5
Mist	0.2	0.7	—	0.9	—	0.2	—	—	—	—	0.4	0.2	0.2	0.3
Number of Observations	533	618	662	553	431	591	504	405	421	380	578	514	2905	3285

XXV. BORNEO NORTH EAST COAST.



XXVI. CELEBES-SEA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	41	— 5	N 7° W	N	41 %	1.5	53
February	41	—16	N 21° W	N N W	44	1.5	21
March	42	8	N 10° E	N	43	1.5	79
April	52	18	N 19° E	N N E	55	1.2	86
May	20	—14	N 34° W	N N W	25	1.3	62
June	—32	—18	S 30° W	S S W	37	1.3	60
July	—12	— 6	S 27° W	S S W	14	1.4	157
August	—21	— 7	S 20° W	S S W	22	1.3	175
September	—18	— 2	S 7° W	S	18	1.3	246
October	—10	— 5	S 27° W	S S W	12	1.2	123
November	25	0	N 1° W	N	25	1.5	87
December	28	19	N 34° E	N N E	34	1.2	28
Year	13	— 2	N 9° W	N	13	1.35	1177

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	39	10	N 15° E	N N E	41 %	1.3	51
February	5	47	N 84° E	E	47	1.5	22
March	31	24	N 38° E	N E	40	1.5	73
April	13	33	N 68° E	E N E	35	1.3	78
May	—30	—16	S 28° W	S S W	34	1.2	65
June	—42	14	S 18° E	S S E	44	1.5	50
July	—50	4	S 4° E	S	50	1.4	160
August	—46	16	S 19° E	S S E	49	1.4	159
September	—57	0	S	S	57	1.4	230
October	—46	12	S 15° E	S S E	48	1.2	111
November	7	24	N 75° E	E N E	25	1.4	84
December	20	41	N 64° E	E N E	45	1.3	19
Year	—13	17	S 53° E	S E	21	1.37	1102

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	40	3	N 4° E	N	40 %	1.4	104
February	23	16	N 34° E	N N E	28	1.5	43
March	37	16	N 24° E	N N E	40	1.5	152
April	32	25	N 38° E	N E	41	1.3	164
May	— 5	—15	S 72° W	W S W	16	1.3	127
June	—37	— 2	S 4° W	S	37	1.4	110
July	—31	— 1	S 2° W	S	31	1.4	317
August	—33	5	S 8° E	S	34	1.4	334
September	—38	— 1	S 2° W	S	38	1.4	476
October	—28	4	S 7° E	S	29	1.2	234
November	16	12	N 38° E	N E	20	1.5	171
December	24	30	N 52° E	N E	38	1.3	47
May—October	—29	— 2	S 4° W	S	29	1.35	1598
November—April	29	17	N 30° E	N N E	34	1.42	681
Year	0	8	E	E	8	1.37	2279

In the *Celebes-sea* there rarely enter any westerly components in the direction of the wind, the prevailing directions of the monsoonwinds being from the S from May to October, and from the N N E and N E from November to April.

The S monsoon sets in during the latter half of May and lasts, with a steadiness of about 40 % till September.

Near the *Celebes* coast this monsoon may be depended upon at night, when the landbreeze and the monsoonwind set together, the resulting direction being S S E; at daytime, on the contrary, the monsoonwind is counteracted by the seabreeze and, therefore, the percentages of calms and of varying and circulating winds — always pretty high in these regions — attains rather high values and unsteady winds from all quarters are experienced; the average direction of the wind at this time inclines to the W and S S W.

The force of the wind is low, a force denoted by 4 having been recorded only three times at nighthours and with variable winds, and never at daytime.

In October the steadiness decreases, the force is minimum, and E and N E winds occasionally appear.

In November the N monsoon begins to prevail with winds blowing from the two northern quarters of the compass; for December only a small quantity of observations is available and the same deficiency of data is exhibited by table D for the following six months. Those which have been made seem to point to the conclusion that the N monsoon is at its height from January to April and attains a maximum in February and March and further, that, in this season, near the *Celebes* coast the wind veers to the eastward at night- and to the westward in daytime.

At coast-places the condition of the climate considerably differs from that in the offing, owing to the preponderant influence of land- and seabreezes and to the rainfall caused by the proximity of the mountainrange stretching along the northern neck of land.

Generally the monsoons are the better marked the more eastward we go.

At *Tontoli* f. i. the observations show hardly any difference for the different months: N and N W winds blow here in either season at 9 a. m. and 2 p. m., whilst E winds are almost invariably experienced at 6 p. m.

At *Kema*, situated at the eastern extremity, on the contrary, from June to October, S and S S E winds blow at 9 a. m. and 2 p. m. and S W winds at 6 p. m., whereas from November to May N W winds prevail at 9 a. m. and 2 p. m., and W winds at 6 p. m.; the latter station, therefore, belongs to the *régime* of the *Molucca-sea* rather than to that of the *Celebes-sea*.

Whilst the monsoons are better marked in the eastern parts of the *Celebes-sea* than in the western parts where the proximity of *Borneo* prevents the full development of the monsoons, the same may be said of the seasons.

At *Tontoli*, near the northern entrance of *Makasser*-strait, the rainfall is almost equally distributed over the whole year; here the heaviest rainfall is experienced in June and a second maximum occurs in December; a principal minimum is recorded in April and a secondary in September.

At *Kwandang*, situated about two degrees farther eastward, the driest month is September, a secondary minimum of rainfall being recorded in March and April; the wettest months are from November to February, with a secondary maximum in May.

At *Menado* the seasons are still better marked; here the secondary maxima and minima are hardly perceptible: September is the driest month with an average monthly rainfall of 77 mM., December and January the wettest with an average rainfall amounting to about 500 mM.

Immediately East of the north-easterly point of land the rainfall lessens considerably owing to the shelter afforded by the mountainrange against the moist N and N W winds.

Although the observations of rain made at sea are not very numerous, the percentages in table D confirm the statements on the conditions of the weather at coast-places.

The maxima and minima of rainfall in January and September are evident in this table, which shows a pretty high percentage of light showers, in the *Celebes-sea*, occurring during both seasons. Heavy squalls, accompanied by thunder seldom occur and almost exclusively in the height of the S monsoon: evidently they are due to the sudden coming off of the landbreezes in the early nighthours.

From December to April, and in January especially, a pretty heavy swell sets in from the North; consequently the roads and bays do not afford safe anchorage during these months; when the S monsoon is at its height high and heavy seas are at times experienced.

In the N monsoon the currents are generally weak: in 11 cases out of 24 no current was observable; this is due to the fact that the drift-currents caused by the N winds annihilate for a great part the marine-currents which, running along *Borneo's* E coast flow off partly in *Makasser*-strait and partly to the eastward along the N coast.

During the S monsoon, on the contrary, the drift-currents are very weak and the perennial current along *Borneo's* E coast in the western parts of the sea, and the drift-current to the northward emanating from the *Molucca-sea* cause a gyrating motion in a direction contrary to that of the hands of a watch; this motion causes southerly currents in the western parts, easterly currents, which flow along the coast of *Celebes* in the northern parts of the sea and northerly currents in the eastern regions.

Consequently the average value of the resultant, as shown in the chart, is very small, but the mean value calculated when the different directions are not taken into account is rather large during this season, whilst in the more central parts of the sea currents from every point of the compass are equally probable.

Observations of tides are going on at *Tontoli*, in the Gulf of *Amurang*, at *Taruna* on the isle of *Sangi* and at *Lirong* on the *Talauer Islands*.

Observations of rainfall have been made at *Tontoli*, *Kwandang*, *Menado* and at the more inland stations *Limbotto*, *Kele Londej* and *Massarang*; of wind at *Tontoli*.

TABLE D. CELEBES-SEA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**16.3**	9.7	**17.5**	**27.9**	**15.7**	3.5	3.6	6.0	3.9	4.9	7.6	11.4	10.1	11.2
N N E	12.5	12.9	1.6	5.4	—	—	1.4	0.8	2.7	0.6	**12.1**	8.6	1.7	8.1
N E	8.8	9.7	16.7	26.1	7.2	2.4	6.3	4.0	4.2	8.6	9.1	17.1	8.5	**11.7**
E N E	1.3	**16.1**	9.5	3.6	—	—	0.9	1.2	3.0	3.1	7.6	—	1.5	6.3
E	3.8	—	7.9	6.3	8.4	4.7	6.8	4.8	5.4	6.8	1.5	8.6	6.1	4.8
E S E	1.3	—	0.8	—	—	—	2.3	1.6	3.9	1.2	3.0	—	1.3	1.1
S E	1.3	3.2	2.4	0.9	6.0	7.1	6.8	10.5	9.6	4.9	3.0	11.4	6.8	4.4
S S E	3.8	—	0.8	—	1.2	3.5	3.2	6.5	2.4	6.2	—	—	2.8	1.8
S	1.3	3.2	0.8	1.8	8.4	15.3	**12.2**	**14.5**	9.3	8.0	—	—	**10.3**	2.2
S S W	—	—	—	3.6	—	3.5	3.6	3.6	4.5	4.9	4.5	—	3.1	1.6
S W	2.5	3.2	4.0	2.7	3.6	**17.6**	6.3	6.5	**13.8**	**12.3**	5.3	5.7	8.4	5.5
W S W	—	—	2.4	0.9	2.4	2.4	4.5	5.6	4.2	1.9	1.5	—	3.3	1.0
W	10.0	6.5	6.3	1.8	9.6	12.9	8.1	5.6	5.1	6.2	7.6	**20.0**	7.2	9.4
W N W	3.8	6.5	4.8	0.9	6.0	—	3.2	7.3	1.2	5.6	3.8	—	3.1	4.1
N W	10.0	16.1	6.3	7.2	14.5	3.5	6.8	6.0	3.6	6.8	9.8	8.6	6.9	9.6
N N W	6.3	—	9.5	1.8	4.8	—	2.7	0.8	3.9	1.2	—	2.9	2.3	3.3
Circulating	11.3	9.7	4.8	0.9	8.4	9.4	9.5	0.8	3.3	5.6	9.8	—	5.4	6.9
Variable	6.3	3.2	—	3.6	—	7.1	9.0	8.5	12.9	4.9	12.1	—	6.9	4.4
Calm	—	—	4.0	4.5	3.6	7.1	3.2	5.2	3.3	6.2	1.5	5.7	4.5	2.9

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	11.8	9.1	13.8	12.5	6.1	1.4	—	1.7	0.6	3.5	9.4	11.5	3.7	9.9
N N E	4.4	6.1	1.8	2.9	—	—	0.4	0.4	—	—	12.0	—	0.6	4.1
N E	**19.1**	**18.2**	**17.4**	**23.1**	4.9	5.5	2.1	4.5	2.1	7.0	**13.7**	19.2	7.0	**15.8**
E N E	11.8	6.1	8.3	1.9	—	—	0.4	0.8	0.9	1.4	8.5	—	0.7	6.0
E	5.9	15.2	15.6	7.7	9.8	11.0	8.5	2.1	5.4	9.2	6.0	**26.9**	7.4	13.1
E S E	—	6.1	—	8.7	1.2	2.7	1.3	5.8	5.1	2.1	0.9	7.7	4.1	2.8
S E	2.9	3.0	4.6	11.5	8.5	15.1	14.0	17.4	14.7	7.7	—	—	**13.5**	3.0
S S E	—	—	—	—	2.4	6.8	8.9	14.0	10.8	12.7	2.6	—	7.2	2.6
S	—	—	2.8	8.7	8.5	**23.3**	**17.8**	**17.4**	**17.4**	**17.6**	4.3	3.8	5.5	4.8
S S W	—	—	1.8	1.9	—	2.7	7.6	4.1	7.5	7.0	8.5	—	4.0	2.9
S W	1.5	9.1	0.9	1.9	**19.5**	11.0	13.6	5.4	17.4	10.6	6.8	—	11.5	4.8
W S W	—	—	—	2.9	6.1	—	1.7	3.3	7.2	7.7	3.4	—	3.5	1.9
W	13.2	—	5.5	—	12.2	4.1	6.4	2.5	3.9	0.7	4.3	—	4.9	4.0
W N W	4.4	3.0	0.9	—	4.9	—	—	1.2	0.6	—	8.5	—	1.1	2.8
N W	5.9	3.0	9.2	7.7	1.2	5.5	1.3	0.8	0.6	3.5	3.4	23.1	2.9	8.0
N N W	2.9	12.1	1.8	—	1.2	—	—	0.8	1.2	0.7	—	—	0.5	2.9
Circulating	8.8	—	7.3	4.8	7.3	2.7	5.1	5.8	1.8	0.7	2.6	—	4.6	3.2
Variable	7.4	9.1	5.5	1.9	1.2	6.8	8.9	3.3	1.2	3.5	4.3	—	3.9	5.0
Calm	—	—	2.8	1.9	4.9	1.4	2.1	8.7	1.8	4.2	0.9	7.7	3.5	2.6

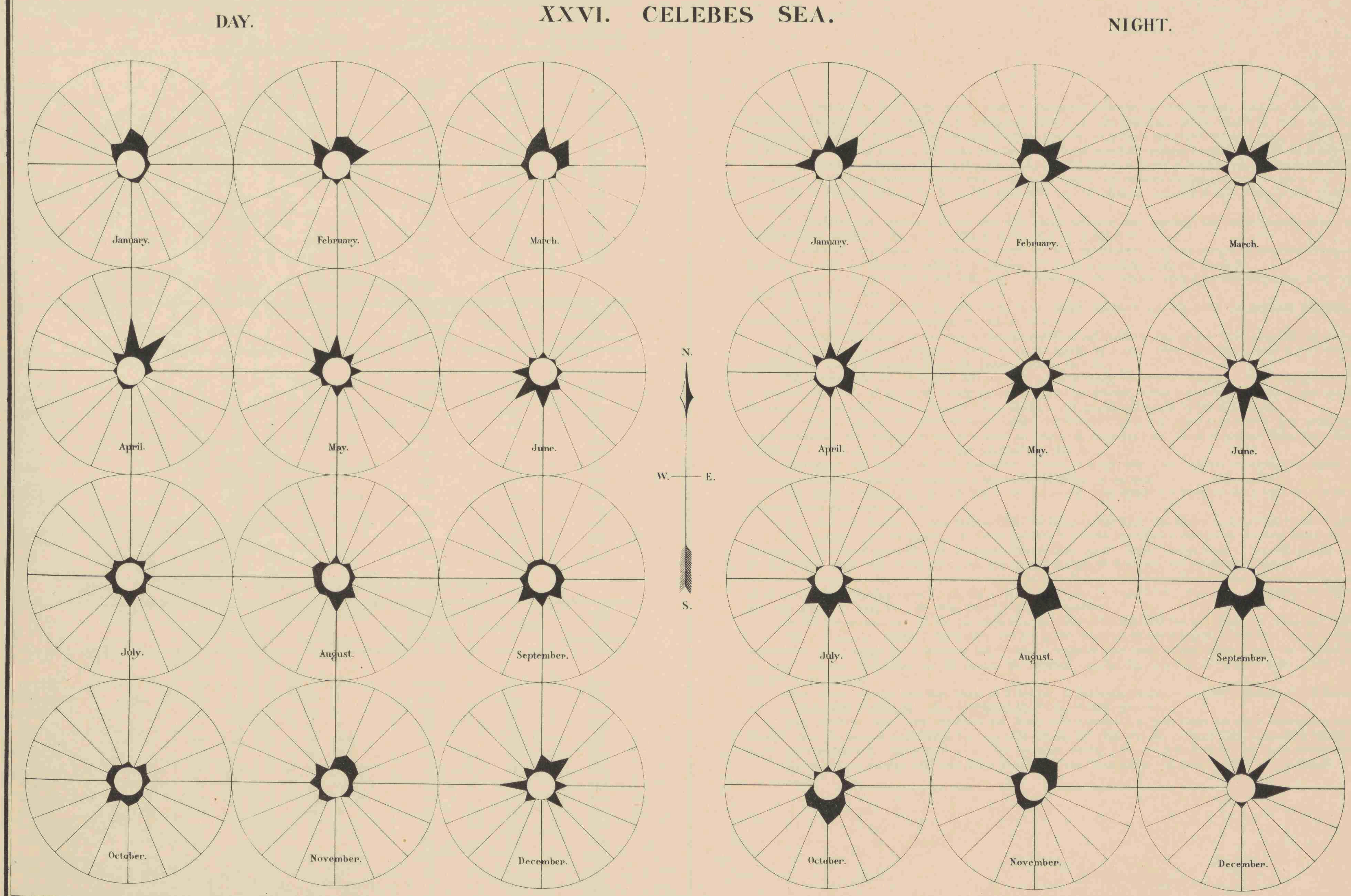
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	46.6	26.2	22.5	20.3	5.1	16.2	4.0	9.4	10.0	2.0	4.5	22.0	10.8	20.6
High Swell	—	—	1.2	—	—	—	—	0.6	—	—	—	—	0.1	0.2
Waves	4.4	—	1.2	—	—	5.8	—	1.2	1.5	—	—	—	1.4	0.9
Sea	6.6	8.7	2.5	4.8	2.1	7.8	4.7	10.7	12.7	5.2	4.8	4.5	7.1	5.4
High Sea	—	—	—	—	—	—	—	—	—	48.5	—	—	—	8.1
Calm	42.4	65.2	72.7	75.0	92.9	70.2	91.4	78.1	75.9	44.3	90.8	73.6	80.6	64.8
Number of Observations	45	23	85	122	98	64	151	149	194	146	140	47	778	486

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	33.7	40.5	37.0	51.9	63.1	44.2	46.7	57.7	51.6	56.9	56.8	55.6	52.5	46.8
Overcast	23.7	42.9	40.0	21.6	17.3	33.5	34.4	25.0	34.9	26.0	24.6	29.3	27.8	31.1
Showery	12.9	—	4.7	3.8	3.2	4.0	5.4	2.8	2.8	5.9	2.4	—	3.7	4.3
Rain	28.7	16.7	15.8	20.5	15.7	12.6	10.1	11.6	8.4	8.7	12.3	15.2	13.2	16.2
Squalls	—	—	—	0.6	—	—	0.3	0.3	0.2	—	—	—	0.2	—
Thunder	—	—	—	—	—	2.1	0.3	0.3	0.2	1.8	—	—	0.5	0.3
Hazy	1.0	—	2.6	1.8	0.8	3.8	2.9	2.4	1.9	0.8	4.1	—	2.3	1.4
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	101	42	152	163	127	107	317	333	475	234	171	44	1522	744

XXVI. CELEBES SEA.



XXVII. PACIFIC OCEAN.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	50	— 3	N 3° W	N	50 %	1.5	214
February	56	— 8	N 8° W	N	57	1.5	243
March	65	7	N 6° E	N	65	1.6	291
April	43	3	N 4° E	N	43	1.4	212
May	—22	—22	S 45° W	S W	31	1.4	202
June	—54	1	S	S	54	1.5	188
July	—56	—23	S 22° W	S S W	61	1.6	301
August	—75	—11	S 8° W	S	76	1.8	250
September	—62	—23	S 21° W	S S W	66	1.6	319
October	—46	—15	S 18° W	S S W	48	1.4	139
November	— 2	—32	S 86° W	W	32	1.4	156
December	47	— 4	N 4° W	N	47	1.5	197
Year	— 5	—11	S 66° W	W S W	12	1.52	2712

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	60	7	N 7° E	N	60 %	1.5	202
February	67	7	N 5° E	N	67	1.6	229
March	68	13	N 11° E	N	69	1.6	269
April	43	5	N 7° E	N	43	1.3	198
May	—14	—17	S 51° W	S W	22	1.4	185
June	—46	1	S	S	46	1.5	178
July	—58	—19	S 18° W	S S W	61	1.6	309
August	—65	—10	S 8° W	S	66	1.7	237
September	—66	—21	S 18° W	S S W	69	1.6	289
October	—35	0	S	S	35	1.1	111
November	61	—24	N 77° W	W N W	66	1.3	153
December	61	4	N 4° E	N	61	1.5	191
Year	7	— 5	N 36° W	N W	9	1.48	2551

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	55	2	N 2° E	N	55 %	1.5	416
February	62	— 1	N 1° W	N	62	1.6	472
March	67	10	N 9° E	N	68	1.6	560
April	43	4	N 5° E	N	43	1.4	410
May	—18	—20	S 48° W	S W	27	1.4	387
June	—50	1	S 1° E	S	50	1.5	366
July	—57	—21	S 20° W	S S W	61	1.6	610
August	—70	—11	S 8° W	S	71	1.8	487
September	—64	—22	S 19° W	S S W	68	1.6	608
October	—41	— 8	S 11° W	S	42	1.3	250
November	30	—28	N 43° W	N W	41	1.4	309
December	54	0	N	N	54	1.5	388
May—October	—50	—14	S 16° W	S S W	52	1.53	2708
November—April	52	— 2	N 2° W	N	52	1.50	2555
Year	1	— 8	N 83° W	W	8	1.52	5263

The observations have been mostly made in the region between the north-easterly point of *Celebes* and the *Halmaheira* islands; it may, therefore, be questioned whether the denomination „*Pacific Ocean*" be well chosen from a geographical point of view; it was thought advisable however to make a distinction between these northern parts of the *Molucca-sea*, lying open to the ocean and the southern parts enclosed between the isles of the eastern Archipelago.

The monsoons in these parts are strongly marked: as is shown by table C northerly and southerly components predominate, westerly components appear from July to November, but easterly components hardly ever occur.

The N monsoon sets in in November when S W and W winds prevail, but N and at times N E winds are also met with.

In December the steadiness of the northerly winds increases and westerly and south-westerly winds have ceased to blow altogether, the wind veering from the N N W to the N E.

In February and March the monsoon comes to full development with percentages of steadiness amounting to 68 %; in April the monsoon begins to abate, but still bears a decidedly northerly character.

In May winds from the S and S W begin to blow, but the monsoon cannot be depended upon, N W winds being experienced as well.

In June the S or S S W monsoon blows with reliable steadiness and this steadiness gradually increases till August when table C shows percentages as high as 71 %.

In October the monsoon diminishes in force and steadiness and northerly winds appear with appreciable percentages.

The force of the wind, generally pretty strong, is highest in August, when an average value of 1.8 has been calculated and lowest in October when this value decreases to 1.3.

The S S W monsoon, therefore, may be said to be stronger as well as steadier in these regions than the N monsoon; the force of the wind, though pretty strong on the average, never attains high values; a force of 5 or 6 has never been recorded and of 4 only 23 times in 5263, and almost exclusively in the S monsoon.

Notwithstanding the steadiness of the monsoons, variable and circulating winds appear with large percentages, and consequently the weather is not so settled as might be expected from the well marked directions. This is confirmed by the percentages of rainy days exhibited in table D.

Throughout the whole year the probability of rain is pretty great; two maxima of rainfall are found: the principal maximum in June and July and a secondary maximum in January.

The seasons consequently do not follow the monsoons; the steady S S W winds bring rain as well as the northern winds and even more so.

September and October are the driest months, but February and March also show a secondary minimum of rainfall.

The rainfall is not so steady as f. i. near *Borneo's* N E coast and often comes off in showers, which may be expected in all parts of the year with circulating and variable winds: heavy squalls however are seldom met with; the sky is less bright than in the *Celebes-sea* and the percentages of cloudiness are considerably higher.

The condition of the sea is, on the whole, not favourable; whenever northerly winds blow, a pretty heavy swell, comparable with that observed at *Atjeh's* E and N E coast, is experienced; from May to October the swell is less, but „sea" and „high sea" are often recorded in those months.

In May, September and October the conditions are most favourable and the percentages of „calm sea" highest.

The currents are mostly drift-currents, running in the direction of the prevailing winds and, on the average, somewhat stronger during the N monsoon than in the S monsoon; the mean values, deduced from the available data are resp. 19.3 and 16.3 miles per 24 hours; the greatest velocities on record are 57 and 48 miles to the N N E and E N E respectively.

Observations of tides have been made at *Kema* and at *Gamsungi*, situated at the most eastern point of *Halmaheira Isle*, and other tidal stations have been established at *Galela*, *Ternate* and *Batjan*.

Tidal constants have been calculated for *Kema* and *Gamsungi*; at both places the sun's semi-diurnal tide is stronger than the moon's semi-diurnal tide and consequently the tidal streams in these regions generally always set in the same direction at a given hour of the day and their turning-points do not follow the time of the moon's transit.

Observations of rainfall have been made at *Kema*, *Ternate* and *Batjan*; of wind at *Kema* and *Gamsungi*.

TABLE D. PACIFIC OCEAN.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**24.1**	**18.9**	**22.8**	**23.1**	4.1	0.7	0.6	0.2	1.5	3.1	10.1	**23.4**	5.0	**17.1**
NNE	10.1	9.7	14.0	4.5	2.4	1.6	—	—	0.2	—	0.9	8.9	1.4	7.3
NE	5.8	11.1	20.3	22.7	3.1	1.7	1.5	0.9	0.2	4.1	5.7	7.6	5.0	9.1
ENE	2.7	2.9	2.5	1.3	1.4	1.0	—	—	0.4	—	—	3.9	0.7	2.0
E	4.0	1.1	2.5	5.5	5.4	1.7	2.5	0.2	1.0	5.6	4.8	4.9	2.7	3.8
ESE	1.5	0.5	0.2	0.3	0.3	1.4	0.4	1.3	1.3	1.0	0.4	—	0.8	0.6
SE	1.5	0.8	0.6	0.3	4.1	11.3	8.4	8.5	5.7	8.2	1.8	1.3	6.4	2.4
SSE	0.6	1.1	—	—	3.1	15.1	2.9	10.9	6.1	3.1	1.3	1.0	6.4	1.2
S	—	1.6	0.6	3.9	10.8	**16.1**	18.9	**31.7**	17.7	**23.6**	3.5	1.6	**16.5**	5.2
SSW	—	—	—	0.6	12.5	13.4	16.8	18.4	**25.0**	6.2	7.5	1.3	14.5	2.5
SW	1.2	2.6	0.8	5.2	**16.9**	10.6	**21.1**	16.5	18.9	22.6	**17.6**	5.9	14.4	8.5
WSW	0.6	—	0.4	1.3	4.4	3.1	6.4	2.5	4.4	2.1	7.0	0.7	3.7	1.8
W	5.5	3.2	4.1	8.8	5.4	2.1	4.3	1.3	4.4	8.7	9.3	2.0	4.4	5.5
WNW	3.4	3.4	3.5	1.9	3.4	0.3	0.8	0.2	—	—	5.7	1.0	1.1	2.8
NW	9.8	16.1	8.6	7.8	8.5	0.7	2.3	1.1	1.5	4.1	8.8	15.8	3.7	10.5
NNW	7.6	13.4	10.3	2.3	3.1	1.0	0.8	0.2	—	—	2.6	7.2	1.2	6.9
Circulating	4.0	1.6	1.4	3.2	4.7	7.5	5.7	2.0	3.8	4.1	4.4	5.3	4.5	3.5
Variable	16.5	10.5	5.3	5.5	4.4	9.9	5.7	3.3	6.3	0.5	7.0	5.6	5.9	7.6
Calm	1.2	1.6	2.1	1.6	2.0	1.4	0.8	0.7	1.5	3.1	1.3	2.6	1.3	2.0

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**28.4**	**28.8**	**30.4**	**21.5**	3.8	0.4	—	0.7	0.7	6.6	6.4	**27.6**	4.5	**21.4**
NNE	12.3	14.4	18.4	8.7	—	1.1	0.2	0.2	0.2	1.5	4.5	15.5	1.7	11.1
NE	11.0	14.9	21.5	17.1	4.5	2.6	1.0	1.2	0.4	5.1	6.9	11.9	4.5	11.9
ENE	3.2	4.6	0.2	0.4	0.4	1.5	1.0	0.2	0.4	—	1.5	2.7	0.7	2.0
E	2.2	1.6	3.4	9.5	7.5	3.7	1.4	0.7	1.1	6.6	4.5	2.7	4.0	3.5
ESE	0.6	0.3	0.5	1.1	1.9	3.3	3.3	1.5	0.7	0.7	0.5	0.7	2.0	0.6
SE	3.5	0.5	—	1.8	5.7	9.5	9.0	9.8	5.2	9.6	1.5	0.3	6.8	2.6
SSE	—	0.3	—	1.1	3.0	12.1	7.3	9.1	7.0	4.4	1.0	0.3	6.6	1.0
S	—	0.8	1.4	0.7	10.2	**16.8**	14.5	**26.0**	22.0	**21.3**	4.0	1.0	**15.0**	4.8
SSW	—	0.8	—	2.2	**15.1**	9.1	15.9	20.6	**24.4**	7.4	4.0	2.0	14.6	2.4
SW	1.3	1.6	1.4	5.5	14.3	8.8	**23.1**	12.3	17.9	10.3	10.9	2.0	13.7	4.6
WSW	—	0.3	0.5	1.8	5.7	5.1	5.7	0.5	4.1	1.5	5.0	—	3.8	1.2
W	1.6	1.6	2.9	5.5	5.7	2.9	4.9	3.7	3.1	7.4	**12.9**	4.1	4.3	5.2
WNW	2.2	1.6	3.6	4.0	1.5	1.8	0.8	1.2	0.4	0.7	5.9	1.0	1.6	2.5
NW	8.2	10.6	6.3	8.0	8.3	2.2	1.8	1.5	—	—	8.4	7.8	3.6	6.9
NNW	9.1	9.8	3.4	4.4	2.6	—	0.4	0.2	1.1	—	1.5	9.6	1.5	5.6
Circulating	2.5	0.8	1.6	—	5.7	8.4	3.3	3.2	3.7	1.5	11.9	3.4	4.1	3.6
Variable	12.3	4.6	2.3	2.2	3.0	8.8	5.9	6.6	6.5	1.5	5.4	5.5	5.5	5.3
Calm	1.6	1.9	2.3	4.7	1.1	1.8	0.4	0.7	1.1	14.0	3.5	1.7	1.6	4.2

CONDITION OF THE SEA, PERCENTAGE.

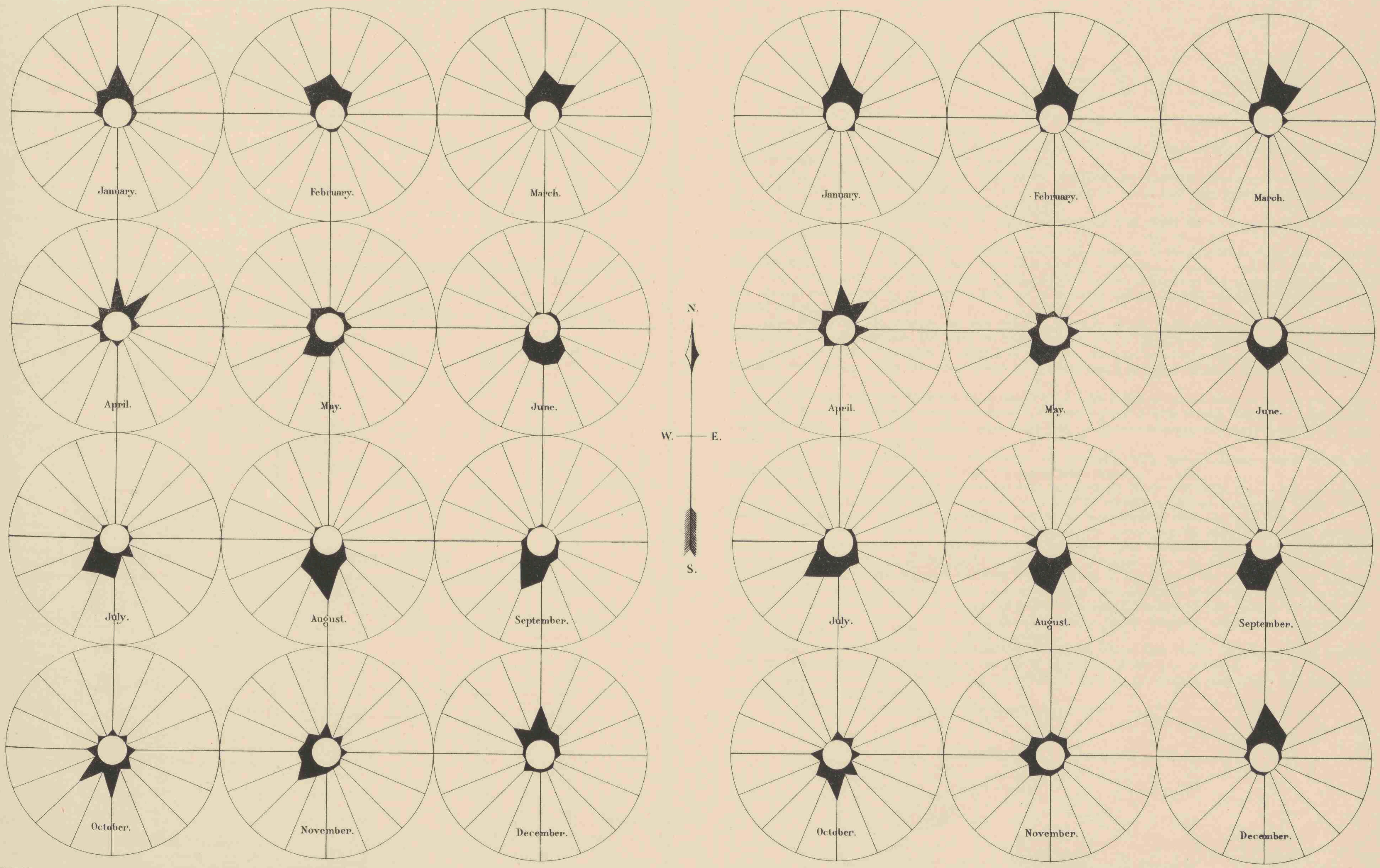
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	46.6	34.9	31.2	26.8	9.1	21.4	11.3	14.1	9.9	11.7	39.1	48.6	15.4	35.4
High Swell	1.4	0.5	0.3	—	—	—	—	—	—	—	0.7	1.3	—	0.7
Waves	1.8	2.6	0.6	1.7	—	—	—	0.5	—	0.5	2.6	3.8	0.4	2.0
Sea	10.6	24.0	18.8	8.1	6.3	9.2	17.3	30.9	20.9	8.4	1.3	6.5	15.5	11.6
High Sea	—	0.5	2.3	0.4	1.6	—	1.8	—	—	—	—	0.7	0.6	0.6
Calm	39.8	37.6	46.8	63.1	83.0	69.4	69.7	54.6	69.3	79.5	56.4	39.3	68.2	49.9
Number of Observations	217	198	302	293	128	108	178	196	263	180	151	156	1166	1204

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	44.9	46.6	48.9	50.5	37.4	34.4	32.7	36.8	46.0	53.5	42.5	48.3	39.6	47.5
Overcast	27.7	31.1	31.1	22.9	36.3	29.7	32.5	43.4	35.8	29.3	29.5	28.5	33.4	29.5
Showery	5.2	6.5	6.0	3.7	4.7	6.1	9.4	4.0	3.0	0.8	6.6	5.6	5.2	5.1
Rain	20.3	14.6	11.3	21.1	19.0	28.1	22.6	14.4	10.5	11.2	17.4	16.4	19.3	15.2
Squalls	0.3	—	—	0.3	0.3	0.6	0.7	—	—	—	0.3	—	0.3	0.1
Thunder	0.3	—	0.2	0.5	0.5	0.3	1.2	—	0.6	0.4	0.7	0.6	0.5	0.4
Hazy	1.5	1.3	2.5	1.2	1.8	1.1	1.2	1.5	4.1	4.8	3.3	0.8	1.8	2.4
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	409	466	559	411	384	378	607	482	612	247	306	379	2874	2366

XXVII. PACIFIC OCEAN.

DAY. NIGHT.



XXVIII. GULF OF TOMINI.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	45	— 6	N 8° W	N	45 %	1.6	18
February	28	—26	N 43° W	N W	38	1.3	69
March	39	3	N 4° E	N	39	1.3	103
April	8	14	N 60° E	E N E	16	1.3	96
May	—26	— 3	S 7° W	S	26	1.3	53
June	—25	7	S 14° E	S S E	26	1.5	78
July	—40	10	S 14° E	S S E	41	1.6	34
August	—10	— 8	S 8° W	S	13	1.6	104
September	—17	1	S 3° W	S	17	1.5	75
October	—40	3	S 4° E	S	40	1.4	40
November	—14	2	S 29° E	S S E	14	1.5	63
December	23	—18	N 38° W	N W	29	1.4	39
Year	— 2	— 1	S 27° W	S S W	2	1.44	772

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	50	—19	N 21° W	N N W	53 %	1.4	14
February	29	—19	N 34° W	N N W	35	1.3	67
March	54	2	N 2° E	N	54	1.3	93
April	32	22	N 35° E	N W	39	1.2	99
May	6	— 9	N 56° W	N W	11	1.5	49
June	—13	— 5	S 21° W	S S W	14	1.4	81
July	—20	12	S 65° E	W S W	23	1.7	33
August	—32	—10	S 17° W	S S W	34	1.7	104
September	—17	— 9	S 27° W	S S W	19	1.5	70
October	— 8	9	S 48° E	S W	12	1.6	43
November	20	2	N 6° E	N	20	1.5	60
December	41	—11	N 16° W	N N W	42	1.4	37
Year	12	— 3	N 14° W	N N W	12	1.47	750

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	48	—13	N 15° W	N N W	50 %	1.5	32
February	29	—23	N 39° W	N W	37	1.3	136
March	47	3	N 4° E	N	47	1.4	196
April	20	18	N 42° E	N E	27	1.3	195
May	—10	— 6	S 31° W	S S E	12	1.4	102
June	—19	1	S 3° E	S	19	1.5	159
July	—30	11	S 20° E	S S E	32	1.7	67
August	—21	— 9	S 23° W	S S W	23	1.7	208
September	—17	— 4	S 13° W	S S W	17	1.5	145
October	—24	6	S 14° E	S S E	25	1.5	83
November	3	2	N 34° E	N N E	4	1.5	123
December	32	—10	N 11° W	N	34	1.4	76
May—October	—20	0	S	S	20	1.55	764
November—April	30	— 4	N 8° W	N	30	1.40	758
Year	5	— 2	N 22° W	N N W	5	1.48	1522

In the gulf of *Tomini* or *Gorontalo* varying and circulating winds occur with large percentages and, on the whole, the monsoons are but weakly marked.

The N monsoon, during which N, N E, but also W and N W winds blow, lasts from December to March; in April the monsoon begins to abate and N E winds prevail.

In May and June the percentages of steadiness are very small and practically there is no predominant direction.

From July to October S S E, S E and S S W winds prevail, but winds from other points of the compass may be also expected so that the monsoon cannot be relied upon.

In November too N, E, W and N W winds, compensating each other, are so frequent that a prevailing direction cannot be said to exist.

The force of the wind is, on the average, pretty high, especially in the S monsoon during the months of July and August; it is least in April; forces more than 3 hardly ever occur.

The rainfall shows the characteristics of these regions viz. two maxima and two minima; table D exhibits two strongly marked maxima, in June and July, and in December, and two minima, one in March and April, and another in October and November.

The observations are however not very numerous and it is perhaps to the deficiency of available data, that the discrepancy is owing between this result and others, deduced from a long series of observations made at *Gorontalo*.

There the principal maximum is recorded in April, May and June, and a secondary maximum in November, December and January, whilst the driest month is September and a secondary minimum is observed in February and March.

At the same time both statements are possibly correct: observations of rainfall taken at sea are apt to vary considerably from those taken on shore; and moreover the results given in table D have been partly collected from observations taken at sea in the southern parts of the Gulf, where observations at coast-places have not yet been carried on for a sufficiently long time.

Showers may be expected during all seasons, but principally from May to August; heavy squalls and thunderstorms are rare and hazy skies may be observed in either monsoon.

The swell of the sea generally is moderate when the monsoons are at their height i. e. in July and August and from December to February and the same may be said of the condition of the sea with respect to the waves; the greatest percentages of „calm sea" are recorded from March to June and in September and October.

From the results of current-observations, as exhibited in the current-chart and those arrived at by means of observations made at *Gorontalo* and *Kema* (vide chapter on tides), it may be inferred that, during the S monsoon, the pretty strong drift-currents to the north-westward in the *Molucca-sea* give rise to a branch running to the westward along the southern shores of the Gulf, which, turning at the head of the Gulf, sets to the eastward along the northern shores and leaves the Gulf as a north-easterly current near the most eastern point of the neck of land.

Observations of tides and tidal streams have been made near *Gorontalo*; the solar influence is greater than the effect of the moon, and the tides are largely affected by a diurnal inequality which causes high water at $7^h\ 48^m$ p. m. in July and at $7^h\ 48^m$ a. m. about December.

Owing to these peculiarities a port-establishment cannot be said to exist, neither for tides, nor tidal streams, which are principally solar streams setting to the N N W ward about $9^h\ 30^m$ a. m. and p. m.

Recently a new tidal station has been established at *Posso* on the southern shore of the Gulf, where also rain-observations are being made.

For a long series of years rain has been observed at *Gorontalo*.

TABLE D. GULF OF TOMINI.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	20.7	14.9	**20.5**	10.2	7.2	0.9	—	4.7	7.0	—	5.3	5.3	5.0	11.1
N N E	**24.1**	—	5.5	8.7	—	—	—	3.5	—	—	—	14.0	2.0	7.3
N E	3.4	11.9	12.3	7.1	2.9	7.8	3.7	4.7	2.6	5.4	7.4	3.5	4.8	7.0
E N E	—	—	2.1	3.9	1.4	0.9	—	4.1	—	—	2.1	3.5	1.7	1.3
E	10.3	2.0	8.9	**12.6**	**13.0**	6.9	14.8	3.5	11.3	5.4	8.5	3.5	10.4	6.4
E S E	—	—	—	1.6	7.2	6.0	—	2.9	8.7	14.3	6.4	—	4.4	3.5
S E	—	1.0	3.4	7.9	7.2	**16.4**	**25.9**	8.7	**13.0**	16.1	5.3	5.3	**13.2**	5.2
S S E	—	—	1.4	1.6	2.9	1.7	—	1.7	1.7	—	5.3	—	1.6	1.1
S	3.4	5.9	1.4	7.1	10.1	6.9	11.1	9.3	11.3	3.6	10.6	1.8	9.3	4.5
S S W	—	—	—	1.6	7.2	6.9	3.7	2.9	3.5	10.7	3.2	—	4.3	2.3
S W	—	6.9	1.4	5.5	13.0	8.6	18.5	12.8	7.0	**23.2**	**12.8**	8.8	10.9	8.9
W S W	3.4	2.0	1.4	6.3	7.2	3.4	—	—	3.5	—	1.1	—	3.4	1.3
W	20.7	15.8	8.9	1.6	7.2	8.6	9.2	5.2	12.2	7.1	4.3	**21.1**	7.3	**13.0**
W N W	—	—	4.1	1.6	7.2	—	—	1.7	0.9	—	1.1	—	1.9	0.9
N W	6.9	**17.8**	7.5	6.3	—	5.2	1.9	4.7	9.6	3.6	11.7	8.8	4.6	9.4
N N W	—	5.0	4.1	0.8	—	—	1.9	3.5	1.7	—	—	7.0	1.3	2.7
Circulating	6.9	5.9	4.8	7.9	4.3	6.9	3.7	9.9	1.7	—	4.3	12.3	5.7	5.7
Variable	—	1.0	4.8	3.9	1.4	12.9	3.7	**15.1**	1.7	7.1	9.6	3.5	6.5	4.3
Calm	—	9.9	7.5	3.9	—	—	1.9	1.2	2.6	3.6	1.1	1.8	1.6	4.0

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	**42.1**	7.4	**22.6**	15.6	**13.5**	11.2	5.5	7.5	4.5	11.6	13.5	14.3	9.5	**18.6**
N N E	—	7.4	12.0	3.9	—	—	—	2.9	—	—	5.6	14.3	1.1	6.6
N E	10.6	9.5	15.8	**16.4**	9.5	4.3	5.5	2.9	8.1	5.8	6.7	12.5	7.8	10.2
E N E	—	1.1	0.8	7.8	—	4.3	—	1.2	—	7.2	—	—	2.2	1.5
E	5.3	6.3	3.0	9.4	5.4	1.7	12.7	3.5	5.4	5.8	10.1	3.6	6.4	5.7
E S E	—	1.1	1.5	3.9	4.1	9.5	—	3.5	3.6	8.7	2.2	1.8	4.1	2.6
S E	5.3	3.2	3.0	5.5	2.7	6.0	**25.5**	6.9	9.0	11.6	4.5	—	9.3	4.6
S S E	—	—	—	0.8	8.1	5.2	1.8	6.9	9.0	—	6.7	—	5.3	1.1
S	—	2.1	—	4.7	2.7	3.4	7.3	11.0	5.4	5.8	4.5	1.8	5.8	2.4
S S W	—	—	1.5	2.3	1.4	3.4	1.8	7.5	1.8	4.3	—	—	3.0	1.0
S W	—	10.5	4.5	1.6	8.1	**14.7**	7.3	**16.2**	11.7	8.7	1.1	3.6	**9.9**	4.7
W S W	—	—	—	0.8	5.4	4.3	1.8	9.2	4.5	—	—	3.6	4.3	0.6
W	31.6	12.6	2.3	4.7	9.5	9.5	10.9	3.5	**14.4**	**14.5**	11.2	12.5	8.8	14.1
W N W	—	1.1	3.0	0.8	2.7	3.4	—	2.3	—	—	—	1.8	1.5	1.0
N W	5.3	**25.3**	13.5	7.0	9.5	0.9	7.3	—	8.1	1.4	**13.5**	**16.1**	5.5	12.5
N N W	—	2.1	6.0	5.5	1.4	—	—	—	—	—	3.4	—	1.2	1.9
Circulating	—	1.1	—	3.1	8.1	2.6	3.6	9.8	6.3	—	4.5	3.6	5.6	1.5
Variable	—	3.2	5.3	0.8	5.4	13.8	9.1	5.2	5.4	14.5	11.2	3.6	6.6	6.3
Calm	—	6.3	5.3	5.5	2.7	1.7	—	—	2.7	—	1.1	7.1	2.1	3.3

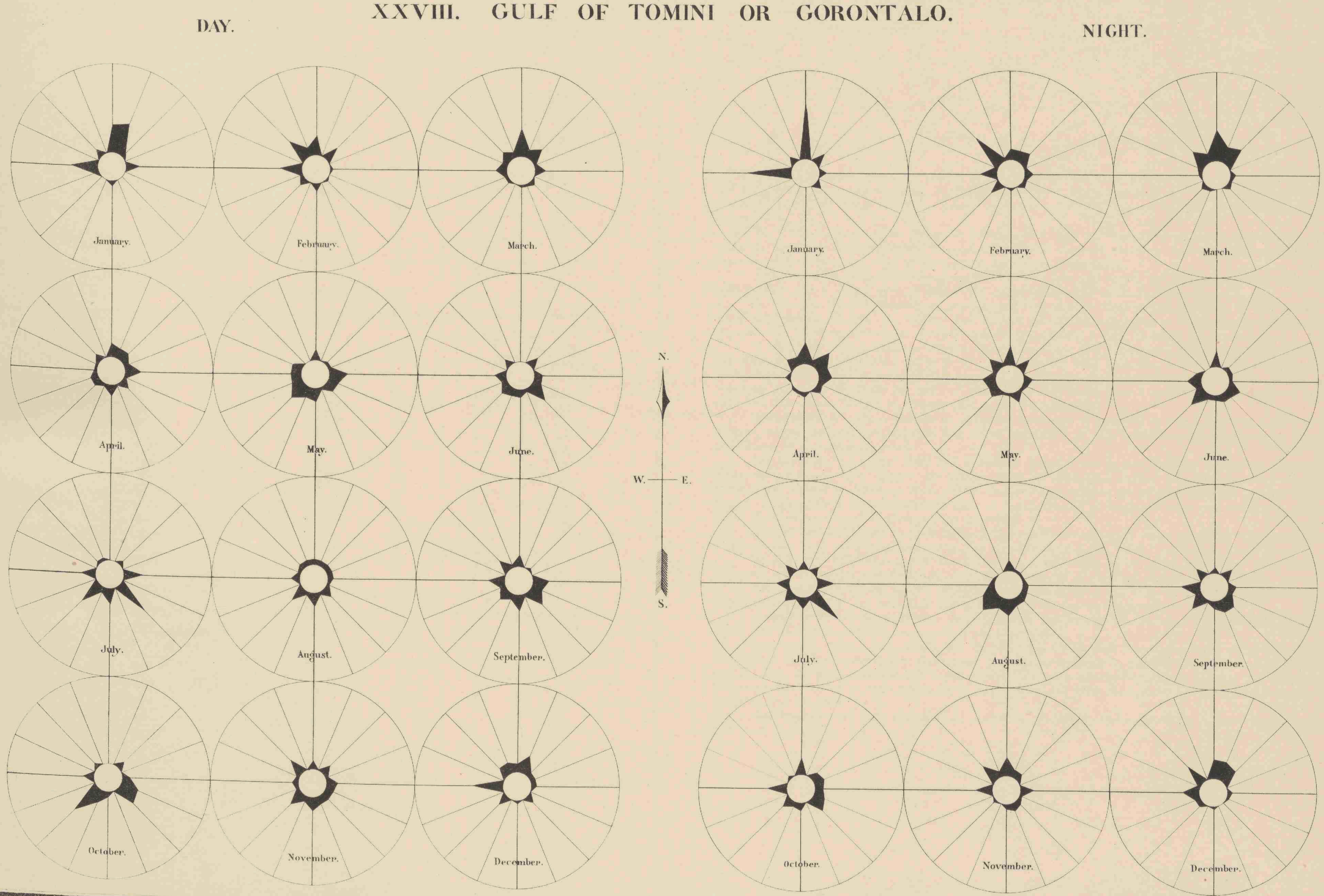
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	19.9	22.5	8.6	1.9	9.5	13.1	31.3	30.5	3.2	1.9	2.3	23.5	14.9	13.1
High Swell	—	1.7	—	—	—	—	—	1.5	—	—	—	—	0.3	0.3
Waves	—	—	—	—	—	—	—	3.1	2.1	—	14.3	—	0.9	2.4
Sea	15.5	6.9	5.5	3.8	2.1	7.7	7.5	18.3	—	7.6	9.8	15.6	6.6	10.2
High Sea	—	—	—	—	—	—	—	—	1.1	—	—	—	0.2	0.0
Calm	64.7	69.0	86.0	94.4	88.5	79.3	61.2	46.9	93.8	90.6	73.7	60.9	77.4	74.2
Number of Observations	32	116	108	107	51	121	51	66	95	53	42	51	491	402

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	48.6	47.0	69.8	52.6	39.4	34.8	30.8	30.7	43.9	55.6	56.9	56.0	38.7	55.7
Overcast	26.7	31.1	18.6	30.9	42.8	26.3	32.3	43.4	27.8	31.4	28.5	20.2	33.9	26.1
Showery	3.0	3.9	3.6	2.6	8.1	6.9	4.7	4.3	2.1	3.5	3.3	2.6	4.8	3.3
Rain	18.9	15.2	6.6	13.4	9.8	30.2	32.3	17.0	17.6	7.3	8.2	21.3	20.1	12.9
Squalls	—	1.6	—	—	—	—	—	—	—	—	0.9	—	—	0.4
Thunder	—	0.8	—	—	—	—	—	0.5	—	—	1.7	—	0.1	0.4
Hazy	3.0	0.8	1.6	0.5	—	1.9	—	4.2	8.8	2.4	0.8	—	2.6	1.4
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	31	132	196	194	103	159	65	212	148	83	123	75	881	640

XXVIII. GULF OF TOMINI OR GORONTALO.



XXIX. MOLUCCA-SEA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	54	—32	N 30° W	N N W	63 %	1.5	106
February	64	—20	N 17° W	N N W	67	1.5	158
March	45	— 6	N 7° W	N	45	1.5	309
April	5	—18	N 74° W	W N W	19	1.4	207
May	—45	7	S 10° E	S	46	1.4	274
June	—47	34	S 36° E	S E	58	1.6	110
July	—73	39	S 28° E	S S E	83	1.7	113
August	—61	13	S 12° E	S S E	62	1.8	123
September	—59	25	S 23° E	S S E	64	1.7	150
October	—56	9	S 10° E	S	57	1.5	142
November	—14	—13	S 40° W	S W	19	1.2	227
December	35	—36	N 45° W	N W	50	1.5	213
Year	—43	0	S	S	13	1.53	2132

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	64	—32	N 27° W	N N W	72 %	1.7	103
February	59	—38	N 33° W	N N W	70	1.6	154
March	49	—10	N 12° W	N N W	50	1.5	293
April	5	— 8	N 58° W	W N W	9	1.4	210
May	—38	15	S 21° E	S S E	41	1.3	271
June	—50	42	S 39° E	S E	65	1.7	106
July	—66	41	S 31° E	S S E	78	1.7	110
August	—68	2	S 2° E	S	68	1.7	122
September	—62	31	S 27° E	S S E	69	1.7	148
October	—52	16	S 18° E	S S E	54	1.5	136
November	—12	—10	S 40° W	S W	16	1.2	223
December	29	— 9	N 17° W	N N W	30	1.6	202
Year	—12	3	S 14° E	S S E	12	1.55	2078

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	59	—32	N 29° W	N N W	67 %	1.6	209
February	62	—29	N 26° W	N N W	68	1.6	312
March	47	— 8	N 10° W	N	48	1.5	602
April	5	—13	N 69° W	W N W	14	1.4	417
May	—42	11	S 15° E	S S E	43	1.4	545
June	—49	38	S 38° E	S E	62	1.7	216
July	—70	40	S 30° E	S S E	81	1.7	223
August	—65	8	S 7° E	S	65	1.8	245
September	—61	28	S 25° E	S S E	67	1.7	298
October	—54	8	S 8° E	S	55	1.5	278
November	—13	—12	S 43° W	S W	18	1.2	450
December	32	—23	N 36° W	N W	39	1.6	415
May—October	—59	22	S 22° E	S S E	63	1.63	1805
November—April	35	—20	N 30° W	N N W	40	1.48	2405
Year	—12	1	S 5° E	S	12	1.56	4210

The distinctive features of the climate in the *Molucca-sea* are: well marked monsoons from the N N W and the S S E, separated by two months, April and November, in which the monsoons turn; large percentages of steadiness, and pretty strong forces; two maxima and minima of rainfall, frequent showers and rather overcast and hazy skies.

The S S E monsoon sets in during the latter half of April and gradually increases in steadiness till July, when the monsoon is at its full height; in August the force of the wind attains its maximum value and in October the percentages of steadiness begin to decrease and the force to grow weaker.

In November the wind blows more from the S W than from other points, but the monsoon cannot be depended upon and the force is, on the average, very feeble: calms, variable and circulating winds frequently occur.

In December the N N W monsoon sets in; N W and N N W winds are prevalent, but N, W S W and W winds may also be expected. In January and February the N N W monsoon is at its height, though neither the steadiness, nor the force of the wind attain the high values exhibited in table D during the S S E monsoon.

In March the monsoon begins to abate in steadiness and the force to decrease; in April the weather is unsettled and winds, though blowing from the N W more than from any other point, may be expected from all directions. In April and May the average force is minimum, but greater than in November, and in both months variable and circulating winds are frequently met with. A force of the wind greater than 3 has been recorded 51 times in the 4210, and more during the N N W monsoon than in the S S E monsoon.

Special attention is drawn to table D, giving the percentages of frequency for winds from every point of the compass, because evidently the data are very reliable and almost for each special direction a most regular increase and decrease of percentages is shown.

The percentages of rainfall show two maxima, a principal one in June, July and August and a secondary maximum in December and January: the driest months are September, October and November and a secondary minimum is recorded in February: these results of observations made at sea are fully confirmed by those deduced from a 12 yearly series of rain-observations made at *Kajelie*, situated on the isle of *Buru*, near the border assumed in the charts between the *Molucca-sea* and the *Ceram-sea*.

Showery weather may be expected during both monsoons but principally when the rainfall is heaviest; squalls on the contrary have not been experienced in June, July and August, but mostly in December and January.

Thunderstorms have been mostly recorded in the months when the monsoons turn i. e. in April, May and November and a hazy sky most frequently occurs towards the end of the S S E monsoon and in March.

The condition of the sea is most favourable when the force of the wind is weakest, consequently large percentages of „calm sea" are recorded in March, April, May, October and November.

A swell of the sea is occasionally met with during both seasons, but not often: during the principal rainy season „sea" and „high sea" however frequently are experienced.

The currents, mostly drift-currents, are, on the average, not very strong: from April to September in the 113 data 34 times „no current" was recorded and from October to March 41 times in the 136: the greatest velocities deduced from the ships calculated and actual positions were 30 miles per 24 hours to the East and West in the S monsoon and 78 miles to the S S E in the N monsoon: on the whole the currents are much steadier during the former than in the latter.

Tidal stations have been established at *Bangai* in the *Bangai Archipelago* and at *Massarete* situated on the S W coast of *Buru Isle*.

TABLE D. MOLUCCA-SEA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	11.6	**25.5**	**20.0**	2.7	1.0	0.5	—	0.9	2.7	0.5	6.2	7.9	1.3	12.6
N N E	8.7	11.9	5.8	4.4	0.5	—	—	—	—	0.5	2.1	4.3	0.8	5.0
N E	5.8	5.8	10.8	4.4	1.7	1.6	—	0.4	1.9	0.5	3.1	2.1	1.7	4.7
E N E	0.6	0.4	1.9	5.1	0.5	—	1.6	—	—	1.4	2.4	1.8	1.2	1.4
E	1.2	1.2	6.9	4.4	3.9	10.9	1.6	6.3	2.7	1.4	3.8	1.5	5.0	2.7
E S E	—	—	0.4	—	3.9	11.5	13.8	5.8	8.1	8.5	2.1	0.6	7.2	1.9
S E	—	0.4	1.1	6.1	**18.4**	**28.4**	**25.4**	15.2	**25.1**	**21.8**	8.6	0.9	**19.8**	5.5
S S E	—	—	1.1	4.4	9.1	10.4	23.3	13.5	17.8	7.6	2.7	1.8	13.1	2.2
S	1.7	—	3.2	4.1	14.0	4.9	24.9	**25.6**	13.9	11.4	8.9	1.5	14.6	4.5
S S W	—	—	1.3	3.4	6.6	6.6	3.2	6.7	7.7	12.8	5.1	2.7	5.7	3.7
S W	3.5	3.7	3.2	6.4	8.3	6.6	1.6	9.4	8.1	15.6	**10.3**	4.3	6.7	6.8
W S W	1.7	2.1	1.1	8.1	2.0	1.6	1.1	0.9	0.8	0.9	6.8	4.6	2.4	2.9
W	8.7	4.5	5.2	7.1	5.9	2.2	—	3.1	1.2	0.5	8.2	6.1	3.3	5.5
W N W	5.8	6.2	3.4	6.8	1.0	—	—	—	0.4	0.9	2.4	8.8	1.4	4.6
N W	**22.0**	11.9	13.8	**14.6**	1.7	1.6	—	1.3	0.4	2.8	5.1	**23.4**	3.3	**13.2**
N N W	19.1	18.5	10.1	3.7	0.2	—	—	0.9	—	—	3.1	14.3	0.8	10.9
Circulating	1.2	1.2	5.6	3.7	4.9	4.4	2.1	7.6	0.8	2.8	6.8	3.0	3.9	3.4
Variable	1.2	4.5	4.1	9.5	11.5	7.1	1.1	1.8	6.9	10.0	6.5	8.5	6.3	5.8
Calm	7.5	2.1	0.9	1.0	4.9	1.6	0.5	0.4	1.5	—	5.8	1.8	1.7	3.0

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	20.4	20.2	**22.5**	7.1	1.6	—	0.5	1.0	0.4	1.0	7.5	10.1	1.8	**13.6**
N N E	8.8	4.4	6.4	2.4	0.3	—	—	—	—	1.5	4.3	4.6	0.5	5.0
N E	1.7	1.6	6.4	6.8	3.1	0.5	1.1	1.0	0.4	2.9	2.8	3.6	2.2	3.2
E N E	2.2	—	0.7	2.4	0.5	—	—	—	0.4	—	2.5	1.6	0.6	1.2
E	1.1	—	3.5	4.1	7.3	12.6	4.9	1.4	3.6	3.9	5.3	0.3	5.7	2.4
E S E	—	—	—	5.1	4.9	12.6	18.0	1.4	10.0	7.3	2.5	0.3	8.7	1.7
S E	—	0.4	4.4	7.1	12.8	**28.6**	**24.6**	13.9	**27.6**	**16.6**	6.4	2.9	**19.1**	5.1
S S E	1.1	—	0.4	1.0	**14.6**	11.5	17.5	17.2	20.0	16.1	3.2	1.0	13.6	3.5
S	0.6	0.8	2.4	5.8	13.0	12.1	20.8	**29.7**	12.8	13.2	7.5	1.6	15.7	4.4
S S W	—	—	0.9	3.4	3.1	3.8	4.4	8.6	4.4	10.7	4.6	1.0	4.6	2.9
S W	1.7	—	0.7	5.8	6.0	1.6	3.3	11.5	8.0	5.9	**13.9**	4.9	6.0	4.5
W S W	—	3.6	2.0	5.1	1.8	0.5	0.5	1.0	0.8	3.9	3.6	6.2	1.6	3.2
W	6.1	4.0	5.9	7.1	4.2	2.7	0.5	2.9	0.8	1.5	9.3	14.0	3.0	6.8
W N W	9.9	13.1	2.4	3.4	1.3	0.5	—	1.0	0.4	1.0	2.5	5.2	1.1	5.7
N W	**24.9**	**21.4**	10.4	**11.6**	2.3	1.1	—	1.9	0.4	1.0	3.9	**14.7**	2.9	12.7
N N W	16.6	17.9	17.2	3.7	0.8	0.5	—	—	1.2	0.5	1.1	12.4	1.0	11.0
Circulating	1.7	0.4	4.4	6.8	4.7	5.5	—	3.8	2.0	4.4	5.0	4.6	3.8	3.4
Variable	—	10.3	6.6	10.2	10.7	4.4	3.3	2.9	6.0	5.4	8.9	9.1	6.3	6.7
Calm	3.3	2.0	2.9	1.0	7.0	1.1	0.5	1.0	0.8	3.4	5.3	2.0	1.9	3.2

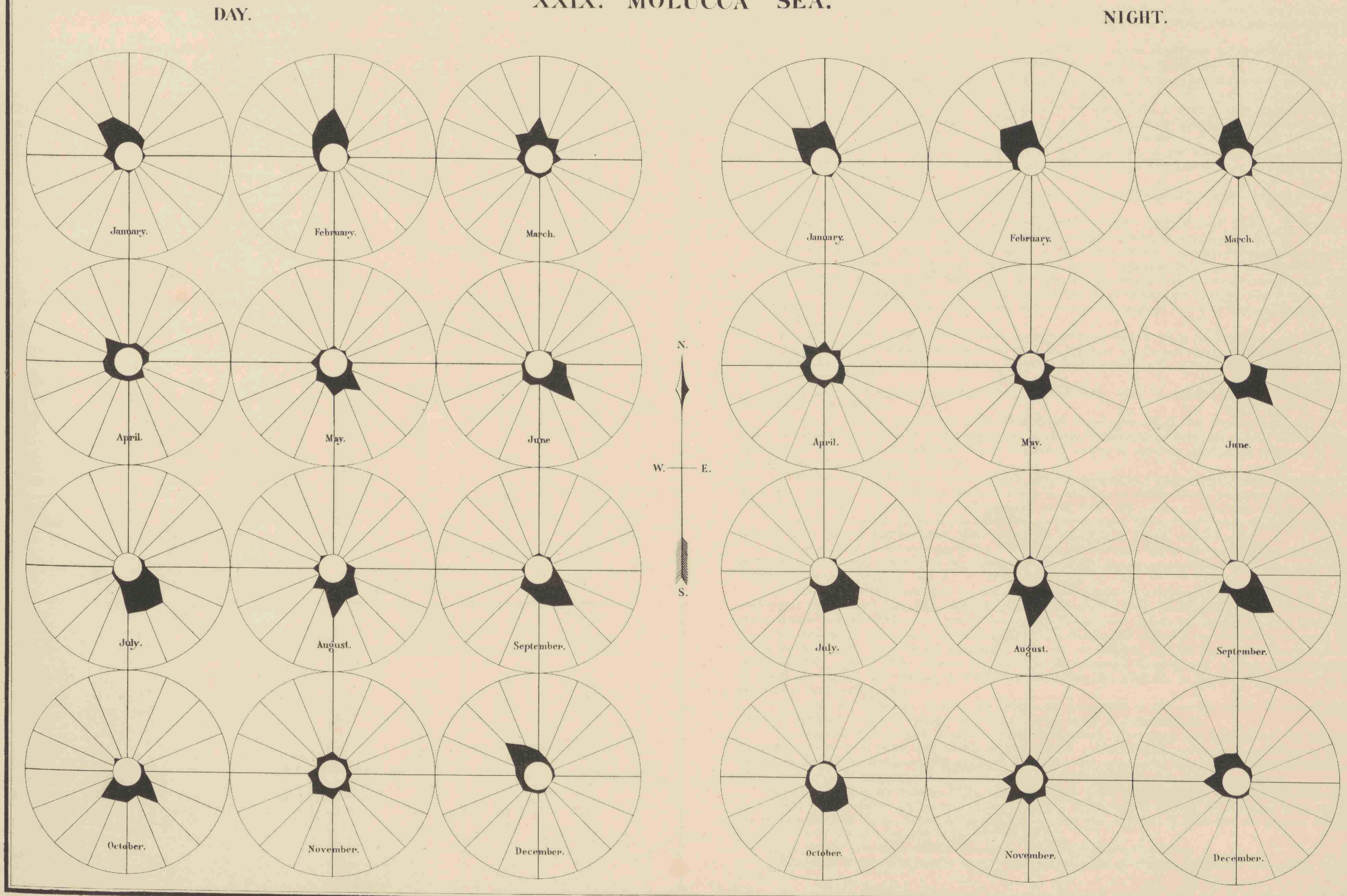
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	21.0	18.7	6.3	8.3	9.2	28.7	19.5	18.9	11.3	7.9	7.8	14.1	16.0	12.6
High Swell	—	3.4	—	—	1.4	1.7	2.9	—	2.5	—	0.5	—	1.4	0.7
Waves	—	—	—	—	—	1.7	—	—	0.8	1.9	0.5	2.5	0.4	0.8
Sea	19.9	15.2	8.8	2.7	2.2	21.3	20.4	31.2	9.5	8.9	1.4	5.0	14.6	9.9
High Sea	—	—	0.4	—	1.4	—	10.7	—	7.2	—	—	6.1	3.2	1.1
Calm	59.1	62.7	84.6	89.0	86.0	46.6	46.7	50.0	68.9	81.3	89.9	72.4	64.5	75.0
Number of Observations	90	59	272	73	141	118	103	122	125	101	208	166	682	896

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	32.9	39.8	34.2	47.3	43.4	36.4	41.0	27.2	41.9	54.3	51.1	41.4	39.5	42.3
Overcast	32.9	42.7	38.4	28.1	31.5	30.7	40.3	37.9	37.6	25.3	27.8	30.2	34.4	32.9
Showery	9.1	4.0	7.8	8.1	6.5	5.6	3.7	9.4	3.0	3.0	5.4	8.1	6.1	6.2
Rain	22.4	12.2	13.6	14.1	17.0	26.4	14.3	20.3	11.4	13.8	9.3	18.3	17.3	14.9
Squalls	1.0	—	0.2	0.3	0.4	—	—	—	0.4	—	0.2	0.8	0.2	0.4
Thunder	—	0.7	1.7	1.0	0.4	—	—	—	—	0.4	2.5	0.3	0.2	0.9
Hazy	1.9	0.7	4.1	1.3	0.9	1.0	0.9	5.3	5.4	3.3	3.8	1.2	2.5	2.5
Mist	—	—	0.2	—	—	—	—	—	0.4	—	—	—	0.1	0.0
Number of Observations	210	304	606	406	541	212	224	246	298	269	451	411	1927	2251

XXIX. MOLUCCA SEA.



XXX. SUNDA-SEA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	11	—79	N 83° W	W	80 %	1.7	86
February	9	—42	N 79° W	W N W	43	1.5	232
March	12	—37	N 72° W	W N W	39	1.6	349
April	—14	25	S 61° E	E S E	29	1.5	334
May	—27	64	S 67° E	E S E	69	1.7	452
June	—27	73	S 69° E	E S E	78	1.7	410
July	—23	73	S 73° E	E S E	77	1.8	330
August	—24	71	S 71° E	E S E	75	1.8	345
September	—31	58	S 61° E	E S E	66	1.7	234
October	—30	51	S 61° E	E S E	59	1.6	383
November	10	— 7	S 36° W	S W	12	1.5	243
December	11	—51	N 78° W	W N W	52	1.6	326
Year	—10	17	S 60° E	E S E	20	1.64	3724

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	16	—74	N 77° W	W N W	76 %	1.7	80
February	22	—49	N 65° W	W N W	54	1.5	215
March	15	—36	N 70° W	W N W	39	1.6	339
April	—17	26	S 58° E	E S E	31	1.6	316
May	—23	68	S 72° E	E S E	72	1.7	435
June	—29	72	S 70° E	E S E	78	1.8	396
July	—25	73	S 71° E	E S E	77	1.8	310
August	—29	71	S 69° E	E S E	77	1.8	338
September	—25	69	S 70° E	E S E	73	1.7	218
October	—39	58	S 56° E	S E	70	1.6	368
November	1	— 6	N 86° W	W	6	1.4	239
December	14	—50	N 74° W	W N W	52	1.6	304
Year	—10	19	S 62° E	E S E	21	1.65	3558

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	14	—77	N 80° W	W	78 %	1.7	166
February	16	—46	N 71° W	W N W	49	1.5	447
March	14	—37	N 70° W	W N W	40	1.6	688
April	—16	26	S 58° E	E S E	31	1.6	650
May	—25	66	S 70° E	E S E	71	1.7	887
June	—28	73	S 69° E	E S E	78	1.8	806
July	—24	73	S 72° E	E S E	77	1.8	640
August	—27	71	S 69° E	E S E	76	1.8	683
September	—28	64	S 66° E	E S E	70	1.7	452
October	—35	55	S 58° E	E S E	65	1.6	751
November	6	— 7	N 49° W	N W	9	1.5	482
December	13	—51	N 76° W	W N W	53	1.6	630
April—October	—26	61	S 67° E	E S E	66	1.71	4869
November—March	13	—44	N 74° W	W N W	46	1.58	2413
Year	—10	18	S 61° E	E S E	21	1.66	7282

The characteristic features of the climate in the *Sunda-sea* are: the almost absolute steadiness of the monsoons, especially of the E S E monsoon; the prevalence of the E S E over the W N W monsoon; the small rainfall and high percentages of haziness.

The E monsoon sets in during the latter half of April and almost immediately blows with great force and steadiness; this state of affairs lasts till October, the direction of the wind during these six months being exactly S 67° E; the force is highest in June, July and August and decreases in September and October; in November, when it is lowest, N W winds begin to appear and to prevail, though there is as yet no persistent direction.

In December the W monsoon sets in and comes to full development in January when force and steadiness are at a maximum; in February the monsoon begins to abate, and during this month and March the direction of the prevailing winds varies from S W to N, whereas in January the wind is almost exclusively from the West.

The general motion of the air, taken throughout the whole year, is from the E S E with a percentage of 21 %, which shows that in these regions the E monsoon considerably predominates over the W monsoon in force as well as in steadiness and duration.

A force of the wind higher than 3 has been recorded 44 times out of 3724 at daytime and 56 times out of 3558 during nighthours and mostly during the E monsoon.

The seasons follow the monsoons; the greatest rainfall — about 30 % of rainy days — is recorded in December and January; in February and March a somewhat smaller percentage is exhibited in table D.

The dry season lasts from May to November; a slight trace of the *two* rainy seasons, observable in the *Molucca-sea,* may be found in the increase of rainfall in June but no February-minimum is shown in the table.

On the whole in the *Sunda-sea* there is but little rain, and it generally comes down in showers, a steady rainfall is rather an exception; heavy squalls occasionally are met with in all seasons, but especially with westerly winds; thunderstorms mostly occur in the months when the monsoons are weakest viz. from February to April and in November and December.

The sky is never bright: in the W monsoon it generally is overcast and in the E monsoon the atmosphere is very hazy, especially in August and September, whilst at the same time the percentage of cloudiness is pretty large; a bright blue sky and starry nights consequently are rare and the principal time of their occurrence towards the end of the W monsoon-period.

On comparing the rainfall at the *Celebes*-coast with that in the offing, we find that the conditions differ entirely for differently situated places.

On the W coast of the southern peninsula, at *Segeri, Pangkadjene* and *Tjamba,* only one rainy and one dry season are observable; at *Makasser* a slight secondary maximum is perceptible in June, but there is no minimum in February; as soon as the south-western corner is rounded, we find at *Alloë* not only a slight maximum in June, but also a secondary minimum in January.

At *Bonthain* the distribution of rainfall is quite different: the quantity is considerably less, the principal maximum is in May and June, and a secondary minimum occurs in February; at *Saleyer-Isle* the principal maximum falls in December, but in June a secondary maximum is shown in the tables and a secondary minimum in February.

On the E coast of the peninsula the rainfall is very heavy and at *Kadjang* and *Balang-Nipa* by far the greatest quantity comes down in May and June; slight minima are perceptible in January and February.

This proves that in the beginning of the S E monsoon the aircurrent blown out from the Australian mainland is moist enough to cause condensation of aqueous vapour whenever the air is compelled to ascend the slopes of the mountainranges near the coast.

In July, August and September the S E aircurrent, emanating from the Australian deserts is too dry for condensation to take place even when dilatation, owing to decrease of pressure, occurs: this is proved by the percentages of atmospheric haziness, which exhibit maxima in August and September all over the eastern parts of the Archipelago.

The explanation given above also holds good for the maximum of rainfall at sea observed in June and July in the eastern regions; here the S E aircurrents, when not yet blowing with full vigour, have to overcome the local atmospheric masses, partly stagnant and partly moving in opposite directions, and, in doing so, are compelled to ascend and deposit their moisture in the form of heavy rains, the propensity to rainfall being promoted by the presencee of floating dust-particles.

In August and September however the whole mass participates in the general motion of the air to the N E ward and there is then no reason why the layers of air should be forced upwards.

The condition of the sea is favourable as far as the swell is concerned, this being heavy with persistent E winds only, but it is rather unfavourable with respect to „waves", which, owing to the unsteadiness of the marine currents, are frequently chopping and cause a disturbed sea whenever the monsoonwinds blow with full vigour; March, April, May and November are the months when large percentages of „calm sea" are on record.

Owing probably to the influence of the perennial currents to the southward emanating from the *Makasser*-strait, the currents are not strong and very unsteady, as is shown in the current chart by the shortness of the arrows; the average velocities during W and E monsoon are 13.1 and 12.5 miles per 24 hours and the greatest velocities on record are 38 and 53 miles, both to the W N W.

Tidal stations have been established at *Saleyer, Bonerate, Kadjang* and *Bonthain.*

Observations of rainfall have been made at *Alloë, Bonthain, Saleyer, Kadjang, Bikeru* and *Balang-Nipa;* of wind at *Bonthain.*

TABLE D. SUNDA-SEA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	2.8	4.3	4.0	3.3	0.4	0.1	0.2	0.3	1.0	1.3	1.9	4.0	0.9	3.1
N N E	—	1.4	2.4	0.8	0.7	0.6	0.3	1.1	—	1.4	0.8	0.4	0.6	1.1
N E	—	0.9	2.4	3.9	4.3	4.3	4.9	3.7	2.5	2.5	3.6	3.2	3.9	2.1
E N E	—	1.2	0.9	7.4	7.6	9.9	11.1	11.2	9.9	9.6	1.4	—	9.5	2.2
E	—	2.3	4.4	13.0	21.5	24.3	**25.5**	23.2	**25.2**	15.7	**13.7**	2.9	**22.1**	6.5
E S E	0.7	1.2	2.4	13.0	**23.5**	20.8	20.9	**24.2**	8.9	**19.6**	5.2	0.9	18.6	5.0
S E	0.7	2.9	3.7	**13.8**	19.5	**25.0**	21.6	20.2	18.9	18.1	7.4	1.5	19.8	5.7
S S E	1.4	1.2	1.0	5.3	5.2	5.4	6.1	4.5	10.2	6.3	3.3	1.0	6.1	2.4
S	2.1	1.2	2.4	2.9	4.2	3.8	2.0	2.2	9.4	5.7	3.6	3.0	4.1	3.0
S S W	—	2.6	3.1	3.7	0.9	0.6	1.0	1.9	2.3	2.8	6.6	2.1	1.7	2.9
S W	2.8	11.0	6.1	4.5	2.4	0.4	0.8	2.1	1.5	6.1	6.8	7.2	2.0	6.7
W S W	11.8	7.8	8.7	3.9	0.7	0.1	0.5	0.2	—	0.8	6.3	7.2	0.9	7.1
W	**45.1**	12.1	12.0	5.6	1.2	0.4	0.3	—	0.3	1.1	10.1	**20.9**	1.3	**16.9**
W N W	10.4	10.1	**14.6**	2.9	0.1	0.3	0.2	0.8	0.8	0.8	6.6	15.2	0.9	9.6
N W	18.8	**15.0**	12.7	6.0	0.9	0.3	0.7	0.2	—	1.1	7.1	14.6	1.4	11.6
N N W	2.1	6.1	7.0	1.2	—	—	0.3	0.2	—	—	4.6	3.6	0.3	3.9
Circulating	0.7	7.5	5.7	3.3	2.5	0.4	1.7	2.2	4.8	1.4	4.4	5.9	2.5	4.3
Variable	0.7	10.1	4.7	4.7	3.0	2.2	1.0	1.3	4.1	3.6	4.4	5.1	2.7	4.8
Calm	—	1.2	1.6	0.8	1.3	1.1	0.7	0.5	0.3	2.2	2.5	1.3	0.8	1.5

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	6.2	5.3	7.4	3.9	0.5	—	1.1	0.2	0.6	0.2	4.2	5.3	1.1	4.8
N N E	1.6	2.5	2.1	1.0	1.6	0.6	1.4	0.3	0.8	0.5	3.3	1.8	1.0	2.0
N E	0.8	1.6	5.1	1.4	4.3	3.7	4.0	3.3	4.4	3.8	6.2	0.8	3.5	3.1
E N E	—	2.5	2.1	5.1	9.8	8.9	10.5	8.8	6.9	5.7	1.5	0.4	8.3	2.0
E	—	3.7	5.1	14.6	**27.4**	**26.1**	**26.2**	**24.5**	**31.7**	15.3	**14.2**	2.0	**25.1**	6.7
E S E	—	1.2	1.7	14.0	17.1	22.3	19.5	22.7	13.5	19.0	3.3	1.2	18.2	4.4
S E	1.6	0.9	2.1	**15.7**	18.0	19.3	19.9	22.7	20.4	**25.6**	5.6	3.5	19.3	6.6
S S E	0.8	1.2	1.5	4.3	7.5	7.6	8.1	4.8	7.4	11.6	4.7	1.6	6.6	3.6
S	—	0.9	1.5	3.5	4.9	4.8	3.9	3.8	6.1	6.5	4.7	2.5	4.5	2.7
S S W	0.8	1.2	2.8	2.0	0.3	1.4	1.4	1.2	—	2.2	0.3	1.4	1.1	1.5
S W	3.1	6.9	7.8	3.3	1.5	0.7	0.4	1.3	1.1	1.5	7.7	5.5	1.4	5.4
W S W	7.8	11.5	**14.2**	5.7	0.3	—	—	—	—	0.5	4.7	8.4	1.0	7.9
W	**48.1**	**15.3**	9.7	5.3	0.8	0.4	—	0.2	0.3	1.0	12.1	**21.3**	1.2	**17.9**
W N W	9.3	15.3	11.2	1.8	0.4	0.3	—	—	—	—	9.8	11.5	0.4	9.5
N W	13.2	14.0	12.9	5.9	0.4	0.4	—	0.2	1.1	1.7	5.0	17.4	1.3	10.7
N N W	3.1	11.5	6.8	1.0	0.1	—	—	—	—	—	3.6	5.1	0.2	5.0
Circulating	1.6	2.5	1.5	3.9	1.3	0.6	1.6	1.5	2.2	0.8	3.9	3.1	1.9	2.2
Variable	0.8	0.6	3.0	5.9	2.5	1.8	1.8	3.8	2.8	2.5	3.0	4.7	3.1	2.4
Calm	1.6	1.2	1.5	1.8	1.2	1.1	0.4	0.7	0.8	1.7	2.1	2.5	1.0	1.8

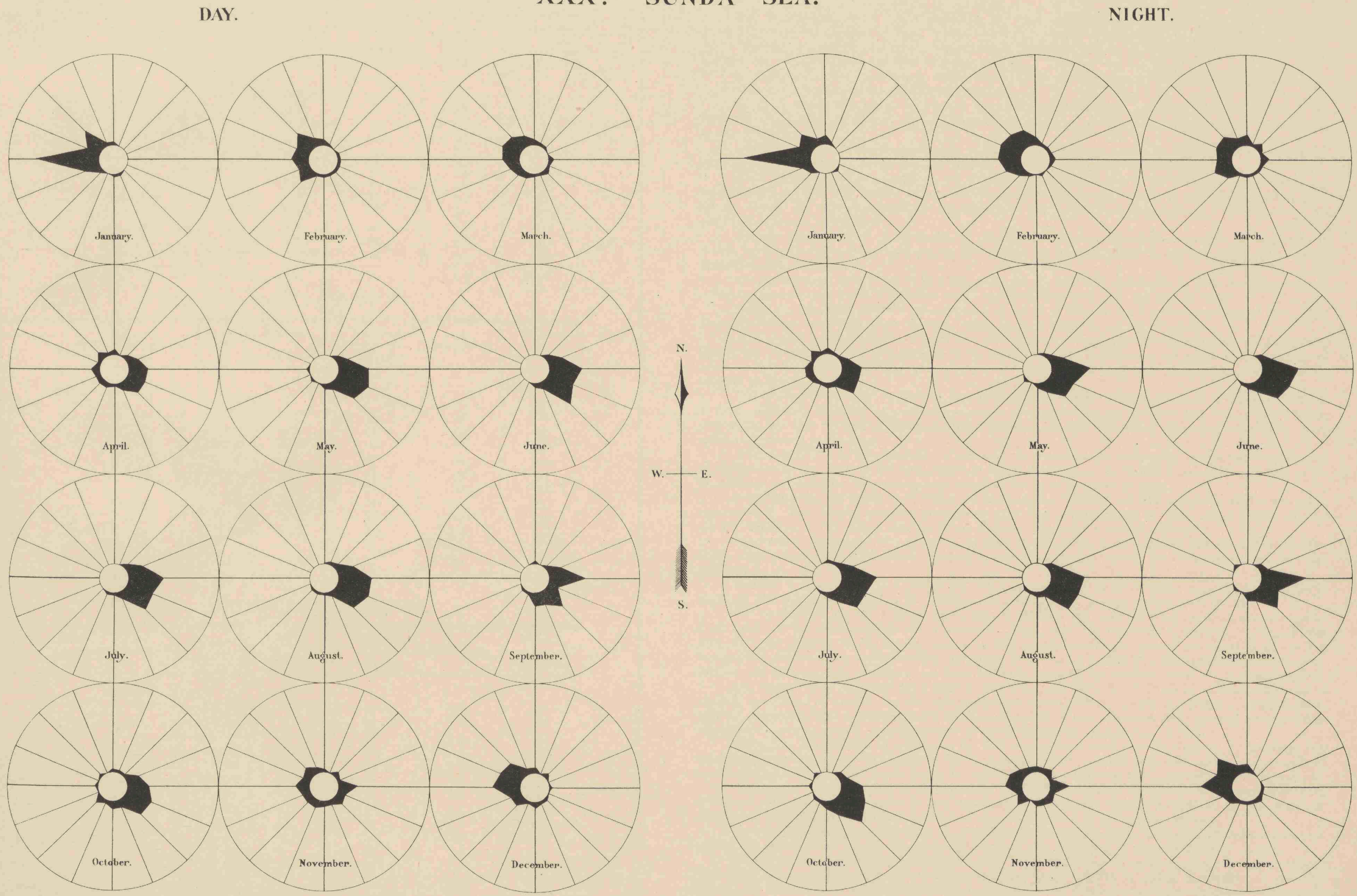
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	6.4	19.9	4.5	10.9	12.2	17.1	26.1	17.4	15.2	15.0	4.7	12.0	16.5	10.4
High Swell	0.8	4.8	—	—	1.3	3.7	5.8	2.5	0.7	7.0	—	—	2.3	2.1
Waves	6.3	—	—	3.7	1.3	0.4	1.0	0.7	9.6	2.2	4.2	1.5	2.8	2.4
Sea	25.2	17.0	14.3	4.6	5.5	18.1	21.3	21.8	13.0	9.3	8.1	16.7	14.1	15.1
High Sea	5.6	—	2.7	1.0	0.5	0.4	2.4	10.0	—	2.3	—	2.6	2.4	2.2
Calm	55.9	58.4	78.5	80.1	79.4	60.4	43.5	47.9	61.6	64.4	83.1	67.2	62.2	67.9
Number of Observations	127	106	152	110	240	228	207	161	159	227	195	271	1105	1078

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	29.8	30.8	49.0	51.3	57.0	44.4	58.3	59.5	56.3	63.9	53.4	33.9	54.5	43.5
Overcast	37.9	41.3	30.1	32.1	28.6	31.6	27.8	24.1	27.6	22.9	27.6	29.7	28.6	31.6
Showery	11.0	7.6	6.6	5.0	3.9	8.3	4.6	1.8	1.4	3.1	6.5	7.9	4.2	7.1
Rain	19.0	16.7	12.4	6.9	7.4	12.2	4.3	2.4	2.9	3.9	5.5	22.2	6.0	13.3
Squalls	1.9	0.5	0.2	0.2	0.3	0.4	—	0.2	—	0.3	—	1.9	0.2	0.8
Thunder	0.6	2.2	1.1	1.3	0.3	0.1	—	—	0.2	0.5	1.7	0.8	0.3	1.2
Hazy	—	1.1	0.9	3.4	2.6	3.1	5.1	12.0	11.7	5.5	5.5	3.7	6.3	2.8
Mist	—	—	—	—	—	—	—	0.3	—	—	—	—	0.1	—
Number of Observations	164	448	689	643	880	796	655	678	450	749	476	632	4102	3158

XXX. SUNDA SEA.



XXXI. WESTERN SUNDA ISLES, NORTHERN COASTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	29	—57	N 63° W	W N W	64 %	1.9	129
February	26	—38	N 56° W	N W	46	1.6	178
March	7	—17	N 68° W	W N W	18	1.5	270
April	— 3	24	S 84° E	E	24	1.4	336
May	—17	47	S 70° E	E S E	50	1.6	459
June	—28	46	S 59° E	E S E	54	1.7	652
July	—23	43	S 62° E	E S E	49	1.6	540
August	—32	40	S 50° E	S E	51	1.7	390
September	—19	38	S 63° E	E S E	42	1.6	575
October	—16	25	S 56° E	S E	30	1.5	542
November	—21	7	S 18° E	S S E	22	1.4	347
December	—13	—25	S 63° W	W S W	28	1.4	246
Year	— 9	11	S 51° E	S E	14	1.58	4664

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	9	—72	N 83° W	W	73 %	1.8	127
February	5	—47	N 84° W	W	47	1.5	179
March	—22	—25	S 49° W	S W	33	1.6	267
April	—39	14	S 20° E	S S E	41	1.4	332
May	—41	39	S 44° E	S E	57	1.5	470
June	—53	39	S 38° E	S E	66	1.7	618
July	—59	47	S 39° E	S E	75	1.6	512
August	—58	31	S 31° E	S S E	66	1.7	357
September	—64	26	S 22° E	S S E	69	1.7	527
October	—60	17	S 16° E	S S E	62	1.6	540
November	—55	4	S 4° E	S	55	1.4	346
December	—44	—17	S 21° W	S S W	47	1.4	253
Year	—40	5	S 8° E	S	40	1.58	4528

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	19	—65	N 73° W	W N W	68 %	1.9	256
February	16	—43	N 70° W	W N W	46	1.6	357
March	— 8	—21	S 69° W	W S W	22	1.6	537
April	—21	19	S 42° E	S E	28	1.4	668
May	—29	43	S 56° E	S E	52	1.6	929
June	—41	43	S 46° E	S E	59	1.7	1270
July	—41	45	S 49° E	S E	61	1.6	1052
August	—45	36	S 39° E	S E	58	1.7	747
September	—42	32	S 37° E	S E	53	1.7	1102
October	—38	21	S 29° E	S S E	43	1.6	1082
November	—38	6	S 9° E	S	38	1.4	693
December	—29	—21	S 36° W	S W	36	1.4	499
April—November	—37	31	S 40° E	S E	48	1.59	7543
December—March	— 1	—38	W	W	38	1.63	1649
Year	—25	8	S 18° E	S S E	26	1.60	9192

The W monsoon in these regions blows with full vigour and steadiness during one month only viz. January and from a W N W direction: at night S and S W winds at times are met with, and during daytime N winds; but in general the influence of land- and seabreezes is perceptible only in the direction of the prevailing wind, which is due W at nighthours and W N W during daytime.

In February the monsoon begins to abate; land- and seabreezes consequently are more frequently experienced, and variable and circulating winds often are met with.

In March westerly components still prevail, but at daytime the monsoon cannot be relied upon; variable and circulating winds being experienced; during nighthours the prevailing winds are from the S, S W, W and W N W, but mostly from the S W.

In April the S E monsoon sets in with pretty high percentages of steadiness, from the S S E at nighthours and from the E at daytime; during the latter time it is not steady enough to be relied upon.

From May to July the strength of the E monsoon gradually increases: the steadiness is greatest during nighthours, as by day the monsoon is counteracted by a landwind which, blowing in an opposite direction, gives rise to variable and circulating winds; for the same reason the average direction is S E and S S E at day- and S E and S S E or even S at nighttime.

In July the monsoon is at its height, in August and September the steadiness becomes somewhat less, in October land- and seabreezes apparently gain in force because the monsoon begins to abate and variable and circulating winds frequently occur.

The same rather unsettled state of things continues in November and December, with this difference, that during the former month S and S S E winds prevail and during the latter S W and W S W winds.

Taken over the whole year the general motion of the air is from the S S E with a percentage of 26 %, which shows the strongly marked prevalence in these regions of the E monsoon over the W monsoon.

With respect to the seasons these parts must be considered as belonging to the western parts of the Archipelago, because the rainfall bears the characteristics of the *China-sea* viz. one dry and one wet season and a maximum of rainfall in February, whilst in the *Molucca-* and *Banda-*seas *two* rainy and *two* dry seasons are observed and a secondary *minimum* of rain in February.

This maximum of rainfall in February and March is not exhibited in the results given in table D because it is hardly perceptible when the frequency only of rain is recorded and not the quantity: but evidence of the fact is afforded by the long series of observations made at *Buleleng* and *Bima* and also at *Banjuwangi* and *Negara*, which stations are situated in *Bali*-strait.

From July to October the probability of rain near the N coast is practically nihil, so that these regions may be ranked among the driest of the Archipelago; in the W monsoon too the rainfall is moderate, decreasing as we go eastward; in general the rainy season may be said to last from December to April.

Notwithstanding this deficiency of rainfall the percentages of showery and even of squally weather are pretty high, especially from January to April; forces greater than 3 have been recorded 88 times out of 4664 at daytime and 127 times out of 4528 during nighthours, and at times even forces of 6 were registered.

The weather consequently may be said to be generally fine during the E monsoon with strong and persistent winds, being subject however to sudden variations due to the contention between the monsoonwinds and land- and seabreezes.

Haziness is observable with S winds and, increasing as the S E monsoon advances, reaches a maximum in September and October, corresponding to a minimum of rainfall, which in other months clears the sky.

The condition of the sea is most unfavourable in January and July; in either monsoon there is a pretty strong swell on the coasts, and in the E monsoon „heavy swell" is frequently experienced; as to „sea" and „high sea" the condition of the sea corresponds to that of the weather; in general the surface is smooth, but with variable and circulating winds, especially during the E monsoon, a turbulent sea may be expected, which however does not last for a long time; in March and from October to December the condition of the sea is most favourable.

The currents near the coast are neither strong nor very steady at the N coasts of these isles, the cause of which is to be found in the fact, that the tidal streams and drift-currents are constantly interfering with each other; from the directions of the currents, exhibited in the current-chart, it may be inferred that a general tendency exists during both seasons to a slight perennial transfer of water through the passages from N to S.

During the S E monsoon no currents to the N W are observed, either near the coasts or in the offing; this statement, deduced from the data afforded by the chart holds good in a general way only and may be contradicted by observations made at special places, where the currents, owing to local circumstances, may follow quite different laws.

Observations of currents made at *Meindertsdroogte* f. i. show that here a strongly marked tendency exists to the N W ward, whilst currents to the S W very seldom occur. There is no reason however to call in question the reliability of either conclusion and the contradiction must be considered as an apparent one only.

Observations of tides have been made at *Meindertsdroogte*, a reef situated near the northern entrance of *Bali*-strait, and at *Pulu Sapudi*, whilst recently other tidal stations have been established at *Banjuwangi* and at *Bima*.

The diurnal and semi-diurnal constituents of the tides being of about equal importance, it is impossible to state whether the characteristic feature is semi-diurnal and largely affected by diurnal inequalities, or, inversely, diurnal with disturbances of a semi-diurnal period; consequently it is hardly possible to give a reliable description and the reader is referred for details to the chapter on tides.

TABLE D. WESTERN SUNDA ISLES, NORTHERN COASTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	6.2	6.3	2.7	4.0	3.0	2.1	2.3	1.4	2.9	4.1	5.9	2.2	2.6	4.6
N N E	0.4	2.1	2.5	4.6	2.9	1.8	1.7	1.7	1.7	3.0	4.1	0.6	2.4	2.1
N E	2.1	1.0	5.2	6.5	5.2	3.0	6.5	4.5	3.6	5.1	5.1	2.8	4.9	3.6
E N E	—	1.0	4.5	9.5	8.9	9.5	7.5	4.5	10.1	7.5	2.0	1.3	8.3	2.7
E	1.6	2.1	4.7	9.5	16.0	14.6	11.5	14.8	10.8	7.0	4.9	2.2	12.9	3.8
E S E	1.6	1.4	2.0	6.3	9.1	12.0	11.3	10.4	10.6	8.8	4.7	1.3	10.0	3.3
S E	—	0.7	5.2	8.0	**18.4**	**16.8**	**18.3**	**19.0**	**15.6**	9.1	8.7	6.2	**16.0**	5.0
S S E	—	2.1	3.7	4.8	7.3	10.3	9.1	7.9	8.9	**10.2**	5.3	3.4	8.1	4.1
S	2.1	2.8	5.0	3.4	5.6	8.8	7.3	9.7	6.7	6.7	**16.7**	8.1	6.9	6.9
S S W	0.8	0.7	2.7	6.1	1.9	4.1	3.2	5.8	2.2	4.3	6.7	9.2	3.9	4.1
S W	4.1	5.6	3.7	3.8	2.1	1.6	1.5	3.7	2.4	3.9	5.7	9.8	2.5	5.5
W S W	3.3	2.8	3.5	2.1	0.7	0.6	1.1	1.1	1.4	1.8	3.5	4.8	1.2	3.3
W	19.3	8.7	10.2	1.1	0.6	1.3	0.9	1.2	1.5	3.0	3.0	7.6	1.1	8.6
W N W	20.6	12.8	**12.9**	2.1	0.1	0.2	1.5	0.5	1.4	1.1	1.0	6.7	1.0	9.2
N W	**23.5**	**21.2**	10.7	3.4	2.2	1.6	1.8	1.2	1.9	1.9	2.4	9.2	2.0	**11.5**
N N W	4.1	9.0	3.7	2.9	1.0	1.1	1.5	1.4	2.2	2.2	3.7	5.9	1.7	4.8
Circulating	5.3	4.2	7.2	4.8	2.8	2.6	5.2	3.2	6.9	9.6	4.7	**12.0**	4.3	7.2
Variable	4.5	15.3	7.2	**14.9**	10.6	5.8	7.3	6.5	8.0	9.8	9.3	3.9	8.9	8.3
Calm	0.4	0.3	2.7	2.3	1.7	2.0	0.6	1.5	1.1	1.0	2.6	2.8	1.5	1.6

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	1.3	1.5	2.1	1.4	1.1	0.6	0.1	—	0.1	—	1.4	0.3	0.6	1.1
N N E	—	3.0	—	0.6	0.5	0.1	0.1	0.3	—	0.1	1.0	0.6	0.3	0.8
N E	—	1.1	1.4	1.6	2.2	0.6	0.2	1.5	—	0.9	1.2	1.1	1.0	1.0
E N E	—	1.5	1.4	3.3	2.8	2.7	2.4	1.1	0.9	0.9	0.8	0.6	2.2	0.9
E	0.4	2.3	4.2	6.5	13.5	10.4	11.3	8.7	3.1	5.1	4.1	4.6	8.9	3.5
E S E	—	0.4	2.1	5.9	10.4	12.3	12.9	7.4	7.5	6.0	4.5	5.7	9.4	3.1
S E	1.3	1.1	6.8	12.4	**19.9**	**18.9**	22.5	**23.2**	**22.6**	13.8	9.7	7.7	**19.9**	6.7
S S E	0.4	1.1	4.0	10.8	15.7	18.2	**23.0**	16.9	21.2	**20.8**	9.3	7.7	17.6	7.2
S	4.3	5.3	10.5	**13.8**	8.1	16.5	13.3	14.8	16.1	16.1	**25.0**	9.7	13.8	11.8
S S W	3.4	0.8	7.0	6.1	3.5	2.9	4.6	8.0	6.1	11.3	13.0	12.3	5.2	8.0
S W	7.2	9.1	8.2	8.5	3.8	2.2	1.4	5.3	7.3	5.7	7.6	**15.4**	4.8	8.9
W S W	2.1	7.2	6.3	1.8	0.8	1.2	0.2	0.7	1.0	1.7	2.9	10.9	1.0	5.2
W	**31.9**	**17.4**	**14.5**	1.2	2.3	1.1	0.4	1.6	0.3	1.4	1.7	5.4	1.2	**12.1**
W N W	22.1	15.8	6.8	1.4	0.4	—	—	0.8	0.3	0.5	0.8	2.9	0.5	8.2
N W	18.3	11.7	5.1	3.3	0.8	1.1	—	0.2	0.3	0.6	1.2	4.0	1.0	6.8
N N W	0.9	2.6	3.0	1.0	1.1	0.1	—	—	0.1	0.5	0.8	0.9	0.4	1.5
Circulating	2.6	6.4	4.9	4.7	3.9	4.1	2.6	3.0	5.3	5.5	4.8	6.3	3.9	5.1
Variable	3.0	10.2	8.9	12.6	6.8	5.8	3.7	5.6	6.8	8.8	7.6	4.0	6.9	7.1
Calm	0.9	1.1	2.8	3.0	2.4	1.3	1.4	1.0	0.9	0.6	2.9	—	1.7	1.4

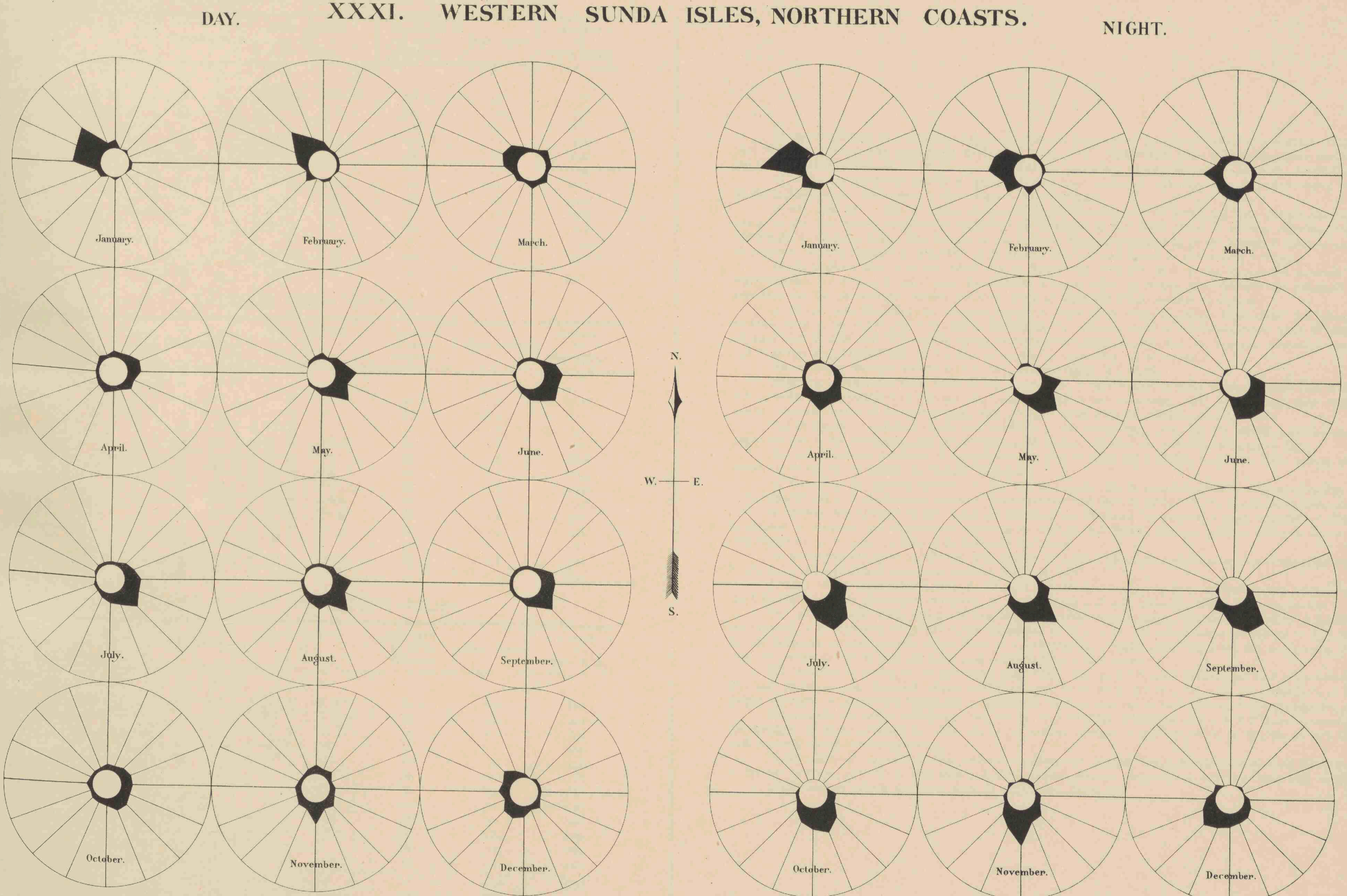
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	25.7	22.5	11.8	25.4	27.7	22.0	34.1	23.4	31.3	9.2	22.9	19.0	27.3	18.5
High Swell	1.1	2.0	—	2.5	0.7	6.4	3.6	4.6	3.9	0.5	3.1	1.5	3.6	1.4
Waves	3.1	—	—	1.7	2.9	1.7	1.6	2.5	2.6	2.0	—	—	2.2	0.9
Sea	25.5	6.0	1.6	11.1	3.5	10.9	8.7	7.8	7.9	7.3	1.4	2.9	8.3	7.5
High Sea	2.1	1.0	1.6	—	0.4	2.5	4.7	1.7	3.9	1.9	0.5	3.4	2.2	1.8
Calm	42.7	68.6	85.1	59.4	64.9	56.7	47.6	60.2	50.4	79.2	72.3	73.3	56.5	70.2
Number of Observations	98	102	109	118	266	295	196	191	230	205	223	206	1296	943

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	32.5	38.0	55.2	52.3	56.4	58.4	68.6	68.7	61.7	60.5	51.4	50.7	61.0	48.1
Overcast	30.3	37.6	27.2	27.6	28.3	28.1	21.2	22.4	22.8	24.4	30.1	27.3	25.1	29.5
Showery	10.5	6.8	6.7	6.4	3.8	3.9	1.8	3.1	1.6	1.2	3.5	4.4	3.4	5.5
Rain	17.6	14.9	7.1	7.8	6.2	5.9	2.0	1.5	0.9	1.9	8.7	13.5	4.1	10.6
Squalls	7.6	0.6	0.4	0.8	0.2	0.3	0.1	0.2	0.3	—	0.2	0.6	0.3	1.6
Thunder	0.4	0.3	0.4	1.8	1.0	0.4	0.3	—	0.3	0.5	1.3	1.2	0.6	0.7
Hazy	1.2	2.0	3.2	3.7	3.9	3.2	6.1	4.2	12.6	11.5	5.0	2.4	5.6	4.2
Mist	—	—	—	—	0.4	—	—	0.2	—	—	—	—	0.1	—
Number of Observations	250	356	538	660	913	1210	1041	734	1091	1073	691	499	5649	3407

XXXI. WESTERN SUNDA ISLES, NORTHERN COASTS.



XXXII. WESTERN SUNDA ISLES, SOUTHERN COASTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	25	—47	N 61° W	W N W	53 %	1.8	81
February	22	—33	N 56° W	N W	40	1.6	137
March	2	0	N	N	2	1.5	131
April	—24	29	S 87° E	E	38	1.4	223
May	—16	45	S 70° E	E S E	48	1.6	293
June	—30	41	S 53° E	S E	51	1.7	394
July	—17	36	S 66° E	E S E	40	1.6	360
August	—32	33	S 45° E	S E	46	1.7	282
September	—16	31	S 62° E	E S E	35	1.5	314
October	—12	15	S 51° E	S E	19	1.6	297
November	—29	1	S	S	29	1.4	198
December	—21	—32	S 56° W	S W	38	1.4	210
Year	—12	10	S 40° E	S E	16	1.57	2920

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	— 1	—63	W	W	63 %	1.8	72
February	0	—38	W	W	38	1.4	132
March	—29	— 5	S 9° W	S	29	1.5	143
April	—38	17	S 25° E	S S E	42	1.4	220
May	—40	32	S 37° E	S E	51	1.5	298
June	—52	36	S 35° E	S E	63	1.7	383
July	—62	43	S 34° E	S S E	75	1.5	329
August	—60	28	S 25° E	S S E	66	1.7	256
September	—62	26	S 23° E	S S E	67	1.6	277
October	—63	12	S 10° E	S	64	1.6	299
November	—49	3	S 4° E	S	49	1.4	197
December	—42	—22	S 28° W	S S W	47	1.4	207
Year	—42	6	S 8° E	S	42	1.54	2813

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	12	—55	N 78° W	W N W	56 %	1.8	153
February	11	—36	N 73° W	W N W	38	1.5	269
March	—14	— 3	S 12° W	S S W	14	1.5	274
April	—31	23	S 37° E	S E	39	1.4	443
May	—28	39	S 55° E	S E	48	1.6	591
June	—41	39	S 44° E	S E	57	1.7	777
July	—40	40	S 45° E	S E	57	1.6	689
August	—46	31	S 34° E	S S E	55	1.7	538
September	—39	29	S 37° E	S E	49	1.6	591
October	—38	14	S 20° E	S S E	40	1.6	596
November	—39	2	S 3° E	S	39	1.4	395
December	—32	—27	S 40° W	S W	42	1.4	417
April—November	—38	27	S 35° E	S E	47	1.58	4620
December—March	— 6	—30	S 79° W	W S W	31	1.55	1113
Year	—27	8	S 17° E	S S E	28	1.57	5733

On consulting table D, which gives the results deduced from a great quantity of reliable observations, we find that northerly and westerly components of the wind rarely occur; consequently there is no compensation between the general motions of the air due to the two monsoons, and there is a considerable transfer of air to the N N W ward.

As a rule the monsoons near these shores are much more reliable at night than during daytime and in and at the entrance to the straits than in the offing and near the coast.

In and near the straits the wind always blows in the direction of the straits and with considerable force, owing to the well known tendency of aircurrents (as exhibited in the lower strata at least) of travelling along waterways, avoiding the land. This draught in the straits is stronger in proportion as the passage is narrower, just as a current becomes stronger in proportion as its channel narrows, and lessens as the channel widens.

The E monsoon sets in in the latter half of March with S winds which at that time begin to prevail at nighthours and continue up to July, when the monsoon is at its height; in August and September the steadiness is somewhat less but the direction remains the same: S S E at night and E S E and S E at daytime.

In October and November the monsoon begins to abate and S winds to prevail; in December the principal direction is from the S S W and S W, and in January the W monsoon comes to full development, when W winds at night and W N W and N W winds during dayhours predominate; in February the monsoon decreases in force and steadiness and in March there is an equal probability of winds from all directions.

The monsoons therefore may be said to turn with the hands of a watch.

From the summarizing table, given in the introduction, it appears that in these regions, though open to the S E monsoon, the percentages of variable and circulating winds are remarkably high; an unsettled state of the weather, a characteristic of the *Indian Ocean* south of *Java*, consequently is experienced here as well.

This statement is confirmed by the fact, exhibited in the summarizing table, that the rainfall is less here than anywhere else in the Archipelago, but the percentages of showery weather are notwithstanding pretty high.

The rain therefore, whenever it occurs, may be said to come down mostly in showers, with variable and circulating winds: heavy squalls are frequent in January.

In the offing the greatest quantity of rain falls in January, but at coastplaces the distribution of rainfall is quite different and to a great extent dependent on local influences, as has been shown to be the case at *Java's* south coast.

At *Negara* the greatest rainfall occurs in November and December: in January a small minimum of minor importance is observed, and a secondary maximum in February and March; here the principal minimum occurs in July whilst at sea it occurs at some time from July to October.

At *Banjuwangi* the driest months are from July to November, the greatest rainfall is experienced from December to February and a secondary maximum occurs in May and June.

A force of the wind greater than 3 has been recorded 55 times out of 2920 at daytime, and 68 times in 2813 during nighthours, and almost exclusively in January, June and July, especially during the latter months.

The atmosphere in these regions is very hazy; in September and October very high percentages of haziness are recorded, a circumstance which proves the atmosphere to be very dry; it is however moist enough to give rise to the formation of large cumuli, which float in a pale blue sky; bright starry nights are rare and stars of the first and second magnitude only are dimly seen surrounded by a hazy corona.

The condition of the sea is, on the whole, much better than at the S coast of *Java:* the swell is considerably less and abates towards the coast; during the W monsoon heavy swells are rare, but when the monsoon is at its height, especially in August and September, a considerable swell coming out of the *Timor-sea* is frequently experienced.

The currents are mostly driftcurrents and run to the S E in the W monsoon and to the S W in the E monsoon: the strongest W monsooncurrent on record was of 45, and the strongest E monsooncurrent of 36 miles in 24 hours, both currents setting towards the E S E.

In the straits the currents are tidal streams of considerable strength, which, whenever the direction of the wind is opposite to theirs, give rise to tidal races and eddies, which often are dangerous for small and even large vessels.

Observations of rainfall have been made at *Negara* and *Banjuwangi.*

TABLE D. WESTERN SUNDA ISLES, SOUTHERN COASTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	8.0	5.2	2.5	4.9	2.5	1.8	3.4	1.8	3.4	4.6	4.5	1.9	3.0	4.5
N N E	0.7	1.9	3.5	4.3	2.4	2.0	2.2	1.6	2.3	4.0	3.8	0.6	2.5	2.4
N E	2.7	1.9	5.5	5.5	5.2	2.9	8.8	5.2	3.7	6.3	2.4	2.6	5.2	3.6
E N E	—	1.4	6.5	10.7	9.9	7.2	7.1	5.0	10.5	5.7	1.7	1.3	8.4	2.8
E	1.3	1.9	5.5	11.3	16.4	12.3	9.6	11.3	9.4	8.0	4.1	1.3	11.7	3.7
E S E	2.7	2.3	2.5	7.9	7.6	12.7	10.3	9.3	8.4	1.7	2.4	2.3	9.4	2.3
S E	—	0.9	6.5	7.6	**16.8**	**17.5**	**13.3**	**16.7**	**13.5**	6.7	8.9	3.9	**14.2**	4.5
S S E	—	2.8	5.0	3.0	5.6	9.2	9.0	8.7	6.2	9.2	3.8	3.5	7.0	4.1
S	3.3	3.8	6.5	3.4	6.7	8.9	7.5	10.1	7.5	7.6	**21.6**	7.4	7.4	8.4
S S W	1.3	—	4.5	7.3	2.6	5.5	4.4	7.5	3.7	5.9	7.6	**12.5**	5.2	5.3
S W	5.3	6.6	2.5	2.4	2.2	1.9	1.0	4.0	3.7	5.0	6.5	11.9	2.5	6.3
W S W	4.7	3.8	2.0	2.1	0.2	1.2	1.7	1.2	0.9	2.9	3.8	5.8	1.2	3.8
W	16.0	6.6	5.0	1.2	0.9	1.2	1.4	1.6	3.0	2.1	2.7	12.5	1.6	7.5
W N W	14.0	10.8	8.5	0.9	0.2	0.3	1.7	0.6	0.7	1.3	1.4	8.0	0.7	7.3
N W	**19.3**	**18.8**	7.5	3.0	1.3	2.5	1.7	1.0	2.3	1.1	1.7	4.8	2.0	8.9
N N W	6.7	10.4	5.0	2.1	1.3	1.3	1.8	1.4	2.1	3.4	4.5	3.9	1.7	5.7
Circulating	7.3	5.2	9.0	5.8	3.4	3.5	6.3	3.2	9.6	11.8	4.1	9.0	5.3	7.7
Variable	6.0	16.0	**9.5**	**14.6**	12.9	6.0	8.6	8.1	8.2	**11.8**	12.0	4.5	9.7	**10.0**
Calm	0.7	—	2.5	1.8	1.9	2.2	0.5	1.6	1.1	1.1	2.4	2.3	1.5	1.5

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	0.8	2.2	2.7	1.9	0.9	1.2	0.2	—	0.2	—	2.4	—	0.7	1.4
N N E	—	4.4	—	0.3	—	0.1	0.2	0.5	—	0.2	1.4	0.7	0.2	1.1
N E	—	1.1	2.2	3.4	1.5	0.9	0.4	1.4	—	0.4	2.1	1.0	1.3	1.1
E N E	0.8	2.2	2.2	4.9	2.4	2.4	2.2	0.7	1.6	1.0	0.7	0.7	2.4	1.3
E	—	2.7	5.4	4.9	13.2	7.8	8.8	7.2	6.7	2.5	5.9	4.7	8.1	3.5
E S E	—	0.8	4.9	7.4	7.7	12.6	11.4	8.1	7.4	6.1	3.5	5.0	9.1	3.4
S E	2.3	1.1	8.9	12.3	**18.5**	17.7	**24.8**	**22.1**	**20.5**	9.8	9.8	6.0	**19.3**	6.3
S S E	0.8	1.6	6.3	10.2	14.1	**18.3**	20.0	19.1	19.9	**21.5**	9.1	5.7	16.9	7.5
S	6.8	6.0	11.2	**14.8**	8.4	17.1	17.1	13.7	14.7	19.5	**23.1**	8.4	14.3	**12.5**
S S W	6.0	1.1	8.0	6.8	4.8	2.4	5.7	7.9	7.8	13.1	11.5	11.4	5.9	8.5
S W	11.3	13.1	6.3	7.4	5.5	2.4	1.4	7.2	8.5	6.1	8.0	**16.8**	5.4	10.3
W S W	—	6.6	4.5	0.9	1.3	1.3	0.2	0.9	1.8	1.8	3.5	12.1	1.1	4.8
W	**26.3**	**14.2**	9.4	1.9	2.0	0.7	0.6	1.6	—	0.8	3.1	8.4	1.1	10.4
W N W	20.3	11.5	3.1	1.2	0.2	—	—	0.5	—	0.4	1.4	2.7	0.3	6.6
N W	15.0	8.2	1.8	2.8	1.1	1.0	—	0.2	0.2	0.8	1.4	2.0	0.9	4.9
N N W	1.5	3.8	1.8	0.3	1.3	0.3	—	—	0.2	0.6	1.0	0.7	0.4	1.6
Circulating	2.3	7.1	5.4	3.7	5.9	4.2	2.2	3.4	5.6	5.5	2.4	7.7	4.2	5.1
Variable	4.5	10.9	**13.4**	11.4	7.5	7.8	3.5	5.3	4.2	9.0	5.9	4.4	6.6	8.0
Calm	1.5	1.6	2.7	3.4	3.7	1.6	1.4	0.2	0.7	0.6	3.5	1.7	1.8	1.9

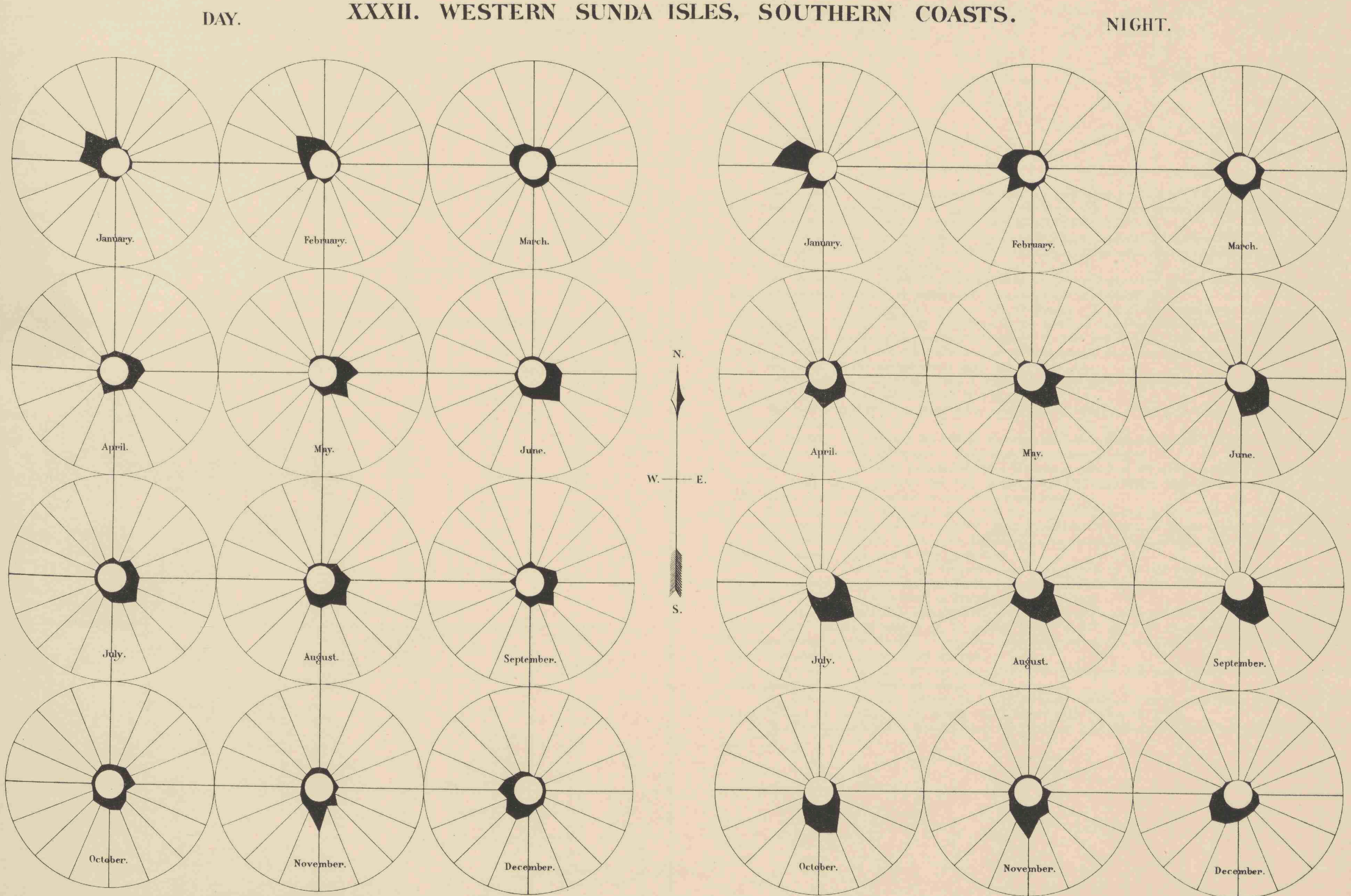
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	23.8	25.0	40.4	31.6	34.5	30.1	37.1	22.6	28.2	6.6	29.3	28.3	30.7	25.6
High Swell	—	—	—	3.3	0.7	6.1	1.1	9.3	5.3	1.3	0.6	2.5	4.3	0.7
Waves	—	—	—	1.6	0.7	2.2	—	2.8	2.3	2.9	—	—	1.6	0.5
Sea	12.2	5.0	—	11.8	2.9	9.7	11.3	6.7	4.6	4.2	1.3	3.1	7.8	4.3
High Sea	3.9	—	—	—	—	1.8	6.2	1.1	0.8	1.3	—	0.6	1.7	1.0
Calm	60.3	70.1	59.6	51.8	61.0	50.2	44.4	57.8	59.1	83.9	68.9	65.4	54.1	68.0
Number of Observations	31	80	46	60	148	176	97	105	132	74	160	162	718	553

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	35.1	34.0	52.1	52.9	56.4	59.0	71.0	67.1	59.2	58.1	50.5	54.6	60.9	47.4
Overcast	30.5	39.6	34.2	27.8	29.2	29.4	21.5	23.4	23.4	27.8	30.3	26.5	25.8	31.5
Showery	10.3	7.3	6.0	5.5	4.2	3.2	0.9	4.0	2.0	1.2	3.6	4.6	3.3	5.5
Rain	15.5	16.6	5.2	6.4	5.2	5.2	1.7	1.8	1.4	3.1	11.5	10.0	3.6	10.3
Squalls	8.7	0.4	0.4	0.5	—	0.4	0.2	0.2	0.2	—	—	0.3	0.3	1.6
Thunder	—	0.8	0.4	2.3	1.1	0.4	0.5	—	0.7	0.4	1.3	2.0	0.8	0.8
Hazy	—	1.5	1.9	4.8	3.9	2.6	4.5	3.7	12.9	9.5	3.1	2.2	5.4	3.0
Mist	—	—	—	—	0.2	—	—	—	0.2	—	—	—	0.1	—
Number of Observations	148	272	271	439	593	770	683	537	564	589	394	411	3586	2085

XXXII. WESTERN SUNDA ISLES, SOUTHERN COASTS.



XXXIII. EASTERN SUNDA ISLES, NORTHERN COASTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	2	—55	N 88° W	W	55 %	1.5	52
February	21	—22	N 48° W	N W	30	1.1	73
March	4	—29	N 83° W	W	29	1.5	152
April	— 2	33	S 86° E	E	33	1.4	222
May	— 7	32	S 78° E	E S E	33	1.4	401
June	—23	57	S 69° E	E S E	61	1.5	360
July	—19	58	S 73° E	E S E	61	1.5	224
August	—23	52	S 66° E	E S E	57	1.6	285
September	— 3	26	S 84° E	E	26	1.4	209
October	— 1	36	E	E	36	1.3	356
November	2	16	N 82° E	E	16	1.4	154
December	11	—44	N 77° W	W N W	45	1.6	172
Year	— 3	13	S 77° E	E S E	13	1.43	2660

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	— 8	—61	S 82° W	W	62 %	1.6	55
February	32	—45	N 54° W	N W	55	1.3	56
March	—13	—40	S 72° W	W S W	42	1.3	143
April	—25	36	S 56° E	S E	44	1.5	222
May	—38	32	S 40° E	S E	50	1.4	384
June	—40	53	S 53° E	S E	66	1.5	352
July	—49	54	S 48° E	S E	73	1.5	206
August	—37	48	S 53° E	S E	61	1.5	276
September	—41	37	S 43° E	S E	55	1.4	205
October	—21	35	S 60° E	E S E	41	1.2	355
November	—19	— 5	S 15° W	S S W	20	1.3	150
December	6	—45	N 83° W	W	45	1.4	162
Year	—21	8	S 21° E	S S E	22	1.41	2566

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	— 3	—58	S 87° W	W	58 %	1.6	107
February	27	—34	N 52° W	N W	43	1.2	129
March	— 5	—35	S 82° W	W	35	1.4	295
April	—14	35	S 69° E	E S E	38	1.5	444
May	—23	32	S 54° E	S E	39	1.4	785
June	—32	55	S 60° E	E S E	64	1.5	712
July	—34	56	S 59° E	E S E	65	1.5	430
August	—30	50	S 59° E	E S E	58	1.6	561
September	—22	32	S 55° E	E S E	39	1.4	414
October	—11	36	S 73° E	E S E	38	1.3	711
November	— 8	6	S 37° E	S E	10	1.4	304
December	9	—45	N 79° W	W N W	46	1.5	334
April—November	—22	38	S 60° E	E S E	44	1.45	4361
December—March	7	—43	N 81° W	W	44	1.43	865
Year	—12	11	S 43° E	S E	16	1.44	5226

The E monsoon in these regions sets in early in April when E, E S E and S E winds begin to prevail; in this month and in May variable and circulating winds occur with pretty high percentages of frequency; in June, July and August the monsoon is at its height, blowing steadily from the E S E.

In September and October it abates, the direction is less constant and variable and circulating winds are frequently experienced; in November winds from every point of the compass may be expected and the frequency of variable winds attains its highest value.

The W monsoon does not set in before December; then westerly winds prevail, but variable winds still are often met with and, especially at daytime, the monsoon cannot be depended upon.

In January the W monsoon comes to full development: W winds blow with great steadiness and a force which, though not high, yet surpasses that shown in the tables for any other month excepting August.

In February the monsoon considerably decreases in force and steadiness and in March winds from the two westerly quadrants prevail, but N E winds occur as well occasionally and calms are not seldom experienced.

Both monsoonwinds are steadier at night than at dayhours.

During either monsoon strong N and S winds blow in the straits and passages and the narrower the channel, the stronger the wind that rushes through it.

The rainfall appears to be considerably heavier in the vicinity of the eastern than in that of the western *Sunda Isles* (northern parts).

In December and January the rainfall is maximum with a frequency of about 30 %; in either month the weather is rather showery and squalls at times, though not frequently, occur.

Thunderstorms are mostly experienced during the turning periods of the monsoons with circulating winds: in June the rainfall slightly increases and July, August, September and October constitute the dry season when rain rarely occurs, though not so seldom as near the western islands.

During this period the atmosphere is very hazy and distant objects are only visible at times when the sky is cleared by occasional showers; during the W monsoon prevailing S winds are usually accompanied by hazy skies.

The force of the wind is rather low, forces greater than 3 having been recorded only 22 times in 5226 and of these 17 times at night, and 5 times at daytime.

The weather consequently may be described in a general way as fine and constant, but overcast and sultry, owing to the high percentages of clouds in the rainy and of haziness in the dry season, while dark blue skies and bright starry nights are only observed in February, March and April.

The condition of the sea is rather favourable: considerable swells are but seldom observed and only with persistant easterly winds; the sea is calm in the W monsoon because in that period the current sets with the wind: in the E monsoon however, the direction of the wind being from the E S E, and that of the currents from the E N E, „seas" and „high seas" are frequently recorded.

In the straits and near the entrances, where tidal streams run with great velocity, turbulent seas are also often encountered and tidal races and eddies occur.

The rates of the strongest currents, as deduced from the differences between astronomical and dead reckoning are of 76 miles per 24 hours to the W S W and of 41 miles per diem to the E S E.

Up to the present moment observations of either tides or wind and rainfall have not been made in these regions.

TABLE D. EASTERN SUNDA ISLES, NORTHERN COASTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	4.9	12.1	6.0	4.7	2.1	0.7	0.3	1.3	5.2	3.0	4.8	3.6	2.4	5.7
NNE	—	1.1	3.4	2.2	2.4	1.4	0.3	0.9	5.8	4.5	9.6	2.1	2.2	3.5
NE	7.4	14.3	10.7	6.3	8.0	6.3	5.7	6.2	7.6	**12.7**	6.7	7.5	6.7	9.9
ENE	—	3.3	2.6	6.9	7.4	8.7	12.3	16.6	8.2	9.7	4.3	—	10.0	3.3
E	—	—	3.0	**15.4**	11.5	19.2	**22.9**	**17.7**	**13.1**	10.3	4.8	—	**16.6**	3.0
ESE	1.2	—	—	15.0	11.6	14.8	14.0	7.5	3.4	9.5	1.0	1.1	11.1	2.1
SE	—	5.5	1.3	9.7	**11.8**	**19.9**	16.3	14.4	11.7	10.5	7.7	0.7	14.0	4.3
SSE	1.2	—	1.7	1.6	6.0	4.3	4.9	8.4	2.1	3.6	1.4	1.8	4.6	1.6
S	4.9	2.2	3.0	1.9	8.7	7.8	4.6	11.8	7.2	3.8	7.7	2.8	7.0	4.1
SSW	—	—	6.0	0.9	4.4	1.6	2.9	1.6	2.7	2.6	3.3	1.1	2.4	2.2
SW	16.0	9.9	7.7	2.8	5.0	1.1	2.0	4.4	3.1	3.8	8.6	13.2	3.1	9.9
WSW	4.9	7.7	10.3	5.0	1.7	—	1.7	0.2	3.4	2.0	2.9	5.0	2.0	5.5
W	**33.3**	12.1	**18.5**	3.8	4.3	1.3	—	0.7	4.5	2.0	**10.5**	**18.1**	2.4	**15.8**
WNW	4.9	2.2	5.6	—	1.2	0.7	0.6	0.4	0.7	1.4	6.7	13.2	0.6	5.7
NW	9.9	**16.5**	5.6	4.4	2.1	1.3	2.0	0.9	2.4	1.8	4.3	8.2	2.2	7.7
NNW	2.5	—	0.4	1.9	0.2	—	1.1	—	0.7	1.6	1.4	7.1	0.7	2.2
Circulating	3.7	3.3	7.3	5.0	2.4	2.5	2.6	2.0	6.5	5.1	1.9	7.5	3.5	4.8
Variable	1.2	—	2.1	11.0	5.8	4.5	3.7	3.1	10.0	8.3	10.5	6.0	6.4	4.7
Calm	3.7	9.9	4.7	1.6	3.6	3.8	2.3	1.8	1.7	3.6	1.9	1.1	2.5	4.2

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	2.2	18.9	5.3	3.2	1.8	0.9	—	0.9	2.1	7.7	1.5	6.8	1.5	7.1
NNE	2.2	—	0.5	0.6	2.3	0.4	—	0.5	—	0.2	—	2.5	0.6	0.9
NE	4.4	2.7	2.4	4.1	3.4	2.0	0.5	3.0	3.8	3.4	4.4	3.8	2.8	3.5
ENE	3.3	—	1.0	5.2	3.4	6.2	5.8	3.9	1.4	7.1	2.9	0.4	4.3	2.5
E	—	—	2.4	14.6	10.1	**22.4**	13.2	17.3	11.1	13.7	7.8	0.4	14.8	4.1
ESE	—	—	0.5	13.4	10.8	13.8	18.9	12.9	16.7	9.2	3.4	0.4	14.4	2.3
SE	—	2.7	1.9	**16.3**	**17.5**	17.8	**22.7**	**22.8**	**19.4**	**14.3**	5.4	3.4	**19.4**	4.6
SSE	—	1.4	1.9	8.2	11.3	10.2	12.6	8.8	8.7	8.5	3.9	3.0	10.0	3.1
S	2.2	—	7.8	6.1	13.8	10.7	11.5	10.1	14.6	8.3	12.7	3.4	11.1	5.7
SSW	5.5	—	6.3	1.7	2.5	5.6	4.4	2.3	3.1	2.1	2.0	2.1	3.3	3.0
SW	18.7	9.5	12.1	5.5	4.8	3.5	1.6	1.6	3.1	5.8	4.9	8.9	3.4	10.0
WSW	—	2.7	11.2	2.9	1.6	—	—	0.9	0.7	0.4	3.8	8.0	1.0	4.4
W	**50.5**	20.3	**14.0**	2.6	2.5	0.7	—	2.1	3.5	2.4	**13.7**	**23.2**	1.9	**20.7**
WNW	—	1.4	8.7	0.9	1.6	—	—	—	0.7	0.4	3.4	8.0	0.5	3.7
NW	2.2	**24.3**	6.8	2.6	0.9	0.4	—	1.6	2.4	1.9	3.4	11.4	1.3	8.3
NNW	2.2	5.4	0.5	1.2	0.4	—	—	—	—	0.6	—	3.0	0.3	2.0
Circulating	3.3	5.4	4.4	2.3	1.8	0.5	1.4	1.8	3.1	2.8	6.4	3.8	1.8	4.4
Variable	—	—	3.4	5.8	6.5	1.8	3.8	6.5	3.8	5.8	12.7	5.9	4.7	4.6
Calm	3.3	5.4	8.7	2.6	3.5	3.1	3.6	3.0	1.7	5.3	7.4	1.7	2.9	5.3

CONDITION OF THE SEA, PERCENTAGE.

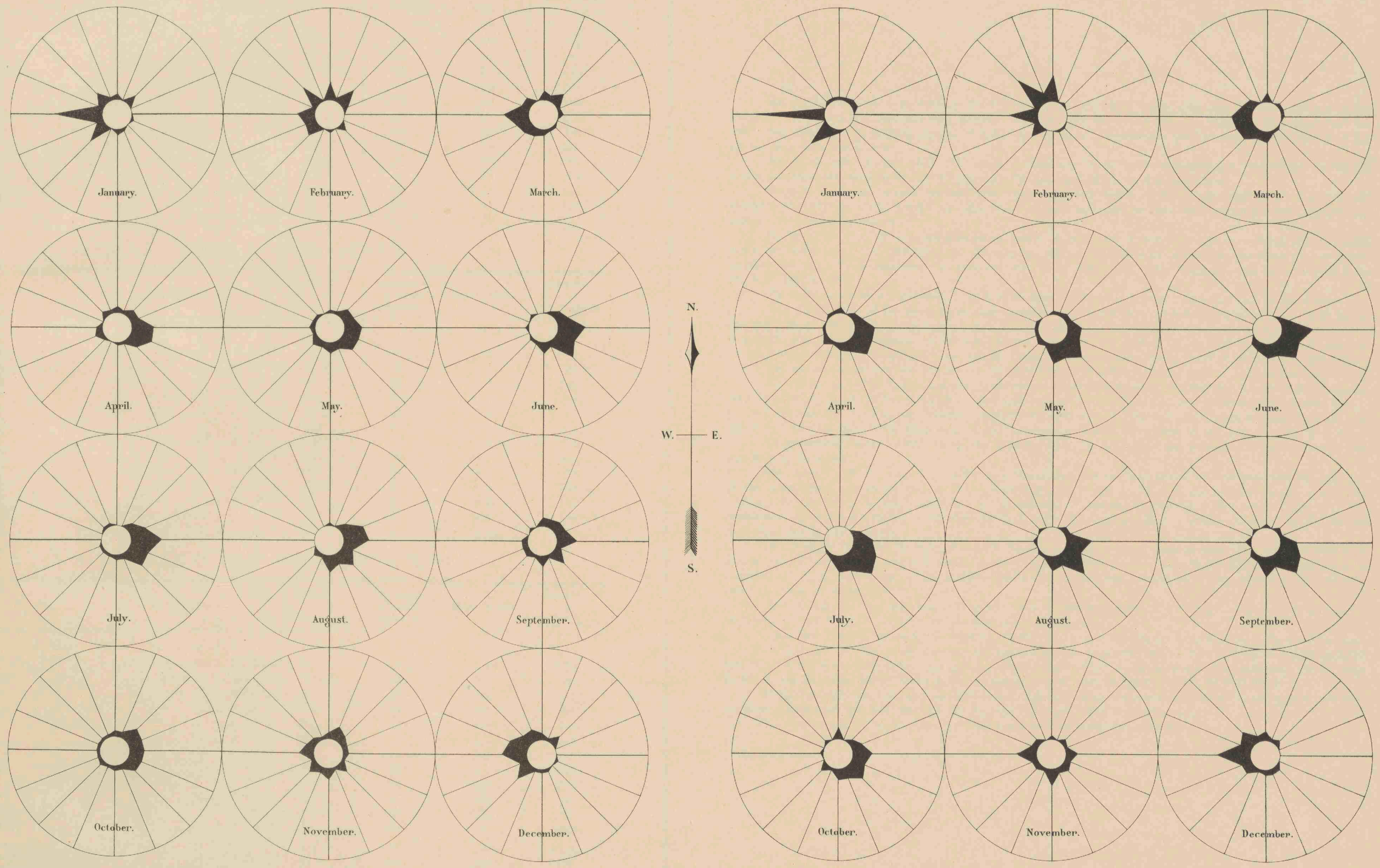
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	17.8	18.4	12.8	15.2	16.5	30.2	14.7	18.7	27.9	14.4	13.1	10.8	20.5	14.6
High Swell	—	—	—	1.0	0.7	0.9	6.7	—	2.1	5.0	—	—	1.9	0.8
Waves	1.2	1.2	—	—	—	1.7	1.0	1.4	3.2	1.2	—	0.9	1.2	0.8
Sea	11.2	2.7	0.7	1.9	4.2	9.7	5.8	20.6	7.6	0.8	4.1	18.2	8.3	6.3
High Sea	6.6	—	2.4	1.9	0.4	0.4	1.9	3.3	—	0.4	0.8	4.9	1.3	2.5
Calm	63.4	77.9	84.1	80.1	78.4	57.3	70.0	56.1	59.2	78.4	82.1	65.3	66.9	75.2
Number of Observations	90	101	128	106	319	239	103	214	94	264	149	103	1075	835

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	31.2	37.1	48.3	53.3	64.0	54.4	65.0	62.2	67.3	68.8	56.8	35.3	61.0	46.3
Overcast	33.0	42.5	34.5	26.4	23.7	29.3	22.4	21.0	16.6	16.9	20.0	30.4	23.2	29.6
Showery	5.4	2.6	1.7	5.0	1.8	3.4	3.4	3.1	1.3	2.7	4.7	11.1	3.0	4.7
Rain	26.6	16.4	14.5	11.1	6.7	8.6	3.1	4.9	2.5	2.4	11.8	18.1	6.2	15.0
Squalls	0.9	0.9	0.4	0.5	0.3	0.2	0.2	0.2	—	—	—	2.2	0.2	0.7
Thunder	—	—	0.4	0.7	0.7	0.2	0.2	—	0.3	—	3.7	1.2	0.4	0.9
Hazy	1.9	0.7	0.4	3.2	2.9	4.1	5.6	8.7	12.3	9.3	2.5	1.8	6.1	2.8
Mist	1.0	—	—	—	—	—	0.2	—	—	—	0.7	—	0.0	0.3
Number of Observations	109	129	292	443	782	701	448	553	406	704	312	332	3333	1878

XXXIII. EASTERN SUNDA ISLES, NORTHERN COASTS.

DAY. NIGHT.



XXXIV. EASTERN SUNDA ISLES, SOUTHERN COASTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	0	—48	W	W	48 %	1.5	72
February	14	—30	N 66° W	W N W	33	1.2	83
March	8	—25	N 74° W	W N W	26	1.5	139
April	— 6	20	S 73° E	E S E	21	1.4	201
May	—18	25	S 53° E	S E	31	1.4	414
June	—21	41	S 63° E	E S E	46	1.5	289
July	—19	44	S 67° E	E S E	48	1.5	202
August	—29	37	S 51° E	S E	47	1.5	216
September	—14	20	S 55° E	S E	24	1.5	200
October	— 6	22	S 76° E	E S E	23	1.3	274
November	—15	—11	S 36° W	S W	19	1.4	165
December	0	—40	W	W	40	1.4	148
Year	— 9	5	S 29° E	S S E	10	1.43	2403

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	12	—47	N 77° W	W N W	48 %	1.3	103
February	25	—47	N 61° W	W N W	53	1.3	67
March	— 3	—33	S 83° W	W	33	1.4	132
April	—20	4	S 62° E	E S E	20	1.5	203
May	—37	24	S 34° E	S S E	44	1.4	404
June	—47	41	S 40° E	S E	62	1.4	285
July	—51	56	S 48° E	S E	76	1.5	193
August	—38	40	S 47° E	S E	55	1.5	207
September	—43	33	S 38° E	S E	54	1.4	192
October	—11	23	S 65° E	E S E	25	1.2	269
November	—27	— 3	S 7° W	S	27	1.2	151
December	— 5	—37	S 82° W	W	37	1.4	140
Year	—20	5	S 14° E	S S E	21	1.38	2346

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	6	—48	N 83° W	W	48 %	1.4	175
February	20	—39	N 63° W	W N W	44	1.3	150
March	3	—29	N 84° W	W	29	1.5	271
April	—13	12	S 43° E	S E	18	1.5	404
May	—28	25	S 42° E	S E	38	1.4	818
June	—34	41	S 51° E	S E	53	1.5	574
July	—35	50	S 55° E	S E	61	1.5	395
August	—34	39	S 49° E	S E	52	1.5	423
September	—29	27	S 43° E	S E	40	1.5	392
October	— 9	23	S 69° E	E S E	25	1.3	543
November	—21	— 7	S 18° W	S S W	22	1.3	316
December	— 3	—39	S 86° W	W	39	1.5	288
April—October	—26	31	S 50° E	S E	40	1.46	3549
November—March	1	—32	N 88° W	W	32	1.40	1200
Year	—15	5	S 18° E	S S E	16	1.43	4749

The components given in table C clearly exhibit the fact, that winds from the northerly quarters of the compass seldom occur and that the most frequent are those from the S E or from the S W and W: taken over the whole year there is a considerable surplus of southerly and easterly components and the general displacement of the air therefore is to the N N W.

The E monsoon, during which S E winds prevail, sets in in April when however variable and circulating winds are frequently experienced and consequently the monsoon cannot be depended upon.

There is a regular increase in steadiness up to July, and then a regular decreases till October; during this monsoon the wind is much steadier at night than at daytime, when variable and circulating winds predominate, especially in April and October.

In November westerly components begin to appear, S, S W and W winds prevail, but variable and circulating winds are frequent too; in December the W monsoon sets in and lasts till March; the percentages of steadiness however are never very high and the monsoon cannot be relied upon, there being an equal probability of S W, W, N W and N winds.

The wind generally is but feeble; a force more than 3 has been registered only 25 times in the 4749.

The salient points of the weather are high percentages of bright sky and low percentages of cloudiness during the dry season, but at the same time a very hazy atmosphere; this haziness gradually increases from April to September when it is maximum; in October, though still a very dry month, the haziness is considerably less and in November, when the atmosphere is cleared by occasional rains, distant objects begin to be distinctly perceptible.

The rainfall, taken over the whole year, is greater than near the southern coasts of the western *Sunda Isles.*

The maximum of rainfall is observed in December, when also showery weather and occasional heavy squalls may be expected; in January the rainfall is less, light showers frequently occur, but squalls are seldom met with.

From January to May the rainfall gradually decreases, but in June a slight increase is observable; the dry season is from July to October, when scarcely any considerable rainfall is experienced and heavy squalls never occur.

Thunderstorms mostly occur during the months when the monsoons are weakest i. e. in April, May and especially in November.

The condition of the sea, is generally very favourable, because these shores are sheltered from the influence of the surrounding seas by the isles of *Flores, Solor* and *Allor* in the N, *Timor* in the S E and *Sumba* in the S W. Consequently the swell, though highest in the E monsoon, is seldom considerable. „Sea" and „high sea" are occasionally recorded and mostly with S W winds because the currents have a strong tendency to flow to the S W ward during both seasons.

During the E monsoon the main motion of the water at the northern coast of these isles is to the S W ward and in the W monsoon to the S E ward. In both seasons therefore the water flows through the passages in a southerly direction and, owing to the configuration of the adjacent isles, a kind of estuary is formed, the principal outlet of which is in the S W.

Table D exhibits the fact that S W winds more or less frequently occur during all seasons; consequently a turbulent sea and chopping waves occur at times, but not frequently.

„Calm sea" prevails, as might be expected, in March and April, October and November, when the monsoons turn.

The average velocities of the currents are pretty high viz. 16.4 miles per 24 hours for the W monsooncurrent and 18.3 for the E monsooncurrent; the greatest values deduced from astronomical and dead reckoning are 76 miles in the E, and 52 miles per 24 hours in the W monsoon, both currents setting to the W S W ward.

In the passages tidal streams run with considerable force and, when the wind blows in an opposite direction or when driftcurrents and tidal streams diverge, tidal races and eddies frequently occur.

No observations of rainfall, wind, or tides made at coastplaces are available.

TABLE D. EASTERN SUNDA ISLES, SOUTHERN COASTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	4.5	10.2	6.5	3.7	2.5	0.9	1.3	0.6	4.7	3.2	6.1	6.2	2.3	6.1
N N E	—	0.9	3.7	3.7	3.2	1.3	0.3	1.8	4.3	4.0	7.8	2.7	2.4	3.2
N E	6.4	12.0	11.2	4.7	7.7	7.6	5.3	5.4	5.7	**13.2**	4.8	8.0	6.1	9.3
E N E	—	2.8	2.3	5.4	5.9	6.7	3.8	10.5	5.7	4.5	1.3	—	6.3	1.8
E	0.9	—	2.3	12.8	8.7	14.3	**21.1**	15.6	10.0	8.4	4.8	—	13.8	2.7
E S E	1.8	—	—	10.1	11.1	11.6	13.5	4.2	4.3	5.3	0.4	—	9.1	1.3
S E	—	4.6	1.9	5.1	**12.1**	**18.0**	17.0	**17.1**	**13.3**	11.6	7.8	2.2	**13.8**	4.7
S S E	0.9	—	1.9	1.0	4.0	3.1	5.3	6.3	7.3	4.5	3.5	1.8	4.5	2.1
S	3.6	1.9	3.3	6.1	8.9	9.1	5.0	15.0	6.0	4.0	7.4	5.3	8.4	4.3
S S W	3.6	—	7.5	3.4	3.7	2.5	2.2	1.5	4.3	4.2	3.9	—	2.9	3.2
S W	12.7	9.3	7.0	3.7	5.4	2.2	1.6	7.5	5.3	5.5	**16.9**	**23.0**	4.3	**12.4**
W S W	11.8	13.9	7.0	6.1	2.9	1.3	1.9	—	3.3	2.6	9.1	7.1	2.6	8.6
W	**18.2**	**13.9**	**13.1**	2.7	4.5	2.5	0.6	3.0	3.7	4.0	6.5	11.5	2.8	11.2
W N W	8.2	1.9	8.9	0.7	1.7	1.6	3.1	0.6	2.3	2.1	0.9	5.3	1.7	4.6
N W	11.8	13.9	6.1	3.4	2.5	2.2	4.1	1.5	3.3	1.6	2.2	12.8	2.8	8.1
N N W	1.8	—	2.3	1.4	0.5	0.2	0.9	—	0.7	1.6	0.9	2.7	0.6	1.6
Circulating	4.5	4.6	7.5	7.1	3.5	3.3	3.8	2.7	7.0	6.6	3.1	6.2	4.6	5.4
Variable	6.4	1.9	2.3	**17.2**	7.6	7.1	6.3	4.8	7.7	9.0	10.8	3.5	8.5	5.7
Calm	2.7	8.3	5.1	1.7	3.5	4.5	2.8	2.1	1.0	4.2	2.2	1.8	2.6	4.1

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	11.6	16.9	4.6	2.6	2.2	1.2	—	0.9	2.2	10.5	3.7	6.5	1.5	9.0
N N E	1.4	2.2	—	0.6	1.7	—	0.7	0.9	—	0.6	0.5	1.0	0.7	1.0
N E	4.1	2.2	2.6	6.8	4.1	2.1	1.0	3.1	2.6	5.8	1.6	6.5	3.3	3.8
E N E	2.1	—	1.5	7.4	3.2	3.6	1.3	4.4	1.5	6.4	—	0.5	3.6	1.8
E	—	—	4.1	12.9	4.9	15.4	15.6	13.5	10.7	**12.0**	5.2	—	12.2	3.6
E S E	—	—	3.1	9.7	10.9	10.2	15.9	8.5	**18.1**	5.8	4.2	0.5	12.2	2.3
S E	1.4	2.2	4.1	**17.1**	**18.4**	**22.3**	**30.5**	**26.7**	16.7	11.4	8.4	5.5	**22.0**	5.5
S S E	0.7	1.1	2.0	5.8	9.2	8.3	13.6	6.9	8.9	2.9	6.3	2.5	8.8	2.6
S	1.4	2.2	7.1	6.5	13.1	15.2	8.3	12.9	15.2	9.4	11.5	4.0	11.9	5.9
S S W	3.4	—	5.1	1.6	3.9	6.4	3.6	1.9	4.4	2.0	5.2	—	3.6	2.6
S W	16.4	9.0	8.2	5.5	5.5	4.7	1.7	2.8	4.8	9.6	4.7	**21.0**	4.2	11.5
W S W	1.4	9.0	5.1	1.9	2.7	0.2	—	0.6	1.5	0.6	3.1	9.0	1.2	4.7
W	**28.1**	18.0	**14.8**	1.3	2.4	1.2	—	3.5	3.3	2.3	11.5	13.5	2.0	**14.7**
W N W	0.7	3.4	13.8	1.0	2.2	—	0.7	—	0.7	0.9	—	3.5	0.8	3.7
N W	13.7	**20.2**	7.1	1.9	1.0	0.5	—	2.8	3.0	2.0	3.1	10.5	1.5	9.4
N N W	4.1	4.5	4.6	1.6	1.0	—	—	—	—	0.9	—	2.5	0.4	2.8
Circulating	4.8	4.5	3.1	3.5	2.0	0.9	1.7	1.9	3.0	2.9	9.4	3.5	2.2	4.7
Variable	—	—	2.6	9.4	7.3	3.8	1.7	3.5	1.5	6.1	**13.1**	4.5	4.5	4.4
Calm	4.8	4.5	6.6	2.9	3.9	4.0	4.0	5.0	1.9	7.6	8.4	5.0	3.6	6.2

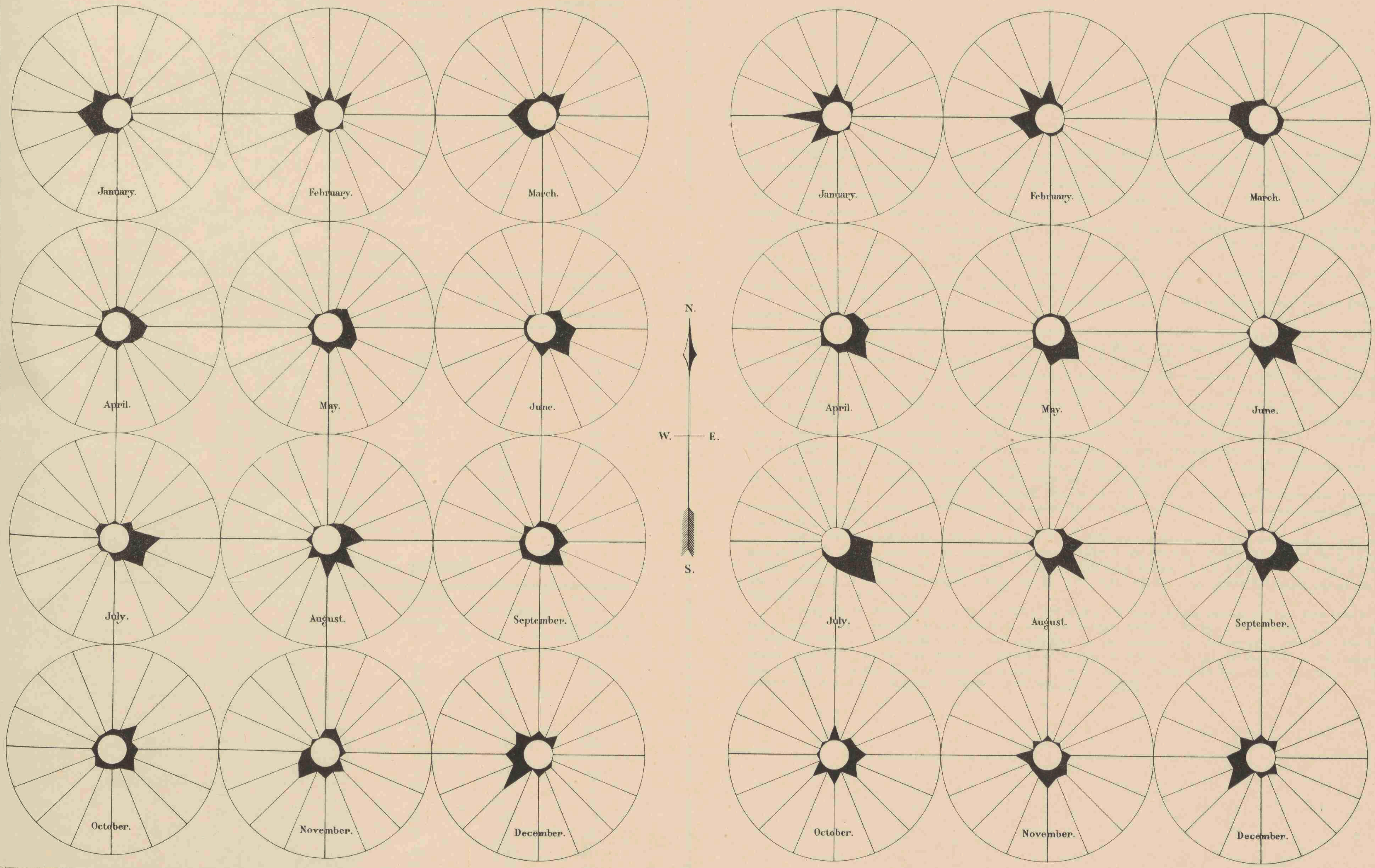
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	16.1	18.4	13.4	14.9	17.6	27.7	13.9	16.2	30.1	15.0	15.2	11.7	20.0	15.0
High Swell	—	—	—	0.9	0.3	0.4	—	—	1.8	—	—	—	0.6	—
Waves	1.3	1.1	—	1.0	0.3	1.7	2.8	0.5	2.7	0.9	—	0.6	1.5	0.7
Sea	6.9	2.7	2.6	1.9	5.7	12.7	7.6	19.3	3.7	0.9	4.1	8.1	8.5	4.2
High Sea	3.1	—	2.6	—	0.4	—	2.1	—	—	—	0.8	2.9	0.4	1.6
Calm	72.7	77.9	81.4	81.4	75.9	57.6	73.6	64.2	61.8	83.3	80.0	76.8	69.1	78.7
Number of Observations	141	101	117	108	321	293	144	223	111	240	150	172	1200	921

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	35.9	35.3	48.3	55.2	60.2	59.5	64.1	62.4	63.8	72.3	58.3	45.3	60.9	49.2
Overcast	33.1	42.3	33.6	23.2	22.9	24.4	22.7	19.6	18.8	15.2	21.0	22.3	21.9	27.9
Showery	8.3	4.2	2.2	4.8	3.1	2.5	2.6	2.0	2.3	2.2	2.9	8.4	2.9	4.7
Rain	17.3	15.5	14.9	13.0	7.1	9.4	3.6	6.0	2.1	0.4	9.3	20.0	6.9	12.9
Squalls	0.7	0.8	0.4	0.5	0.2	0.2	0.3	—	—	—	0.4	2.4	0.2	0.8
Thunder	—	—	0.4	1.0	0.8	0.2	0.3	—	0.3	—	4.6	0.7	0.4	1.0
Hazy	4.1	2.0	0.4	2.5	5.9	3.9	6.3	10.2	12.8	5.0	3.1	1.0	6.9	2.6
Mist	0.7	—	—	—	—	—	0.3	—	—	5.0	0.7	—	0.1	1.1
Number of Observations	145	150	271	401	818	563	393	415	390	541	317	296	2980	1720

DAY. XXXIV. EASTERN SUNDA ISLES, SOUTHERN COASTS. NIGHT.



XXXV. INDIAN OCEAN, SOUTH OF SUNDA ISLES.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—32	— 2	S 4° W	S	32 %	2.1	42
February	—12	4	S 18° E	S S E	13	1.0	9
March	—56	26	S 24° E	S S E	62	1.8	60
April	2	58	N 88° E	E	58	1.5	39
May	—49	53	S 49° E	S E	72	1.5	45
June	—27	81	S 71° E	E S E	85	1.9	76
July	—34	72	S 65° E	E S E	80	1.8	74
August	—40	63	S 58° E	E S E	75	1.8	24
September	—53	72	S 54° E	S E	89	1.7	24
October	—	—	—	—	—	—	—
November	0	25	E	E	25	1.3	3
December	—30	—25	S 39° W	S W	39	1.7	73
Year	—30	39	S 53° E	S E	49	1.65	469

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—32	— 9	S 15° W	S S W	33 %	2.1	38
February	—30	—43	S 55° W	S W	52	1.3	9
March	—50	21	S 22° E	S S E	54	1.9	57
April	—14	66	S 79° E	E S E	67	1.4	39
May	—29	55	S 62° E	E S E	62	1.5	40
June	—30	70	S 82° E	S	76	1.9	73
July	—43	64	S 56° E	S E	77	1.8	69
August	—56	64	S 49° E	S E	85	2.2	22
September	—55	65	S 51° E	S E	85	1.7	24
October	—	—	—	—	—	—	—
November	30	13	N 24° E	N N E	33	1.0	3
December	—28	—16	S 28° W	S S W	32	1.8	70
Year	—31	32	S 46° E	S E	45	1.69	444

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	—32	— 6	S 11° W	S	33 %	2.1	80
February	—21	—20	S 44° W	S W	29	1.2	18
March	—53	24	S 25° E	S S E	58	1.9	117
April	— 6	62	S 84° E	E	62	1.5	78
May	—39	54	S 54° E	S E	67	1.5	85
June	—29	76	S 70° E	E S E	81	1.9	149
July	—39	68	S 60° E	E S E	78	1.8	143
August	—48	64	S 53° E	S E	80	2.0	46
September	—54	69	S 52° E	S E	88	1.7	48
October	—	—	—	—	—	—	—
November	15	19	N 52° E	N E	24	1.2	6
December	—29	—21	S 36° W	S W	36	1.8	143
March—November	—32	55	S 60° E	E S E	64	1.69	672
December—February	—27	—16	S 31° W	S S W	31	1.70	241
Year	—30	35	S 50° E	S E	46	1.69	913

Strong winds, overcast skies, very showery weather and, in the absence of rain, a very hazy atmosphere are the characteristics of the weather in these parts; heavy swells and turbulent and high seas are also experienced.

As is shown in table C, the whole mass of air has a tendency to move N W ward because the W monsoon, with S and S W winds, blows only during the three months December, January and February; it is never steady enough to be relied upon and at times S E winds occur.

Early in March the E monsoon sets in with S E, S S E and S winds and continues with great regularity and strength till October; from June to September there is an almost absolute certainty of S E and S S E winds blowing, the percentages of steadiness amounting to 80 % and 88 % respectively.

For October no observations are available and very few in November, but it appears from table D, that during the latter month variable and circulating winds frequently occur.

The average force of the wind is relatively great and about equal to that recorded in the *China-sea* and the eastern parts of the *Java-sea.*

A force of the wind higher than 3 has been recorded 31 times out of 913 and during almost every month.

January and February are the wet months when — as the not numerous observations appear to prove — rainy and showery weather and even heavy squalls are frequently experienced.

In the other months the rainfall is considerably less, but nevertheless showery weather has been recorded throughout the whole year, so that, in this respect, this region belongs to those where showers are more frequent than anywhere else in the Archipelago, it being surpassed only by the southern parts of the *Banda-sea.*

Bright skies seldom are observed; in the W monsoon the sky is generally overcast and during the E monsoon the atmosphere is very hazy owing to the large quantity of dust-particles conveyed thither by the S E winds coming from the Australian deserts; the haziness is densest in September, towards the end of the dry season.

The number of observations respecting the condition of the sea is not sufficient to justify conclusions but, as far as they go, they all appear to prove it on the whole very unfavourable.

In the E monsoon a heavy swell is frequently observed coming out of the *Timor-* and *Harafura* seas, generally accompanied by high waves; in the short W monsoon, on the other hand, the swell is not considerable, but high seas are frequently experienced.

During the E monsoon the currents are pretty strong with an average value of 22.0 miles per 24 hours, and flow steadily to the W; they may be regarded as a continuation of the perennial westerly currents of the *Timor-sea;* as they move W ward however these currents combine with those running to the S E near the S coast of *Java,* and consequently a stream is formed flowing to the S W ward, which is favourable for vessels coming out of *Bali*-strait and bound for the S.

During the W monsoon the currents generally set to the S E ward because easterly currents then flow along the S coast of *Java* and S E streams penetrate into the passages between the *Sunda Isles:* these currents to the E ward however are counteracted and partly annihilated by the influence of the perennial currents to the S W issuing from the *Timor-sea* and, therefore, currents of variable directions are frequently observed and the resulting branch to the S which — as has been stated above — is in the E monsoon found almost opposite *Bali*-strait now shifts to the E and runs between the 120th and 124th degrees of longitude.

TABLE D. INDIAN OCEAN, SOUTH OF SUNDA ISLES.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	—	10.0	0.9	8.8	—	—	—	—	—	—	—	—	1.5	2.2
NNE	—	—	—	5.2	—	—	—	—	—	—	—	—	0.9	—
NE	1.1	—	3.6	10.5	1.5	5.4	3.6	—	—	—	—	0.7	3.5	1.1
ENE	1.1	—	—	—	1.5	8.2	2.2	—	2.4	—	—	1.6	2.4	0.5
E	2.2	10.0	5.5	**29.8**	7.5	19.0	**29.2**	28.6	19.5	—	25.0	3.9	22.3	9.3
ESE	5.6	**20.0**	3.6	7.0	**23.9**	**36.7**	24.8	16.7	14.6	—	—	6.3	20.6	7.1
SE	14.6	10.0	**28.2**	15.8	23.9	24.5	19.0	**31.0**	**46.4**	—	—	14.2	**26.8**	13.4
SSE	14.6	—	21.8	10.5	22.4	2.0	10.2	7.1	12.2	—	—	3.9	10.7	8.1
S	1.1	—	16.4	—	1.5	0.7	5.8	4.8	4.9	—	—	2.4	3.0	4.0
SSW	5.6	—	3.6	—	6.0	—	—	—	—	—	—	8.7	1.0	3.6
SW	5.6	20.0	2.7	—	—	—	—	—	—	—	—	10.2	—	7.7
WSW	—	—	—	—	—	—	—	—	—	—	—	7.9	—	1.6
W	**19.1**	10.0	5.5	—	—	—	—	4.8	—	—	—	**18.9**	0.8	10.7
WNW	12.4	—	5.5	—	—	—	1.5	—	—	—	—	11.8	0.3	5.9
NW	4.5	10.0	—	2.0	1.5	0.7	—	—	—	—	—	0.7	0.7	3.0
NNW	—	—	0.9	3.5	1.5	—	0.7	—	—	—	—	—	1.0	0.2
Circulating	1.1	—	—	—	7.5	1.4	—	—	—	—	25.0	3.2	1.5	5.9
Variable	10.1	10.0	—	7.0	1.5	—	1.5	7.1	—	—	**50.0**	3.9	2.9	**14.8**
Calm	1.1	—	1.8	—	—	1.4	1.5	—	—	—	—	1.6	0.5	0.9

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	—	—	—	5.4	—	2.1	—	—	—	—	—	—	1.3	—
NNE	—	—	—	1.8	—	—	1.6	—	—	—	33.3	—	0.6	6.7
NE	1.2	—	—	5.4	4.9	0.7	—	—	—	—	—	—	1.8	0.2
ENE	—	—	1.8	3.6	3.3	5.0	4.0	—	2.4	—	—	—	3.1	0.4
E	7.3	—	6.4	**28.6**	11.5	23.6	18.5	20.8	12.2	—	**33.3**	10.5	19.2	11.5
ESE	3.7	—	1.8	14.3	**29.5**	**26.4**	**22.6**	10.4	**34.1**	—	—	8.9	22.9	2.9
SE	11.0	16.7	22.0	23.2	19.7	22.9	21.0	**33.3**	24.4	—	—	10.5	**24.1**	12.0
SSE	**19.5**	—	**32.1**	5.4	4.9	6.4	21.8	27.1	12.2	—	—	3.2	13.0	11.0
S	7.3	—	8.3	1.8	3.3	2.1	1.6	4.2	12.2	—	—	2.4	4.2	3.6
SSW	3.7	—	5.5	—	—	—	2.4	—	—	—	—	4.0	0.4	2.6
SW	8.5	**25.0**	—	—	3.3	0.7	0.8	—	2.4	—	—	9.7	1.2	8.6
WSW	2.4	16.7	5.5	—	1.6	—	—	—	—	—	—	**14.5**	0.3	7.8
W	9.8	16.7	1.8	—	—	—	—	—	—	—	33.3	13.7	—	**15.1**
WNW	11.0	—	1.8	—	—	—	—	—	—	—	—	6.5	—	3.9
NW	9.8	8.3	6.4	1.8	—	—	—	—	—	—	—	2.4	0.3	5.4
NNW	—	—	4.6	1.8	3.3	0.7	1.6	—	—	—	—	—	1.2	0.9
Circulating	1.2	—	1.8	3.6	3.3	0.7	0.8	—	—	—	—	8.1	1.4	2.2
Variable	2.4	16.7	—	3.6	8.2	7.9	1.6	4.2	—	—	—	4.8	4.3	4.8
Calm	1.2	—	—	—	3.3	0.7	1.6	—	—	—	—	0.8	0.9	0.4

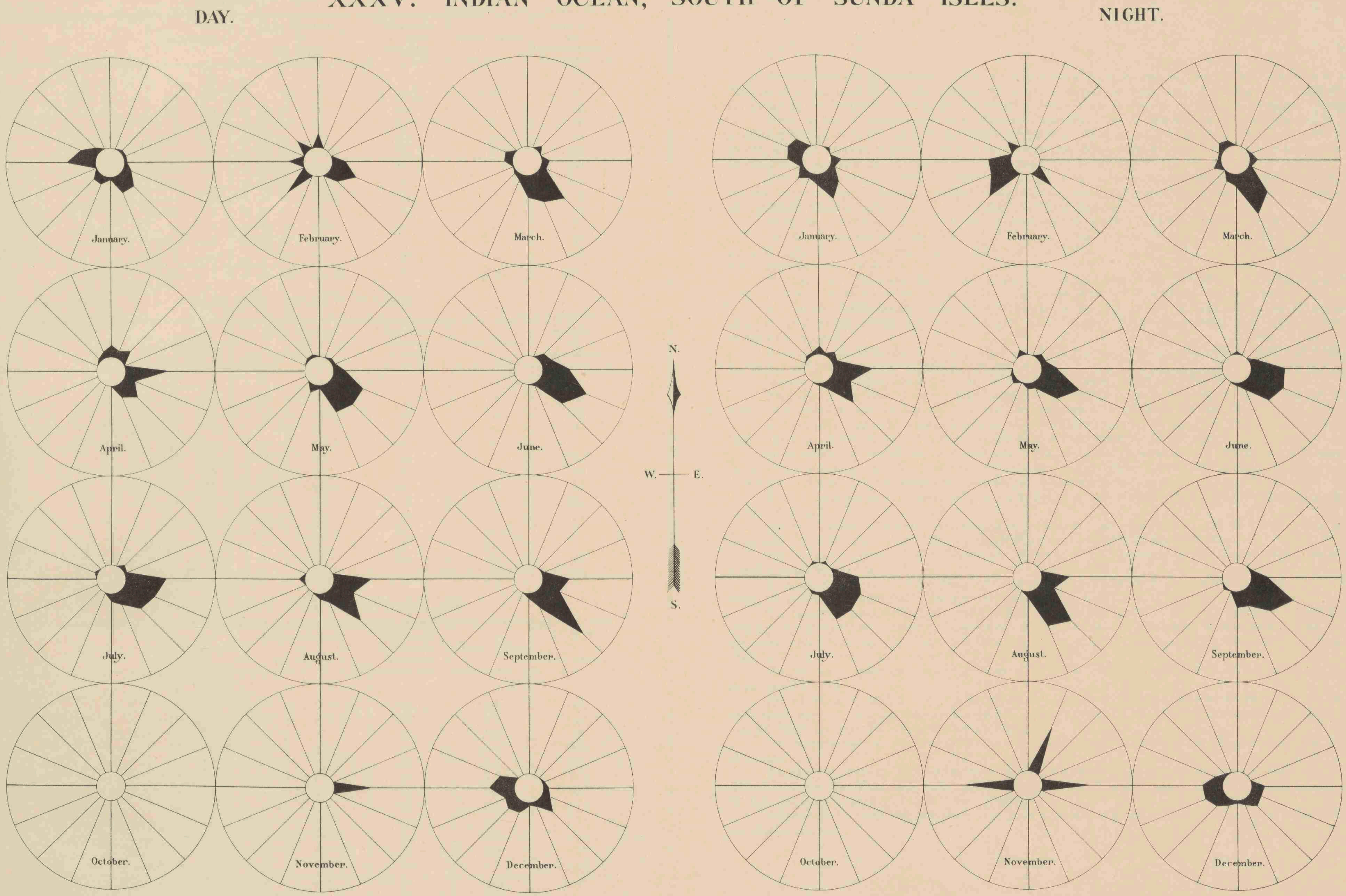
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	20.8	—	—	68.9	35.2	52.6	44.3	—	—	—	—	75.0	33.5	47.9
High Swell	—	—	—	—	7.2	7.3	—	50.0	—	—	—	5.6	10.8	2.8
Waves	—	—	—	10.0	4.2	—	—	50.0	16.7	—	—	—	13.5	—
Sea	62.5	—	—	—	7.7	10.8	3.0	—	—	—	—	19.5	3.6	41.0
High Sea	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Calm	16.7	—	—	21.1	45.9	29.4	52.8	—	83.3	—	—	—	38.8	8.4
Number of Observations	15	—	—	19	26	55	32	2	6	—	—	15	140	30

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	13.3	—	32.5	44.3	34.2	44.0	28.6	19.5	61.6	—	33.3	40.5	38.7	23.9
Overcast	43.4	26.1	54.9	30.7	34.2	37.6	44.8	63.1	15.0	—	66.7	32.9	37.6	44.8
Showery	8.4	26.1	9.4	6.9	7.6	5.5	4.2	8.5	4.4	—	—	6.3	6.2	10.0
Rain	27.8	42.2	—	13.8	11.5	9.6	10.6	8.9	—	—	—	13.0	9.1	16.6
Squalls	6.0	—	—	—	1.3	—	—	—	—	—	—	—	0.2	1.2
Thunder	—	—	0.9	1.5	—	—	—	—	—	—	—	2.8	0.3	0.7
Hazy	1.2	5.6	2.5	1.5	11.4	3.4	11.9	—	19.0	—	—	4.8	7.9	2.8
Mist	—	—	—	1.4	—	—	—	—	—	—	—	—	0.2	—
Number of Observations	83	19	117	72	79	147	143	46	47	—	6	146	534	371

XXXV. INDIAN OCEAN, SOUTH OF SUNDA ISLES.



XXXVI. TIMOR-SEA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	2	—62	W	W	62 %	2.0	17
February	—12	—66	S 81° W	W	67	1.6	12
March	2	—43	N 87° W	W	43	1.8	23
April	—21	18	S 42° E	S E	28	1.6	95
May	—17	34	S 63° E	E S E	38	1.5	149
June	—36	41	S 48° E	S E	55	1.7	104
July	—32	46	S 56° E	S E	56	1.8	105
August	—34	19	S 24° E	S S E	39	1.6	115
September	—38	7	S 10° E	S	39	1.6	71
October	—11	— 8	S 36° W	S W	14	1.4	71
November	—20	—24	S 50° W	S W	31	1.6	40
December	0	—46	W	W	46	1.7	58
Year	—18	— 7	S 21° W	S S W	19	1.66	860

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	25	—66	N 68° W	W N W	71 %	1.5	14
February	—22	—32	S 56° W	S W	39	1.4	12
March	0	2	E	E	2	1.8	24
April	—22	51	S 66° E	E S E	56	1.6	97
May	—28	42	S 56° E	S E	50	1.5	152
June	—50	58	S 49° E	S E	77	1.7	109
July	—44	68	S 57° E	E S E	81	1.8	96
August	—51	50	S 44° E	S E	71	1.5	102
September	—43	39	S 42° E	S E	58	1.5	70
October	—24	25	S 46° E	S E	35	1.5	75
November	—30	4	S 9° E	S	30	1.5	43
December	— 4	—31	S 82° W	W	31	1.6	58
Year	—24	18	S 37° E	S E	30	1.58	852

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	14	—64	N 78° W	W N W	66 %	1.8	31
February	—17	—49	S 71° W	W S W	52	1.5	24
March	1	—21	N 87° W	W	21	1.8	47
April	—22	35	S 58° E	E S E	41	1.6	192
May	—23	38	S 59° E	E S E	44	1.5	301
June	—43	50	S 50° E	S E	66	1.7	213
July	—38	57	S 57° E	E S E	69	1.8	201
August	—43	35	S 39° E	S E	55	1.6	217
September	—41	23	S 30° E	S S E	47	1.6	141
October	—18	9	S 27° E	S S E	20	1.5	146
November	—25	—10	S 22° W	S S W	27	1.6	83
December	— 2	—39	S 87° W	W	39	1.7	116
April—October	—33	35	S 47° E	S E	48	1.61	1411
November—March	— 6	—37	S 81° W	W	37	1.68	301
Year	—21	5	S 13° E	S S E	22	1.64	1712

On inspecting the summarizing table given in the introduction, we find that the distinctive features of the *Timor-sea* are: very great percentages of bright sky, greater than anywhere else in the Archipelago, and corresponding low percentages of cloudiness; percentages of haziness surpassing those of all other regions, and a minimum of rainfall.

Tables A and B exhibit pretty large differences, especially in the E monsoon; not so much however in the resulting directions, as in the values of the eastern components. Those given in table B, at nighthours, are considerably greater, than the components given in table A for daytime; this proves that the observations must have been made for the greater part near the W coast of the isle of *Timor*.

Here the landbreeze, blowing at nighthours, coincides with the prevailing S E direction of the monsoonwinds and the seabreeze tends to diminish the effect of the monsoon; hence high percentages of steadiness during nighthours, and unreliable monsoons with frequent and circulating winds at daytime.

In the W monsoon, on the contrary, the steadiness of this monsoon is greater during dayhours than at night.

The E monsoon sets in in the latter half of March — when however W winds may be expected as well — gradually gains in force and steadiness in April and May, and is at its height in June and July when S E and E S E winds blow very steadily.

In August and September the monsoon begins to abate and October and November may be regarded as the transition months of the monsoons; in the former S S E, in the latter S S W winds are apt to prevail.

In December winds blowing from the S W quarter of the compass may be expected, but the W monsoon does not come to full development before January, when W and W N W winds blow with great regularity, especially in daytime.

In February the W monsoon begins to abate and E S E winds at times are met with together with S winds, though the prevailing directions are still W S W and W N W.

Varying and circulating winds are mostly experienced in November and from February to April.

The force of the wind is pretty high, greatest in January and July (1.8), when the monsoons are at their height, and weakest in May and October (1.5) when the monsoons turn and calms are frequent.

Forces higher than 4 are seldom met with, they have been registered 16 times out of 860 at daytime, and only 4 times out of 852 during nighthours, and almost exclusively during the E monsoon.

In December the rainfall attains its maximum value and January also is rather a wet month; from May to October very few rainy days have been recorded; February and November exhibit about equal probabilities of rain with a percentage of 21 %; in March and April the percentages are from 7 to 9 %.

Heavy squalls seldom occur and mostly in April, November and December, during the latter month accompanied by thunderstorms.

Showery weather is always experienced with a W wind and consequently is recorded with pretty high percentages from November to February; but it sometimes occurs in the E monsoon as well.

The haziness is greatest in July, August and September but is experienced in the other months also whenever E and S winds are blowing.

Although the rainfall at landstations near the coast may be found to differ considerably from that in the offing, its principal characteristics, as observed at *Koepang* during a period of 14 years, may be given here.

The maximum occurs in February, but it differs little from the rainfall in January; during both months the quantity of rain (393 and 355 mM.) is considerable, the more so because the number of rainy days (15 and 17) is not great; this shows that the water comes down in heavy showers; from June to October practically no rain is observed, but the driest months are July, August and September.

The secondary maximum in June, a characteristic of the more northerly situated regions in this longitude, is not observable here.

The condition of the sea is, on the whole, not very favourable; though „heavy swell" and „high sea" have been rarely recorded, the percentages of „calm sea" are low, owing to the fact that „moderate swell" „sea" and „waves" have been recorded with pretty high percentages.

The currents are, on the average, not strong: 10 miles per 24 hours in the W and 16.6 miles in the E monsoon.

During both monsoons they set to the S W and are therefore to be regarded as marine-currents and not as drift-currents; the maximum values deduced from astronomical and dead reckoning of the ship's position are 25 and 38 miles per diem to the S W and W S W respectively.

Observations of wind and tides have been made at *Kupang* and tidal constants for this station are given in the chapter on tides.

TABLE D. TIMOR-SEA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	—	5.3	—	1.3	1.7	—	0.5	—	1.8	5.8	7.9	4.1	0.9	3.9
NNE	—	—	—	2.0	2.6	—	0.5	1.6	—	4.8	—	2.0	1.1	1.1
NE	—	—	—	3.3	5.2	0.6	2.1	1.1	1.8	8.7	—	3.0	2.4	2.0
ENE	—	—	2.4	4.0	3.0	0.6	0.5	—	2.7	1.0	—	2.0	1.8	0.9
E	—	—	—	6.6	14.7	16.9	10.7	15.1	5.4	2.9	1.6	—	11.6	0.8
ESE	2.9	—	—	12.6	15.2	**20.3**	**30.5**	**15.7**	9.9	5.8	—	2.0	**17.4**	1.8
SE	5.9	—	4.9	9.3	**18.2**	18.6	19.8	9.7	14.4	5.8	7.9	2.0	15.0	4.4
SSE	—	—	4.9	5.3	1.7	10.7	5.3	11.9	**17.1**	7.7	12.7	2.0	8.7	4.6
S	8.8	—	4.9	6.6	5.2	3.4	2.7	4.9	3.6	5.8	6.4	3.0	4.4	4.8
SSW	—	—	4.9	4.0	1.3	0.6	3.2	3.2	6.3	5.8	4.8	2.0	3.1	2.9
SW	5.9	5.3	2.4	3.3	4.8	4.5	1.6	9.7	12.6	**12.5**	3.2	12.1	6.1	6.9
WSW	—	**42.1**	9.8	6.0	3.0	3.4	1.6	2.2	1.8	3.8	**17.5**	**16.2**	3.0	**14.9**
W	**29.4**	21.1	7.3	2.0	3.5	2.3	1.1	9.7	6.3	7.7	7.9	14.1	4.2	14.6
WNW	29.4	—	**24.4**	1.3	2.6	2.8	3.7	1.1	6.3	6.7	—	7.1	3.0	11.3
NW	11.8	5.3	7.3	2.6	3.9	1.7	3.2	3.2	2.7	5.8	12.7	14.1	2.9	9.5
NNW	—	—	9.8	1.3	1.3	0.6	0.5	0.5	1.8	—	—	2.0	1.0	2.0
Circulating	—	10.5	7.3	9.3	3.0	4.5	4.8	4.3	1.8	1.9	7.9	6.1	4.6	5.6
Variable	5.9	10.5	9.8	**18.5**	6.9	8.5	7.0	5.4	3.6	4.8	7.9	3.0	8.3	7.0
Calm	—	—	—	0.7	2.2	—	0.5	0.5	—	2.9	1.6	3.0	0.7	1.3

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	—	—	—	1.3	2.1	—	—	—	—	5.2	6.2	4.3	0.6	2.6
NNE	—	11.8	—	1.3	—	—	1.2	0.6	0.9	2.1	—	2.2	0.7	2.7
NE	—	—	—	5.8	4.2	1.1	2.3	1.2	5.6	5.2	—	5.4	3.4	1.8
ENE	—	—	4.5	6.4	1.3	3.2	—	3.7	1.9	10.3	3.1	1.1	2.8	3.2
E	4.5	—	11.4	**17.9**	13.0	11.1	14.5	11.0	9.3	8.2	3.1	2.2	12.8	4.9
ESE	—	17.6	11.4	16.7	13.4	20.0	**31.8**	16.0	18.7	2.1	1.5	4.3	19.3	6.2
SE	—	—	13.6	17.3	**26.9**	**28.9**	30.1	**27.0**	**18.7**	**16.5**	**18.5**	9.7	**24.8**	9.7
SSE	—	—	—	5.1	7.6	16.3	8.1	20.2	12.2	5.2	13.8	—	11.6	3.2
S	—	11.8	11.4	4.5	8.4	7.4	5.8	4.9	13.1	13.4	9.2	1.1	7.4	7.8
SSW	—	—	—	—	5.5	2.1	0.6	3.7	3.7	4.1	6.2	1.1	2.6	1.9
SW	9.1	5.9	4.5	5.1	2.9	0.5	—	4.3	2.8	9.3	6.2	11.8	2.6	7.8
WSW	—	**35.3**	—	1.3	2.5	—	—	1.2	2.8	1.0	3.1	10.8	1.3	8.4
W	22.7	5.9	—	1.3	—	0.5	—	—	2.8	—	3.1	**22.6**	0.8	9.1
WNW	**27.3**	11.8	**25.0**	—	1.7	—	1.2	1.2	0.9	2.1	—	2.2	0.8	**11.4**
NW	18.2	—	—	—	0.8	—	0.6	0.6	2.8	2.1	12.3	8.6	0.8	6.9
NNW	9.1	—	18.2	1.3	0.4	—	—	—	—	—	—	2.2	0.3	4.9
Circulating	4.5	—	—	3.8	1.7	4.2	1.7	1.2	—	3.1	7.7	6.5	2.1	3.6
Variable	—	—	—	9.0	5.9	4.2	2.3	—	1.9	4.1	6.2	2.2	3.9	2.1
Calm	4.5	—	—	1.9	1.7	0.5	—	3.1	1.9	6.2	—	2.2	1.5	2.2

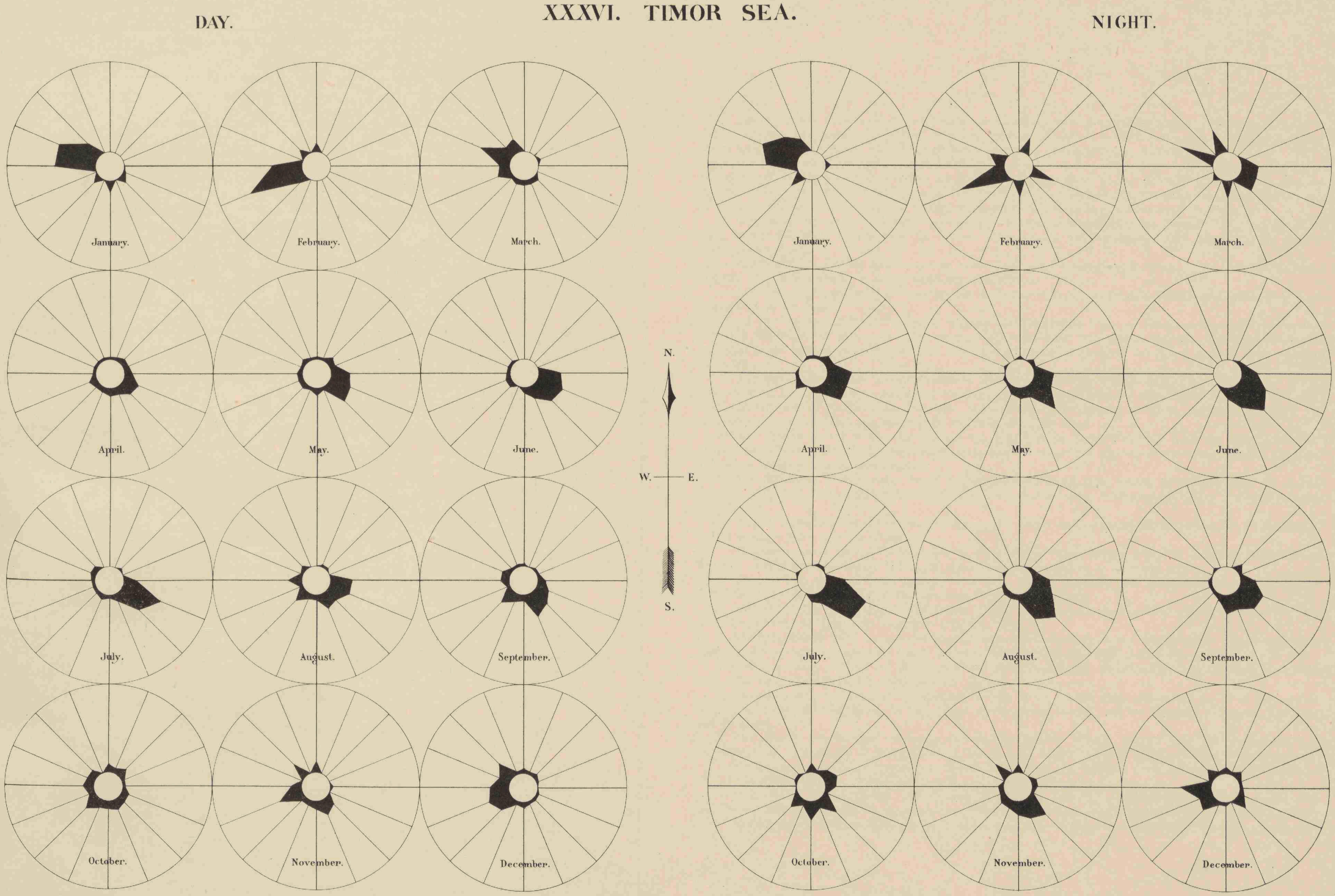
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	55.8	—	—	18.8	23.9	19.2	24.4	13.0	37.0	45.7	53.8	42.7	22.7	49.5
High Swell	—	—	—	—	—	—	1.3	—	—	—	—	—	0.2	—
Waves	—	—	—	1.8	3.7	1.1	1.3	6.8	—	2.9	—	3.0	2.5	1.5
Sea	27.0	—	—	7.7	11.0	28.2	21.4	10.9	2.2	7.5	3.0	30.0	13.6	16.9
High Sea	—	—	—	—	—	—	5.5	—	—	—	—	—	0.9	—
Calm	17.2	—	—	71.8	61.5	51.6	46.3	69.5	60.9	44.1	43.3	24.5	60.3	32.3
Number of Observations	25	—	—	52	109	89	75	131	46	68	35	33	502	161

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	32.5	25.1	74.5	71.3	69.3	74.6	70.9	68.4	60.5	71.1	48.9	37.1	69.2	48.2
Overcast	42.8	41.7	19.1	18.3	16.9	14.7	21.6	18.1	21.3	13.7	23.3	25.0	18.5	27.6
Showery	3.9	12.5	—	2.1	2.4	1.9	2.0	1.3	2.9	1.4	7.5	10.4	2.1	6.0
Rain	21.0	8.4	6.5	6.3	3.3	3.3	—	1.5	2.1	2.8	13.3	23.3	2.8	12.6
Squalls	—	—	—	1.1	—	0.5	—	—	—	0.7	1.2	1.7	0.3	0.6
Thunder	—	—	—	—	—	—	—	—	—	—	3.5	0.9	—	0.7
Hazy	—	12.5	—	1.1	8.3	5.2	5.6	10.8	13.4	10.4	2.5	1.7	7.4	4.5
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	29	24	47	191	303	212	200	215	142	145	82	116	1263	443

XXXVI. TIMOR SEA.



XXXVII. HARAFURA-SEA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	37	—54	N 56° W	N W	65 %	1.6	60
February	25	—63	N 69° W	W N W	68	1.7	94
March	— 1	—20	W	W	20	1.2	237
April	—19	38	S 65° E	E S E	42	1.7	235
May	—40	34	S 40° E	S E	52	1.5	101
June	—57	55	S 44° E	S E	79	1.7	59
July	—55	70	S 52° E	S E	89	2.1	52
August	—54	72	S 53° E	S E	90	1.8	19
September	—63	20	S 18° E	S S E	66	1.3	12
October	—28	46	S 59° E	E S E	54	1.3	54
November	—28	11	S 20° E	S S E	30	1.4	48
December	24	—59	N 68° W	W N W	64	1.5	158
Year	—22	13	S 31° E	S S E	26	1.57	1129

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	33	—47	N 54° W	N W	57 %	1.3	58
February	34	—53	N 58° W	W N W	63	1.7	94
March	— 4	—18	S 77° W	W S W	18	1.4	221
April	—28	39	S 55° E	S E	48	1.5	228
May	—39	30	S 38° E	S E	49	1.5	97
June	—52	65	S 52° E	S E	83	1.6	57
July	—56	75	S 54° E	S E	94	2.0	54
August	—71	62	S 41° E	S E	94	2.0	17
September	—80	32	S 22° E	S S E	86	1.4	7
October	—23	61	S 70° E	E S E	65	1.3	47
November	—38	28	S 36° E	S E	47	1.2	47
December	42	—53	N 51° W	N W	68	1.5	153
Year	—24	18	S 37° E	S E	30	1.53	1080

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	35	—51	N 56° W	N W	62 %	1.5	118
February	30	—58	N 63° W	W N W	65	1.7	188
March	— 3	—19	S 81° W	W	19	1.3	458
April	—24	39	S 59° E	E S E	46	1.6	463
May	—40	32	S 39° E	S E	51	1.5	198
June	—55	60	S 48° E	S E	81	1.7	116
July	—56	73	S 52° E	S E	92	2.1	106
August	—63	67	S 47° E	S E	92	1.9	36
September	—72	26	S 20° E	S S E	77	1.4	19
October	—26	54	S 64° E	E S E	60	1.3	101
November	—33	20	S 31° E	S S E	39	1.3	95
December	33	—56	N 60° W	W N W	65	1.5	311
April—November	—46	46	S 45° E	S E	65	1.60	1134
December—March	24	—46	N 62° W	W N W	52	1.50	1075
Year	—23	16	S 35° E	S E	28	1.57	2209

The distinctive features of the weather in the *Harafura-sea* are: a strongly marked preponderance of the E over the W monsoon, rather a high force of the wind during the climax of the monsoons (especially the E monsoon) and a great probability of rain throughout the whole year, two or three months excepted.

The E monsoon, with prevailing S E and E S E winds, sets in in the latter half of March or April; the results (given in table C) of observations made at sea, point to March as the month of transition, but according to observations made at *Tual* from November 1888 to March 1890, the turning point of the monsoons falls in April as in the year 1889 and probably also in 1890 when March bore a decidedly W monsoon character.

The observations made on board ship however have been taken mostly in the western parts of the sea near the *Aroë Islands* and while cruising near the S coast of *New-Guinea*, so that possibly both results, though slightly divergent, are exact.

From April to October the E monsoon blows with great steadiness and attains to full vigour in July and August, when E winds may be almost absolutely counted upon.

In October the monsoon begins to abate and in November it can no longer be relied upon, though S S E winds still prevail in the offing.

At *Tual* however the period of the W monsoon was observed in 1889 to extend over the month of November.

In the offing the W monsoon does not begin before December and lasts till February, but the steadiness, as expressed in the percentages, is far less than that found during the E monsoon, calms and variable winds occurring frequently.

The force of the wind is pretty considerable when the E monsoon is at its height; the average value in July amounting to 2.1 and somewhat less in the W monsoon; but at *Tual*, (which is sheltered by the isle of *Groot Key* from the influence of the prevailing S E winds, and somewhat more open to W winds), the greatest velocity, viz. 4.36 Metres per second, has been observed in December with a W wind.

The average annual temperature at *Tual* has been found to be 27°.4 C., July being the coolest (26°.0) and October the hottest month (28°.2); the highest temperature on record (35° C.) was observed in October at noontide; the lowest (21°.5) in August about sunrise.

The rainfall at *Tual* is rather heavy during all months of the year, differing considerably from one year to another. The mean annual rainfall, deduced from a series of observations at this station during two years, amounts to 2597 mM.

August, September and October are the dry months with a mean monthly rainfall of resp. 65, 46 and 90 mM. and 8, 5 and 7 rainy days per month.

The rainy season lasts from November to July, during which time a secondary minimum is observed in February, a maximum in January and March and a secondary maximum in June and July.

In the offing the dry season appears to be from July to November, the period of greatest rainfall in May and June, and another of somewhat less rain from December to January.

Throughout the whole year the sky is very cloudy: the lowest percentage of cloudiness stated at *Tual* was 54 % for October, the highest for November 1888 viz. 84 %.

Showery weather may be expected during all months, especially in the vicinity of the mountainous isles; heavy squalls are experienced during the W monsoon only and especially from December to February.

They are mostly accompanied by heavy rainfall and thunderstorms, which seldom occur during the E monsoon.

The haziness of the sky is much less here than in the *Timor-sea*.

The percentages of „calm sea", as exhibited in table D are, on the whole rather low; as far as they go the records show that the best months in this respect are March and October, and the next best September, November and December.

The currents are not very strong in this sea, the greatest velocity deduced from astronomical and dead reckoning being 48 miles per 24 hours to the W during the E monsoon and 21 miles to the S E in the W monsoon.

The average direction is towards the W and S W during both seasons; consequently the general motion of the current may be stated to be from *Torres*-strait into the *Timor-* and *Banda-seas*.

The direction of the current however is far less constant than that of the wind, and a rough sea therefore may be experienced, whenever the monsoons are at their height and wind and current are setting in opposite directions.

Rainfall has been observed, but not very regularly, at *Dobo*, where also a tidal station has been established.

TABLE D. HARAFURA-SEA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	14.4	1.9	5.1	4.6	—	1.0	—	—	6.3	5.6	2.9	3.3	2.0	5.5
NNE	1.0	1.2	0.3	2.5	—	—	—	—	—	—	—	—	0.4	0.4
NE	1.0	—	1.8	4.6	6.3	2.0	—	—	—	1.4	4.4	1.2	2.2	1.6
ENE	2.1	1.2	0.6	2.5	7.0	—	—	—	—	2.8	—	1.6	1.6	1.4
E	1.0	0.6	7.2	8.6	4.4	14.0	13.2	17.6	12.5	21.1	1.5	0.8	11.7	5.4
ESE	—	0.6	6.9	19.3	8.2	10.0	22.6	26.5	—	8.5	2.9	0.4	14.4	3.2
SE	—	1.2	3.9	**20.8**	**26.6**	**40.0**	**50.9**	**35.3**	6.3	**36.6**	**30.9**	1.6	**30.0**	12.4
SSE	—	1.2	3.6	5.3	15.8	16.0	5.7	14.7	18.8	4.2	13.2	—	12.7	3.7
S	—	2.5	2.1	4.3	3.8	11.0	3.8	5.9	**43.8**	2.8	4.4	4.9	12.1	2.8
SSW	—	3.1	3.0	0.5	2.5	—	—	—	—	—	1.5	0.8	0.5	1.4
SW	10.3	2.5	6.0	2.3	10.7	4.0	1.9	—	6.3	1.4	8.8	9.0	4.2	6.3
WSW	3.1	—	1.2	1.3	0.6	—	—	—	—	1.4	—	2.0	0.3	1.3
W	17.5	23.5	12.7	4.1	1.9	—	—	—	—	9.9	4.4	17.6	1.0	14.3
WNW	5.2	**24.6**	**18.7**	1.5	1.3	—	—	—	—	—	—	17.6	0.5	11.0
NW	**38.1**	24.6	3.6	2.0	1.3	1.0	—	—	—	1.4	17.6	**24.6**	0.7	**18.3**
NNW	—	3.7	1.5	2.3	1.9	—	—	—	—	—	—	10.2	0.7	2.6
Circulating	—	1.9	1.8	4.6	1.9	—	—	—	—	1.4	—	0.8	1.1	1.0
Variable	2.1	2.5	7.8	6.9	4.4	—	1.9	—	—	—	2.9	1.2	2.2	2.8
Calm	4.1	3.1	12.0	2.0	1.3	1.0	—	—	6.3	1.4	4.4	2.0	1.8	4.5

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	18.5	1.4	0.6	1.9	2.6	—	—	—	—	3.2	1.7	5.8	0.8	5.2
NNE	—	2.1	0.6	0.3	—	1.1	—	—	—	—	—	1.2	0.2	0.7
NE	4.9	4.9	2.6	1.7	3.2	2.1	—	—	—	1.6	—	2.5	1.2	2.8
ENE	—	2.1	0.6	2.2	4.5	6.4	—	—	—	—	—	—	2.2	0.5
E	—	—	7.7	13.2	3.9	4.3	7.3	2.9	10.0	**35.5**	19.0	0.8	6.9	10.5
ESE	—	2.1	8.7	19.4	8.4	18.1	36.7	11.8	—	9.7	—	0.4	15.7	3.5
SE	—	0.7	4.2	**21.1**	**25.3**	**48.9**	**46.8**	**58.8**	20.0	33.9	**31.1**	—	**36.8**	11.6
SSE	—	0.7	3.2	6.6	13.0	7.4	5.5	17.6	**30.0**	—	12.1	0.8	13.4	2.8
S	3.7	1.4	3.2	3.6	10.4	8.5	3.7	8.8	30.0	1.6	6.9	1.6	10.8	3.1
SSW	3.7	1.4	1.0	1.7	1.9	—	—	—	10.0	—	1.7	1.2	2.3	1.5
SW	8.6	2.8	4.5	1.4	3.2	—	—	—	—	3.2	5.2	5.3	0.8	4.9
WSW	4.9	1.4	3.5	3.3	1.3	—	—	—	—	—	5.2	0.8	0.8	2.6
W	8.6	11.1	**18.0**	3.6	3.9	—	—	—	—	1.6	1.7	11.5	1.3	8.8
WNW	8.6	**34.7**	12.2	1.7	—	—	—	—	—	—	—	14.8	0.3	11.7
NW	**30.9**	18.1	5.5	2.5	3.2	—	—	—	—	6.5	10.3	**29.6**	1.0	**16.8**
NNW	1.2	8.3	1.9	1.7	—	—	—	—	—	—	—	15.6	0.3	4.5
Circulating	—	—	1.3	3.0	1.3	1.1	—	—	—	—	—	0.4	0.9	0.3
Variable	—	4.2	8.7	9.1	10.4	—	—	—	—	—	—	4.5	3.3	2.9
Calm	6.2	2.8	11.9	2.2	3.2	2.1	—	—	—	3.2	5.2	2.9	1.3	5.4

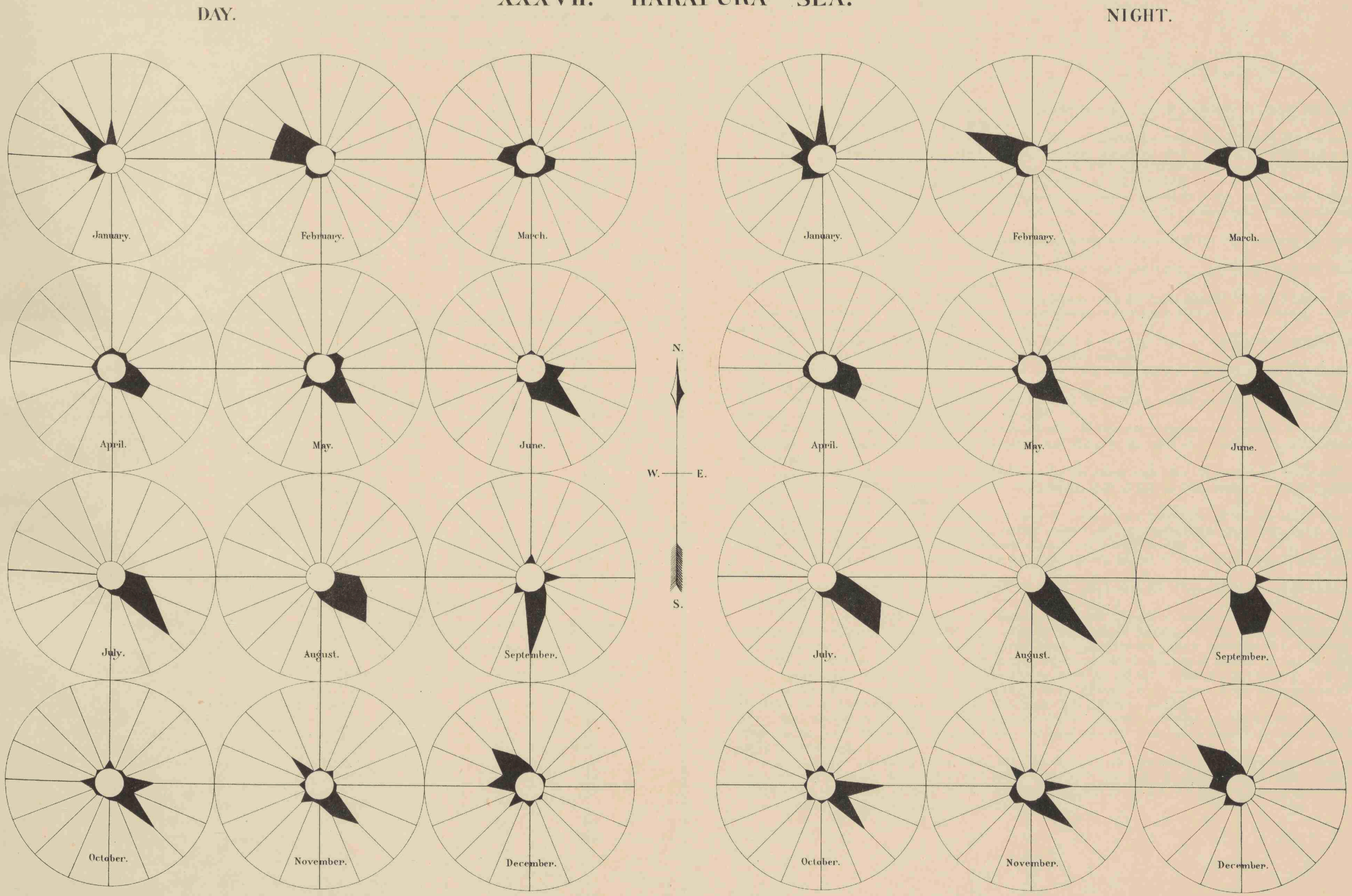
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	34.5	37.1	10.5	31.4	35.9	19.5	7.8	13.7	22.9	6.3	17.4	9.3	21.9	19.3
High Swell	1.7	—	—	0.7	2.0	—	—	—	—	—	—	0.4	0.5	0.4
Waves	—	0.9	1.4	0.7	—	0.9	1.6	—	—	—	4.4	3.5	0.6	1.7
Sea	12.1	17.7	9.8	11.0	8.9	25.1	15.5	50.0	4.2	5.2	1.1	11.9	19.1	9.6
High Sea	0.9	—	0.4	0.7	0.9	—	—	—	—	—	—	0.4	0.3	0.3
Calm	50.9	44.5	78.1	55.7	52.4	54.5	75.2	36.4	72.9	88.6	77.2	74.7	57.8	69.0
Number of Observations	114	108	287	145	103	112	64	22	20	99	92	288	466	988

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	33.6	23.8	49.1	39.8	49.5	50.0	59.4	53.0	75.0	55.4	60.2	25.6	54.5	41.3
Overcast	45.7	42.9	25.6	34.7	18.0	16.7	32.1	35.3	20.0	20.8	29.0	40.9	26.1	34.2
Showery	4.3	2.4	6.0	3.7	4.5	2.6	2.8	2.9	—	4.0	4.3	8.0	2.8	4.8
Rain	14.7	26.8	18.0	19.6	27.0	29.0	5.7	5.9	—	15.8	3.2	20.8	14.5	16.6
Squalls	1.7	2.4	0.7	0.3	0.5	—	—	—	—	—	—	2.6	0.1	1.2
Thunder	—	0.6	0.2	0.7	—	—	—	—	—	—	—	1.0	0.1	0.3
Hazy	—	1.2	0.4	1.1	0.5	1.8	—	2.9	5.0	4.0	2.2	1.0	1.9	1.5
Mist	—	—	—	—	—	—	—	—	—	—	1.1	—	—	0.2
Number of Observations	116	168	450	455	200	114	106	34	20	101	93	312	929	1240

XXXVII. HARAFURA SEA.



XXXVIII. BANDA-SEA, SOUTHERN PARTS.

TABLE A. DAY-HOURS.

	Components. N	Components. E	Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
January	43	—77	N 62° W	W N W	88 %	1.9	107
February	34	—85	N 68° W	W N W	92	3.1	18
March	12	—30	N 72° W	W N W	32	1.6	43
April	—35	52	S 55° E	S E	63	1.5	178
May	—46	76	S 58° E	E S E	89	2.0	64
June	—40	63	S 58° E	E S E	75	2.0	94
July	—69	61	S 41° E	S E	92	2.0	54
August	—54	78	S 55° E	S E	95	1.7	41
September	—76	56	S 36° E	S E	94	1.5	31
October	—45	55	S 50° E	S E	71	1.5	115
November	—42	28	S 34° E	S S E	50	1.5	109
December	12	—43	N 76° W	W N W	45	1.4	113
Year	—26	20	S 38° E	S E	33	1.81	967

TABLE B. NIGHT-HOURS.

	Components. N	Components. E	Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
January	51	—75	N 56° W	N W	91 %	1.9	99
February	34	—79	N 67° W	W N W	86	2.9	18
March	18	—24	N 54° W	N W	30	1.5	42
April	—35	43	S 50° E	S E	55	1.4	176
May	—48	71	S 56° E	S E	86	1.9	68
June	—42	64	S 56° E	S E	77	1.9	93
July	—63	69	S 48° E	S E	93	2.0	46
August	—52	81	S 57° E	E S E	96	1.8	40
September	—64	64	S 45° E	S E	91	1.5	33
October	—42	62	S 56° E	S E	75	1.4	110
November	—44	45	S 46° E	S E	63	1.3	102
December	12	—46	N 76° W	W N W	48	1.3	108
Year	—23	23	S 45° E	S E	33	1.73	935

TABLE C. DAY AND NIGHT-HOURS.

	Components. N	Components. E	Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
January	47	—76	N 58° W	W N W	89 %	1.9	206
February	34	—82	N 67° W	W N W	89	3.0	36
March	15	—27	N 61° W	W N W	31	1.6	85
April	—35	48	S 54° E	S E	59	1.5	354
May	—47	74	S 57° E	E S E	88	2.0	132
June	—41	64	S 58° E	E S E	76	2.0	187
July	—66	65	S 45° E	S E	93	2.0	100
August	—53	80	S 57° E	E S E	96	1.8	81
September	—70	60	S 41° E	S E	92	1.5	64
October	—44	59	S 54° E	S E	74	1.5	225
November	—43	37	S 41° E	S E	57	1.4	211
December	12	—45	N 75° W	W N W	47	1.4	221
April—November	—50	61	S 50° E	S E	79	1.71	1354
December—March	27	—58	N 65° W	W N W	64	1.98	548
Year	—24	21	S 41° E	S E	32	1.80	1902

An inspection of the summarizing table of the introduction shows, that in more than one respect the southern parts of the *Banda-sea* offer very marked peculiarities.

The percentages of bright sky are very high and there is recorded a corresponding minimum of cloudiness.

As to the frequency of showers these parts exhibit higher percentages than are found anywhere else, and at the same time the monsoons are more strongly marked than in most parts of the Archipelago, whereas the average value of the force of the wind surpasses considerably that found in other regions.

In April the E monsoon sets in with considerable steadiness and as early as May the monsoon attains to full vigour; from May to July the average force is highest viz. 2.0 and the probability of E S E or S E winds becomes almost a certainty.

From August to October the steadiness remains the same, but the force of the wind gradually decreases to 1.8 on the average in August and 1.5 in September and October.

In November S E winds still prevail, but W and N W winds are at times experienced, whilst the average force then and in the next month is minimum.

The W monsoon sets in in December: in the beginning calms are rather frequent and the steadiness of the W N W monsoonwinds is small, but soon the monsoon reaches its height and in January and February attains to great force and almost absolute reliability.

The average force of the wind appears to be highest in February, but the number of observations made during that month is rather small and the outcome consequently uncertain.

In March the W monsoon still prevails, but E and E S E winds begin to blow and varying and circulating winds are often experienced.

A force of the wind greater than 3 has been registered 57 times out of 1902, mostly in January and February, and with an equal frequency during night- and dayhours.

The rainfall appears to be rather heavy from December to February, when showery weather is recorded with percentages by far higher than are found anywhere else, whilst at the same time heavy squalls are occasionally experienced.

From March to June the rainfall is moderate and the dry season lasts from July to October or November.

The June maximum of rainfall, observed in the northern parts of this sea near *Amboina*, is not observed here, not even as a secondary maximum.

The observations of rainfall made during a series of 6 and 5 years respectively at *Serwaru* (isle of *Letti*) and *Sejra* (*Tenimber isles*) on the whole confirm the outcome of the observations made in the offing, both places however showing a secondary minimum of rain in February, which is not recorded in table D.

This discrepancy may be ascribed to the insufficiency of the number of observations made on board ship in this month.

It is difficult however to form a scheme of rainfall which suits this whole region, because it considerably differs in different places.

There is a considerable difference f. i. between the rainfall observed at *Serwaru* and that occurring at *Tual*, and still greater differences are met with if one compares the rainfall at *Serwaru* with that recorded at *Banda*, where this phenomenon bears a totally different character, though apparently the physical conditions of both stations are about the same and, on the other hand, even essential differences exist in this respect between *Serwaru* and *Sejra*.

Thunderstorms seldom occur in these parts of the *Banda-sea* and the haziness of the atmosphere is less than in the more northerly situated regions: in fact it gets denser gradually as we proceed to the northern parts of the *Banda-sea* and to the *Ceram-sea*, a remarkable fact, which it is difficult to explain.

The condition of the sea is, on the whole favourable: the swell is seldom considerable, but „sea" may at times be met with; the number of observations concerning the state of the sea is however far from sufficient to afford a reliable basis.

The currents, principally drift-currents, set with the wind and are rather strong, the average values being 16.7 miles per 24 hours during the E monsoon, and 16.0 miles during the W monsoon; the greatest velocities on record are 53 miles per 24 hours to the E N E in the former, and 46 miles to the E in the latter monsoon.

A tidal station has been established at *Dammer*.

TABLE D. BANDA-SEA, SOUTHERN PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	—	1.7	1.4	3.2	—	—	—	—	—	—	0.6	3.9	0.5	1.3
NNE	—	—	5.8	—	—	—	—	—	—	—	2.4	—	—	1.4
NE	—	—	—	3.2	1.5	4.8	—	—	—	1.6	1.2	—	1.6	0.5
ENE	—	—	2.9	5.6	1.5	4.3	—	—	—	2.7	—	1.7	1.9	1.2
E	—	—	2.9	16.5	10.8	8.1	2.8	8.5	—	19.2	7.2	0.5	7.8	5.0
ESE	0.5	—	7.2	15.5	**39.2**	18.8	15.0	35.2	4.3	14.8	13.8	1.7	21.3	6.3
SE	—	—	2.9	**24.3**	38.5	**41.9**	**55.1**	**52.1**	**66.0**	**36.3**	**30.5**	6.1	**46.3**	12.6
SSE	—	—	4.3	7.7	2.3	8.1	17.8	2.8	14.9	2.7	5.4	—	8.9	2.1
S	1.0	—	—	11.3	3.1	1.6	7.5	1.4	14.9	7.1	11.4	4.4	6.6	4.0
SSW	—	—	4.3	—	—	—	—	—	—	2.7	0.6	1.7	—	1.6
SW	3.0	—	1.4	3.2	—	1.1	1.9	—	—	5.5	11.4	3.3	1.0	4.1
WSW	1.0	—	5.8	—	—	—	—	—	—	0.5	—	3.9	—	1.9
W	16.4	24.1	15.9	3.2	—	—	—	—	—	2.2	0.6	12.8	0.5	12.0
WNW	24.4	**56.9**	**17.4**	—	—	—	—	—	—	—	2.4	**20.0**	—	**20.2**
NW	**50.2**	13.8	7.2	1.1	—	1.6	—	—	—	—	7.8	20.0	0.5	16.5
NNW	2.0	—	8.7	—	—	0.5	—	—	—	—	—	—	0.1	1.8
Circulating	0.5	—	5.8	0.4	—	1.1	—	—	—	0.5	2.4	6.7	0.3	2.7
Variable	—	—	5.8	0.7	3.1	8.1	—	—	—	1.1	1.2	1.7	2.0	1.6
Calm	1.0	3.4	—	4.2	—	—	—	—	—	2.7	1.2	11.7	0.7	3.3

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	2.1	—	—	1.5	—	1.7	—	—	—	—	—	1.2	0.5	0.6
NNE	—	—	6.3	0.8	1.5	1.1	—	—	—	—	—	1.2	0.6	1.3
NE	—	1.9	—	3.4	1.5	3.4	—	—	—	1.8	3.5	—	1.4	1.2
ENE	—	—	4.7	3.4	—	6.7	—	—	—	4.2	—	0.6	1.7	1.6
E	—	—	9.4	16.5	10.6	7.9	6.4	2.8	—	20.6	11.3	1.2	7.4	7.1
ESE	—	—	—	10.3	**39.4**	16.3	20.1	**52.1**	15.2	12.7	17.0	1.8	25.6	5.3
SE	—	—	4.7	**28.0**	25.0	**38.8**	**60.6**	45.1	**69.2**	**38.8**	**34.8**	2.5	**44.5**	13.5
SSE	—	—	4.7	3.8	15.9	12.9	4.2	—	5.8	2.4	1.4	1.8	5.4	1.7
S	1.1	—	3.1	11.5	3.0	4.5	8.5	—	3.8	6.7	11.3	6.1	6.9	4.5
SSW	—	—	1.6	1.1	—	—	—	—	—	2.4	2.8	1.2	0.2	1.3
SW	1.1	—	3.1	5.4	—	—	—	—	—	3.0	3.5	2.5	0.9	2.2
WSW	1.1	—	3.1	0.4	—	—	—	—	—	—	—	2.5	0.1	1.1
W	14.9	15.4	**15.6**	2.3	—	—	—	—	—	—	2.1	16.6	0.4	10.8
WNW	14.4	**65.4**	12.5	0.8	—	—	—	—	—	—	1.4	16.0	0.1	18.3
NW	**65.4**	9.6	9.4	2.3	—	—	—	—	—	—	2.8	**23.9**	0.4	**18.5**
NNW	—	—	15.6	0.8	—	—	—	—	—	—	—	—	0.1	2.6
Circulating	—	—	3.1	0.8	2.3	—	—	—	—	1.2	5.0	2.5	0.5	2.0
Variable	—	7.7	1.6	1.9	0.8	6.2	—	—	—	1.2	—	1.2	1.5	2.0
Calm	—	—	1.6	5.0	—	0.6	—	—	5.8	4.8	2.8	17.2	1.9	4.4

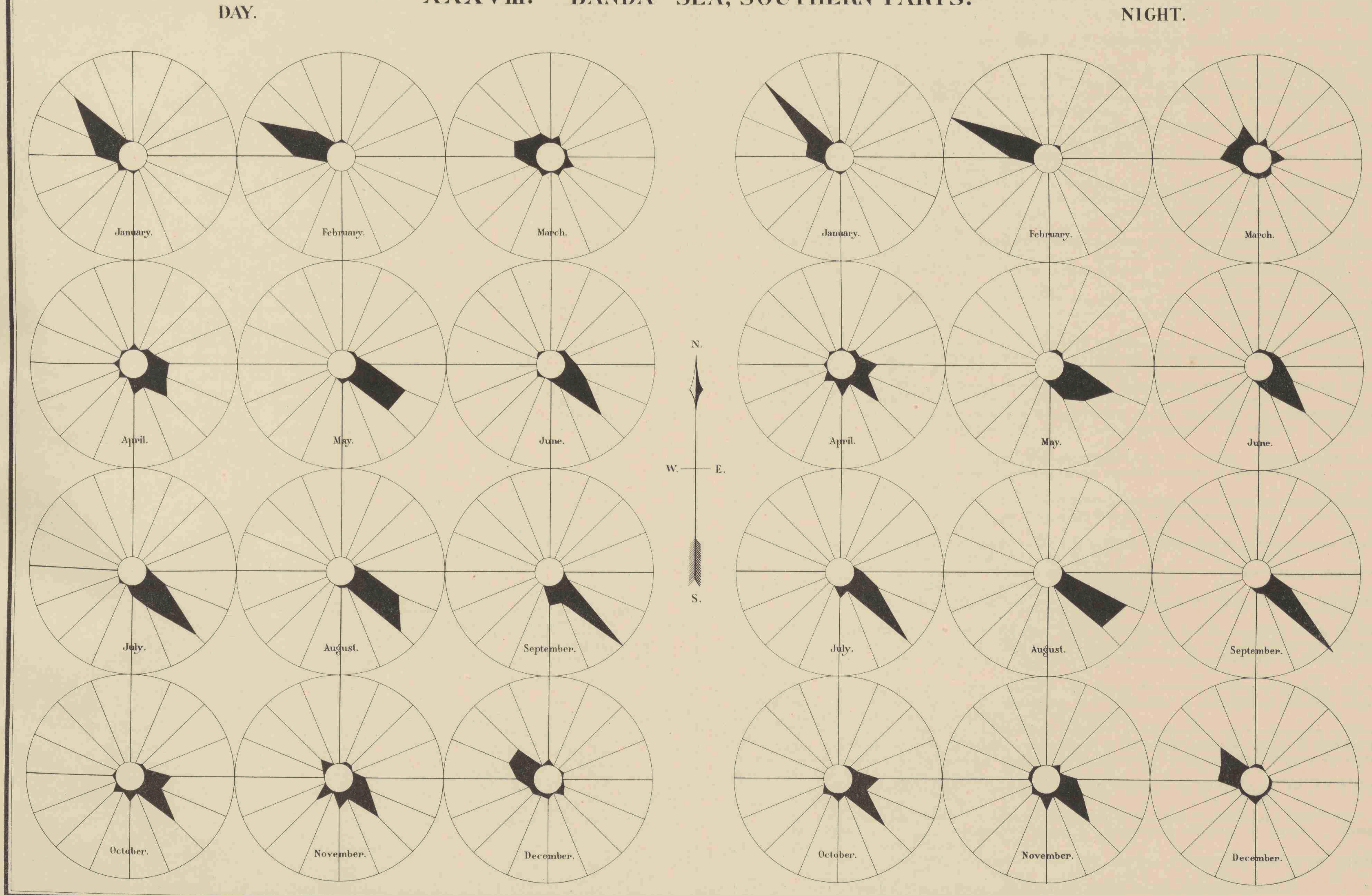
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	24.7	10.0	45.9	12.2	21.9	28.0	2.8	32.4	20.7	12.5	9.7	14.1	19.7	19.5
High Swell	1.0	—	—	0.3	—	—	—	—	—	—	—	—	0.1	0.2
Waves	10.6	—	—	7.2	—	3.0	—	5.9	4.8	2.6	2.2	4.5	3.5	3.3
Sea	19.7	10.0	2.1	9.5	15.7	20.6	23.8	17.7	14.7	9.4	2.8	10.8	17.0	9.1
High Sea	2.0	22.5	—	—	—	1.5	—	—	—	—	1.1	—	0.3	4.3
Calm	42.2	57.5	52.1	70.9	62.5	47.1	73.4	44.2	59.8	75.6	84.4	70.8	59.7	63.8
Number of Observations	210	9	48	228	32	68	73	34	62	193	186	157	497	803

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	40.5	8.4	43.4	61.4	46.3	52.7	62.1	65.3	89.1	70.8	65.3	35.2	62.8	43.9
Overcast	9.1	25.0	30.6	14.9	36.3	26.7	23.8	23.5	7.7	18.4	23.2	25.9	22.2	22.0
Showery	24.5	25.0	8.3	8.3	6.9	8.2	5.1	3.7	1.6	1.9	4.4	13.3	5.6	12.9
Rain	22.9	33.4	16.5	13.8	10.7	12.5	5.0	2.5	—	4.5	4.4	22.9	7.4	17.4
Squalls	2.1	5.6	—	0.6	—	—	2.2	—	—	—	—	0.5	0.5	1.4
Thunder	—	2.8	—	—	—	—	—	—	—	0.9	0.5	1.0	—	0.9
Hazy	1.1	—	1.2	1.1	—	—	1.9	5.0	1.6	3.2	2.4	1.4	1.6	1.6
Mist	—	—	—	—	—	—	—	—	—	0.5	—	—	—	0.1
Number of Observations	188	36	85	350	132	184	100	81	64	223	207	217	911	956

XXXVIII. BANDA SEA, SOUTHERN PARTS.



XXXIX. BANDA-SEA, NORTHERN PARTS.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	34	—50	N 57° W	W N W	60%	1.8	256
February	29	—45	N 58° W	W N W	54	1.7	280
March	3	—29	N 84° W	W	29	1.5	396
April	—27	22	S 38° E	S E	35	1.5	440
May	—34	37	S 47° E	S E	50	1.6	333
June	—55	57	S 47° E	S E	79	1.8	233
July	—57	59	S 46° E	S E	82	1.9	240
August	—56	62	S 48° E	S E	84	1.9	194
September	—42	18	S 23° E	S S E	46	1.6	270
October	—54	38	S 35° E	S E	66	1.4	259
November	—23	— 1	S 4° W	S	23	1.4	349
December	6	—39	N 81° W	W	39	1.5	399
Year	—23	11	S 26° E	S S E	25	1.63	3649

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	42	—55	N 52° W	N W	69%	1.7	259
February	45	—49	N 47° W	N W	67	1.7	278
March	18	—25	N 53° W	N W	31	1.5	380
April	—16	26	S 60° E	E S E	31	1.5	436
May	—31	36	S 50° E	S E	48	1.6	310
June	—53	60	S 50° E	S E	80	1.9	229
July	—56	57	S 46° E	S E	80	2.0	233
August	—59	61	S 46° E	S E	85	1.9	186
September	—62	45	S 36° E	S E	77	1.6	267
October	—47	42	S 42° E	S E	63	1.4	234
November	— 8	4	S 27° E	S S E	9	1.3	344
December	26	—35	N 53° W	N W	44	1.4	368
Year	—17	14	S 39° E	S E	22	1.63	3524

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	38	—53	N 55° W	N W	65%	1.8	515
February	37	—47	N 52° W	N W	60	1.7	558
March	11	—27	N 68° W	W N W	29	1.5	776
April	—22	24	S 47° E	S E	33	1.5	876
May	—33	37	S 48° E	S E	50	1.6	643
June	—54	59	S 48° E	S E	80	1.9	462
July	—57	58	S 46° E	S E	81	2.0	473
August	—58	62	S 47° E	S E	85	1.9	380
September	—52	32	S 32° E	S S E	61	1.6	537
October	—51	40	S 39° E	S E	65	1.4	493
November	—16	2	S 7° E	S	16	1.4	693
December	16	—37	N 67° W	W N W	40	1.5	767
April—October	—49	45	S 43° E	S E	67	1.70	3864
November—March	17	—32	N 62° W	W N W	36	1.58	3309
Year	—20	23	S 49° E	S E	30	1.65	7173

The weather in the northern parts of the *Banda-sea* differs much more markedly from that in the southern parts, than might have been expected from the comparative situation of those seas with respect to the mainland of *Australia*.

The brightness of the sky is considerably less and, in consequence, the haziness considerably denser in the northern than in the southern parts.

The rainfall bears a different character and is greater, though showers are far less frequent, thus showing that smaller quantities of rain come down at one time in the northern than in the southern parts.

Heavy squalls and thunderstorms seldom occur, the atmosphere is hazier, and the monsoon far less steady, whilst the force of the wind is less than in more southern latitudes.

The E monsoon sets in in April, when S E winds begin to prevail; in this month circulating winds often occur and the average force of the wind sinks to a minimum viz. 1.5.

In May the steadiness of the S E monsoon considerably increases, the monsoon may be relied upon and the average force, though still low, is somewhat higher than in April.

During June, July and August the monsoon is at its height; S E winds blow with almost absolute steadiness and at the same time the force of the wind increases and attains its maximum value viz. 2.0 in August.

In January and February the W monsoon attains to full vigour and the average force amounts to resp. 1.8 and 1.7, but its steadiness does not equal that of the E monsoon and variable winds often are met with.

In March the steadiness and force of the wind considerably decrease and, though winds from the N W quadrant of the compass still prevail, the monsoon cannot longer be depended upon; both, March and April, must be considered as transition-epochs, March occasionally exhibiting W monsoon, and April E monsoon characteristics.

It follows from those characteristics of the monsoons, as described here, that, taking the whole year into account, the E monsoon is the better developed of the two, both in strength and duration; and that the general motion of the air must be to the N W ward in consequence, as is shown by the average values of direction and percentages of steadiness given for the whole year in table C.

A force of the wind greater than 3 has been registered 117 times out of 7173, of which 53 at daytime and 64 during nighthours; these rather strong winds have been experienced almost exclusively when the monsoons are at their height i. e. in January and February and in July and August.

The rainfall in these parts is pretty heavy throughout the whole year and dry and wet seasons are far less sharply defined than in the *Timor-sea* for instance, and in many other parts of the Archipelago.

The wet season lasts from May to August, the driest months are September, October and November, whilst from December to April the rainfall is moderate; secondary maxima and minima are not observable in the results given in table D.

On the whole the conclusions drawn from these observations made in the offing are confirmed by the results of the rain-observations made at coast-stations, where however a secondary minimum of rainfall in February may be observed which is not exhibited in table D.

It probably is due to the different methods of observations, that at coast-stations, where the rainfall is measured, being far more accurate than that followed on board ship, where the log only mentions whether or not rain has fallen during the four hours of the watch.

For an account of the rainfall at different coast-places, the reader is referred to the special chapter on rainfall, in which the results are given for a large number of stations.

Showers occur throughout the year, with percentages which, though pretty high, remain beneath those found in the southern parts of this sea, and are lowest from September to November.

Heavy squalls and thunderstorms are rare, and the atmosphere is, on the whole, hazier here than in the southern parts.

This is a remarkable fact, not only on account of the greater distance from the Australian deserts, but also because it would appear that the rainfall, being much heavier and more equally distributed over all months than in the southern parts, would have the effect of decreasing rather than increasing the frequency and density of the haziness.

The condition of the sea is somewhat less favourable than in the southern parts of the *Banda-sea*, and the swell pretty heavy during all months, for which reason it is accompanied by winds from all directions equally; September, October and November are the best months in this respect.

The percentages of „sea" and „high sea" are highest from May to August when they have been frequently registered.

The currents may be considered as drift-currents and are, on the average, somewhat stronger in the E than in the W monsoon, though the percentages of steadiness are about the same and not very high, either in the former or in the latter epoch.

The average value of velocity has been computed at 12.8 miles per 24 hours in the E, and at 11.3 miles in the W monsoon.

The greatest velocities on record are 56 miles to the S S E in the E, and 38 miles to the E in the W monsoon.

Observations of tides have been made, by means of a selfregistering tide-gauge at *Amboina* — another station has been established at *Banda*.

Observations of rainfall have been made at *Kajeli*, (Isle of *Buru*), *Hitulama (Amboina)*, *Amboina*, *Saparua*, *Amahei* and *Banda*;

of wind at the hours 9 a. m., 2 p. m. and 6 p. m. at *Amboina*, *Saparua*, *Amahei* and *Banda*.

TABLE D. BANDA-SEA, NORTHERN PARTS.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	8.9	10.0	3.3	3.0	1.5	—	0.2	0.3	1.8	0.3	2.3	5.7	1.1	5.1
NNE	2.4	2.2	2.0	1.3	—	—	—	0.3	0.4	—	1.9	0.7	0.3	1.5
NE	1.3	2.8	1.6	2.7	3.3	0.9	0.9	1.4	1.1	2.3	3.1	2.1	1.7	2.2
ENE	0.9	0.2	0.3	2.6	3.9	1.9	0.4	0.5	—	0.5	3.5	0.8	1.6	1.0
E	0.2	0.4	2.6	7.5	7.2	4.5	8.3	2.2	3.4	7.3	5.2	0.2	5.5	2.7
ESE	0.4	—	2.4	9.8	14.5	18.1	18.1	20.5	7.6	12.7	3.5	0.5	14.8	3.3
SE	—	0.2	6.0	**15.3**	**23.4**	**44.7**	**39.5**	**53.3**	**32.6**	**29.1**	**12.1**	3.3	**34.8**	8.5
SSE	0.4	0.4	3.9	9.1	8.2	11.5	17.5	10.9	23.6	10.1	6.3	2.8	13.5	4.0
S	0.4	1.3	4.4	8.5	8.7	4.9	7.0	1.9	15.7	15.1	10.8	4.1	7.8	6.0
SSW	0.4	1.1	3.3	3.0	3.2	2.1	—	0.5	0.9	4.2	4.6	3.1	1.6	2.8
SW	4.2	5.0	5.0	4.3	1.1	1.4	0.4	0.8	4.0	4.7	7.1	8.2	2.0	5.7
WSW	7.1	8.1	4.7	3.6	0.9	—	0.4	0.5	0.2	0.3	6.0	6.9	0.9	5.5
W	13.1	10.9	11.2	2.4	2.8	0.2	—	0.3	0.4	1.8	6.3	12.9	1.0	9.4
WNW	12.9	**14.6**	11.1	1.2	1.9	—	—	—	—	—	4.4	7.0	0.5	8.3
NW	**23.1**	13.3	**13.2**	3.0	2.0	0.2	0.2	0.3	0.4	0.3	5.6	**16.3**	1.0	**12.0**
NNW	8.2	10.5	4.9	1.6	0.4	0.5	—	—	0.4	0.3	1.3	4.9	0.5	5.0
Circulating	4.2	7.6	6.5	4.3	5.2	4.2	3.3	2.7	3.4	3.9	5.8	4.7	3.9	5.5
Variable	11.5	10.5	12.4	14.5	8.7	4.2	2.8	3.3	3.6	6.2	8.3	12.1	6.2	10.2
Calm	0.2	0.9	1.3	2.3	3.0	0.5	0.9	0.3	0.4	1.0	1.9	3.9	1.2	1.5

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	6.8	6.9	6.4	5.3	3.2	0.2	0.4	1.1	0.9	1.2	4.3	8.4	1.9	5.7
NNE	1.3	2.2	2.7	2.7	1.6	0.7	0.2	—	0.9	0.9	1.8	1.5	1.0	1.7
NE	2.4	2.7	2.3	4.0	3.4	0.7	0.2	0.8	0.9	2.6	6.2	2.0	1.7	3.0
ENE	0.2	0.6	1.4	2.9	4.2	1.1	0.6	1.1	0.9	2.9	3.9	1.1	1.8	1.7
E	0.2	—	4.8	6.6	6.8	5.7	7.1	2.2	4.7	5.9	5.3	2.4	5.5	3.1
ESE	0.2	—	2.3	9.0	14.8	22.3	19.6	21.0	10.6	17.3	4.5	0.7	16.2	4.2
SE	0.4	0.2	3.8	**20.2**	**22.2**	**41.4**	**38.1**	**46.9**	**37.1**	**29.3**	10.1	2.2	**34.3**	7.7
SSE	0.9	0.6	3.0	7.5	9.6	12.9	16.4	16.3	14.8	10.3	4.3	1.5	12.9	3.4
S	1.5	—	2.3	4.3	7.0	4.8	8.0	5.7	18.8	7.0	8.6	1.8	8.1	3.5
SSW	1.1	1.3	2.7	2.6	2.6	0.5	0.6	—	0.5	6.1	2.5	2.4	1.1	2.7
SW	2.0	2.2	2.5	3.4	2.8	1.1	0.4	—	2.8	4.4	5.3	4.2	1.8	3.4
WSW	3.8	3.5	4.8	1.7	0.8	—	—	—	0.5	0.6	3.1	4.9	0.5	3.5
W	9.7	10.2	9.8	1.8	4.0	—	—	0.5	0.5	2.1	4.1	6.4	1.1	7.1
WNW	20.8	16.5	10.4	1.5	0.8	—	0.2	—	—	0.3	7.1	12.8	0.4	11.3
NW	**27.8**	**21.1**	**14.1**	4.1	1.8	0.2	0.4	0.3	0.2	0.9	5.3	**19.0**	1.2	**14.7**
NNW	11.9	19.6	8.4	3.8	0.6	0.2	0.9	—	—	0.3	2.3	8.8	0.9	8.6
Circulating	1.5	2.9	7.1	5.2	4.8	1.8	2.2	0.8	1.4	3.8	8.0	3.6	2.7	4.5
Variable	6.4	7.9	10.0	11.3	5.8	5.5	3.9	1.9	3.8	2.3	9.0	13.5	5.4	8.2
Calm	0.9	1.3	1.1	2.1	3.0	0.7	0.6	1.4	0.7	1.8	4.1	2.9	1.4	2.0

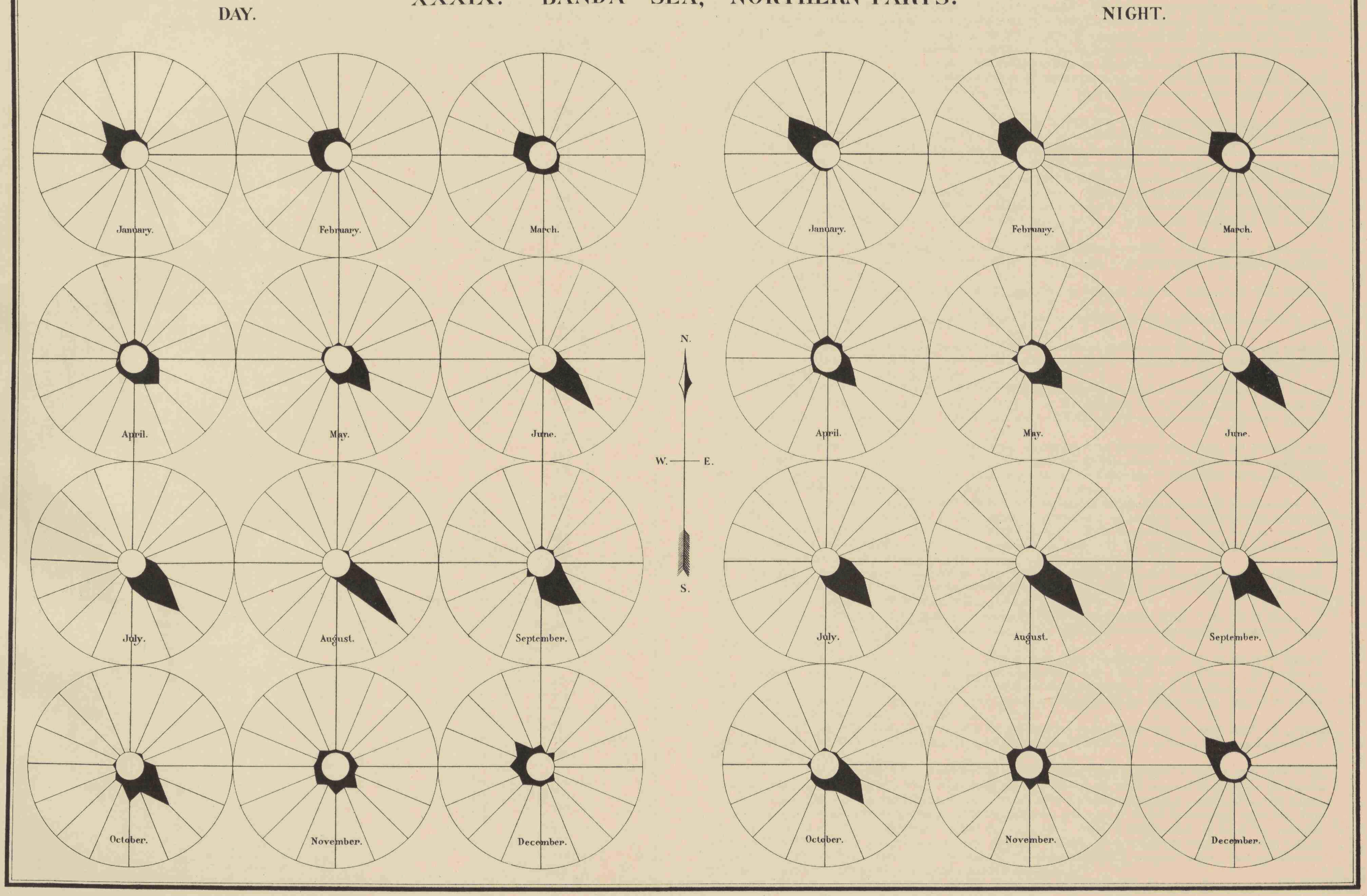
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	37.3	25.7	23.1	20.9	29.0	29.5	29.6	31.2	15.9	7.8	19.6	22.7	26.0	22.7
High Swell	4.4	3.1	2.9	0.7	3.9	6.3	4.6	2.9	—	0.5	—	1.2	3.1	2.0
Waves	0.6	1.2	—	1.0	0.4	6.3	1.6	5.7	—	1.5	0.9	—	2.5	0.7
Sea	11.6	8.0	4.7	10.7	8.0	22.3	27.2	25.5	7.3	5.9	5.2	6.5	16.8	7.0
High Sea	2.8	3.7	0.6	—	0.4	2.3	2.6	11.3	0.6	—	—	0.6	2.9	1.3
Calm	43.5	58.4	68.8	66.9	58.5	33.5	34.6	23.6	76.3	84.4	74.4	69.2	48.9	66.5
Number of Observations	182	163	173	316	250	176	196	141	195	205	249	312	1274	1284

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	36.4	37.3	40.1	39.6	31.9	34.5	26.8	28.4	49.1	44.8	52.6	45.4	35.1	42.8
Overcast	38.8	35.2	30.8	30.4	31.4	30.8	37.7	41.9	33.1	33.9	28.4	28.8	34.2	32.7
Showery	7.7	6.4	6.6	8.1	6.3	7.0	6.0	7.0	3.6	3.1	4.4	6.3	6.3	5.8
Rain	14.6	18.5	19.5	20.1	29.1	25.4	24.6	20.8	10.2	13.3	10.7	14.8	21.7	15.2
Squalls	0.8	0.6	0.4	0.4	0.5	0.5	—	0.3	—	—	0.5	0.8	0.3	0.5
Thunder	0.4	0.8	0.7	0.5	0.5	0.2	0.2	0.6	—	0.5	0.6	1.5	0.3	0.8
Hazy	1.4	1.5	2.1	1.3	0.5	1.6	4.9	1.0	4.2	4.7	2.8	2.5	2.3	2.5
Mist	—	—	—	—	—	0.2	—	—	—	—	0.2	0.2	0.0	0.1
Number of Observations	508	552	766	873	641	458	471	377	532	496	684	761	3352	3767

XXXIX. BANDA SEA, NORTHERN PARTS.



XL. CERAM-SEA.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	44	—40	N 43° W	N W	59 %	1.6	139
February	49	—35	N 35° W	N W	60	1.6	201
March	35	—32	N 43° W	N W	47	1.6	189
April	15	—21	N 53° W	N W	26	1.4	129
May	—22	7	S 18° E	S S E	23	1.4	142
June	—22	9	S 22° E	S S E	24	1.5	157
July	—49	17	S 19° E	S S E	52	1.7	213
August	—61	18	S 16° E	S S E	64	1.6	161
September	—56	7	S 7° E	S	56	1.6	154
October	—31	14	S 24° E	S S E	34	1.4	139
November	—16	—15	S 41° W	S W	22	1.6	87
December	39	—41	N 46° W	N W	57	1.5	177
Year	— 6	—10	S 59° W	W S W	12	1.54	1888

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	51	—30	N 31° W	N N W	59 %	1.7	139
February	41	—32	N 38° W	N W	52	1.5	201
March	29	—25	N 42° W	N W	38	1.4	190
April	— 5	—10	S 63° E	E S E	11	1.3	124
May	—30	16	S 28° E	S S E	34	1.4	137
June	—38	7	S 10° E	S	39	1.5	142
July	—57	22	S 21° E	S S E	61	1.7	210
August	—70	11	S 9° E	S	71	1.6	153
September	—61	8	S 8° E	S	62	1.5	155
October	—49	17	S 18° E	S S E	52	1.4	133
November	—26	—10	S 21° W	S S W	28	1.4	85
December	33	—36	N 47° W	N W	49	1.5	176
Year	—15	— 5	S 18° W	S S W	16	1.49	1845

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	48	—35	N 36° W	N W	59 %	1.7	278
February	45	—34	N 37° W	N W	56	1.6	402
March	32	—29	N 42° W	N W	43	1.5	379
April	5	—16	N 73° W	W N W	17	1.4	253
May	—26	12	S 25° E	S S E	29	1.4	279
June	—30	8	S 15° E	S S E	31	1.5	299
July	—53	20	S 21° E	S S E	57	1.7	423
August	—66	15	S 13° E	S S E	68	1.6	314
September	—59	8	S 8° E	S	60	1.6	309
October	—40	16	S 22° E	S S E	43	1.4	272
November	—21	—13	S 32° W	S S W	25	1.5	172
December	36	—39	N 48° W	N W	53	1.5	353
May—October	—46	13	S 16° E	S S E	48	1.53	1896
November—April	24	—28	N 49° W	N W	37	1.53	1837
Year	—11	— 8	S 36° W	S W	14	1.53	3733

An inspection of the summarizing table of the introduction shows that, as we go northward from the *Southwestern Isles*, the cloudiness increases and in the *Ceram-sea* attains to about the same percentage as in the northern parts of the *Banda-sea*; the rainfall, taken throughout the whole year, is somewhat less here than south of the isle of *Amboina*, but the steadiness of the monsoons is considerably less and, continuing to decrease as we go northward, sinks to percentages below those in the northern and far below those in the southern parts of the *Banda-sea*.

The haziness on the other hand increases, a fact which cannot be ascribed to the influence of *Ceram* because a similar increase is observable on comparing the northern parts of the *Banda-sea* with those situated in more southern latitudes.

The E monsoon, during which S S E winds prevail, sets in later than in the *Banda-sea* viz. about May: during this month the force of the wind is minimum (1.4) and varying and circulating winds occur with very high percentages; in June the monsoon is as yet but weakly developed and the average force is somewhat greater (1.5).

In July, August and September the E monsoon is at its maximum-value and the force (1.6—1.7) highest; the percentages of steadiness however in no case indicate an absolute reliability and varying winds frequently occur.

In October S S E winds still dominate but the monsoon begins to abate and in November westerly components appear: during this month, which may be considered as the transition-epoch of the monsoons, the steadiness attains but low percentages and, besides, winds circulating and varying from all quarters are experienced; the average force is very small viz. 1.4.

The W monsoon, when N W winds dominate, blows from December to March; the percentages of steadiness never attain very high values and variable winds occur in this season with percentages of frequency surpassing those found in all other regions.

In April W N W winds prevail, but practically there is no monsoon and the force of the wind sinks to a minimum-value.

From this description of the monsoons it appears that the influence of the Australian S E monsoon is not felt beyond the isle of *Ceram*.

Whereas the surplus of S E winds, as exhibited by the percentages of steadiness for the whole year, amounts to 30 % in the *Banda-sea*, it is not more than 14 % in the *Ceram-sea* and the direction of the general motion of the air rather from the S W than from the S E.

The average force of the wind at the same time decreases as we go northward and is considerably less in the *Ceram-sea* (1.53) than in the southern and northern parts of the *Banda-sea* viz. 1.80 and 1.65. A force of the wind greater than 3 has been registered only 43 times out of 3733 and almost exclusively in July and January when the monsoons are at their height.

In the *Ceram-sea* rainfall is pretty heavy during all months, more so than near *Banda* and *Amboina*: well marked seasons do not occur; a slight maximum is observable from April to June but practically the rainfall may be said to be about the same throughout the whole year; showery weather too is experienced during all months with equal and pretty high percentages, whilst heavy squalls are very rare.

Thunderstorms are seldom observed, and almost exclusively during the transition-epochs of the monsoons.

The state of the sea in these parts is, as might have been expected, on the whole favourable because continuous rainfall, when not accompanied by heavy gusts and strong winds, tends to smooth the surface of the water: it would appear from table D that a pretty heavy swell rolls in from July to November, but the percentages of „high sea" are remarkably low, lower than anywhere else, except on the coast of *Atjeh*.

Observations of rainfall have been made at *Wahaai* where, as might be argued from its situation with respect to the monsoons, the seasons occur in obverse order from those at *Amboina*: the rainfall at this station occurs under circumstances essentially different from those prevailing in the offing.

Observations of wind have been made at *Gamsungi (Petani)*, the most eastern point of the isle of *Djilolo*.

Here perhaps an explanation of the great differences in the distribution of the rainfall, as observed in the different parts of these seas, might be offered.

When the sun's declination is northerly, a barometric maximum is observed over the mainland of *Australia* and consequently from all sides of this continent the air flows out near the surface of the earth. In the eastern parts of the *Indian Archipelago* and near the N coast of *Australia* this outrush of air is experienced as a dry S S E and S E wind, the deviation to the left being partly due to the influence of the earth's rotation and partly to the draught exercised by *Torres*-strait and the *Sunda-sea*.

As the S E aircurrent proceeds however it absorbs moisture from the sea; this by itself would not produce rain, but at the same time, in overcoming the resistance of the masses of air, it is forced to ascend the layers of air, as it would a mountain slope.

It is this rising of the air which causes the June and July maximum of rainfall in the northern parts of the *Banda-sea*. Later in the year, when the S E monsoon has been blowing for some time, the whole mass of air joins the general movement; at this time there is no resistance offered and a dry season with high percentages of haziness ensues.

An anologous explanation might be given of the secondary minimum of rainfall in February, which also occurs when the N W or N monsoon has been blowing for some time, whilst in March again, owing to the increasing resistance, the north-westerly currents are compelled to ascend. Farther on to the North these characteristics of the monsoons are less marked because, as is the case in the *Ceram-sea*, neither monsoon comes to full development, these parts constituting the border-region of the Australian monsoons.

TABLE D. CERAM-SEA.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	12.1	16.7	11.8	6.0	4.4	3.5	2.4	0.4	2.1	2.5	3.6	3.6	3.1	8.4
NNE	3.9	1.5	2.7	2.7	2.0	3.1	0.5	1.2	0.8	1.5	1.5	1.4	1.7	2.1
NE	1.3	4.9	3.4	6.0	0.5	4.7	0.8	0.4	2.9	6.5	2.9	1.8	2.6	3.5
ENE	0.4	0.6	2.7	—	1.5	2.0	0.5	0.8	0.4	2.0	0.7	—	0.9	1.1
E	0.9	0.6	1.7	3.3	5.9	4.3	3.0	4.7	1.7	6.5	2.2	1.1	3.8	2.2
ESE	—	0.9	0.3	3.3	2.5	2.0	4.1	3.9	3.3	3.5	—	—	3.2	0.8
SE	1.3	—	1.0	2.2	13.8	11.8	**24.5**	14.6	12.4	**15.4**	9.5	0.4	13.2	4.6
SSE	0.9	0.3	2.7	0.5	10.3	**15.0**	12.8	**22.8**	9.5	10.4	**10.9**	1.4	11.8	4.4
S	1.7	0.3	3.4	2.7	6.9	11.4	15.2	20.1	**29.8**	10.9	8.8	1.8	**14.4**	4.5
SSW	—	—	1.3	2.7	1.5	2.8	7.3	9.1	10.7	4.0	1.5	0.4	5.7	1.2
SW	1.7	0.9	4.7	5.5	2.5	2.8	4.1	3.5	5.0	6.0	9.5	0.7	3.9	3.9
WSW	2.2	2.2	0.7	2.7	4.4	3.5	1.4	2.4	1.7	3.5	8.8	2.5	2.7	3.3
W	10.8	6.8	8.4	10.4	6.4	5.1	3.3	2.4	2.1	7.0	3.6	5.1	5.0	7.0
WNW	6.9	12.0	13.5	8.2	4.4	2.4	0.3	—	—	1.5	3.6	11.2	2.6	8.1
NW	**28.0**	**25.0**	**16.5**	9.3	1.0	3.9	3.3	0.4	1.2	1.0	9.5	**29.0**	3.2	**18.2**
NNW	12.1	8.3	13.5	7.1	—	4.3	0.8	0.8	0.8	—	5.8	14.9	2.3	9.1
Circulating	3.9	4.3	3.7	9.3	8.4	2.8	4.1	3.9	5.8	6.0	6.6	5.4	5.7	5.0
Variable	8.2	12.7	7.1	**13.7**	**20.2**	9.8	10.9	7.5	9.5	8.0	10.2	18.1	11.4	10.7
Calm	3.9	1.9	1.0	3.8	3.4	4.7	0.8	1.2	0.4	4.0	0.7	1.1	2.4	2.1

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	11.8	**15.6**	15.6	4.1	2.1	3.5	3.1	0.4	0.4	0.5	7.0	4.6	2.3	9.2
NNE	8.2	3.9	2.2	5.3	1.5	1.8	0.3	0.4	—	1.0	2.3	3.1	1.6	3.5
NE	7.8	2.9	2.5	5.3	2.1	3.5	1.1	0.8	0.4	1.5	1.6	2.7	2.2	3.2
ENE	0.4	1.6	1.5	2.3	1.5	2.6	0.6	—	0.4	2.6	0.8	—	1.2	1.2
E	0.4	1.9	1.5	1.7	5.1	3.1	2.3	1.2	1.7	3.6	3.9	—	2.5	1.9
ESE	—	0.6	—	4.7	1.0	5.3	3.4	3.7	4.1	6.2	0.8	0.8	3.6	1.4
SE	0.8	0.6	1.5	5.8	13.8	7.9	20.6	11.2	7.4	18.6	6.3	3.1	11.1	5.2
SSE	—	0.3	4.4	9.4	**19.0**	**17.6**	**24.5**	**27.0**	21.9	**18.6**	4.7	1.9	**19.9**	5.0
S	—	—	4.4	3.5	8.7	13.7	16.6	20.7	**24.4**	12.4	**14.8**	3.4	14.6	5.8
SSW	0.8	—	2.2	2.3	1.5	5.7	5.4	10.4	7.9	5.7	11.7	1.1	5.5	3.6
SW	0.8	2.6	2.9	6.4	3.1	9.3	4.8	10.0	5.0	6.7	7.0	1.5	6.4	3.6
WSW	1.2	2.9	3.3	6.4	0.5	1.8	0.6	1.7	2.1	1.0	8.6	2.3	2.2	3.2
W	9.0	12.7	8.0	**10.5**	2.6	5.7	1.4	0.4	2.5	6.2	1.6	6.5	3.9	7.3
WNW	11.8	10.7	4.4	4.7	2.6	1.8	0.6	—	0.4	1.0	0.8	11.8	1.7	6.8
NW	**21.6**	13.3	**15.6**	6.4	3.1	1.8	2.0	—	0.8	1.5	3.9	**23.3**	2.4	**13.2**
NNW	9.4	11.0	12.0	2.3	1.0	0.9	—	—	—	1.0	3.1	14.9	0.7	8.6
Circulating	1.6	4.9	1.8	6.4	10.8	4.4	2.3	2.9	5.8	5.7	3.1	5.7	5.4	3.8
Variable	13.5	13.0	12.4	8.8	16.9	5.3	9.3	8.3	14.0	4.1	13.3	12.2	10.4	11.4
Calm	0.8	1.3	4.0	3.5	3.1	4.4	1.4	0.8	0.8	2.1	4.7	1.1	2.3	2.3

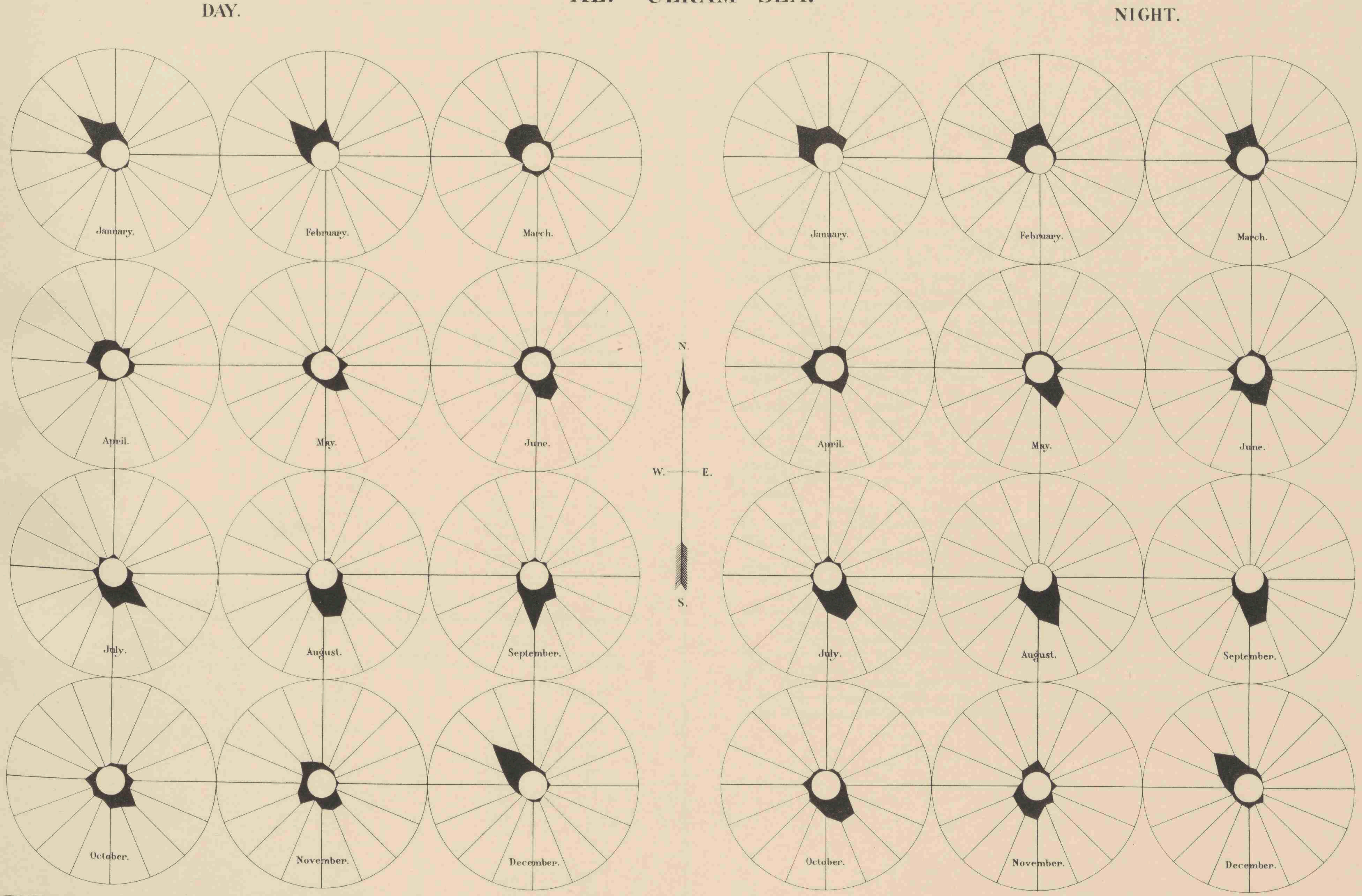
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	16.4	16.4	17.5	5.2	14.3	17.5	34.9	35.1	18.7	25.6	32.3	15.1	21.0	20.6
High Swell	1.0	1.3	—	—	—	0.9	7.5	1.1	6.1	—	—	1.9	2.6	0.7
Waves	—	2.6	0.7	—	—	3.8	1.7	5.2	—	2.6	—	—	1.8	1.0
Sea	7.0	15.3	7.6	10.4	6.9	3.6	10.9	7.2	3.8	5.2	7.4	1.0	7.1	7.3
High Sea	—	—	—	—	—	1.1	6.2	—	—	8.4	1.5	1.9	1.2	2.0
Calm	75.7	64.5	74.2	84.5	78.9	73.4	38.9	51.5	71.5	58.4	58.8	80.2	66.5	68.6
Number of Observations	99	79	144	77	72	108	175	97	81	45	68	106	610	541

CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	41.6	33.2	51.0	36.4	45.0	44.4	43.6	45.2	52.0	41.0	37.2	51.6	44.4	42.6
Overcast	30.2	37.1	27.4	30.5	30.0	28.7	32.7	31.9	28.2	35.5	40.0	26.2	30.3	32.7
Showery	8.5	7.6	5.0	6.6	8.0	5.9	5.8	4.2	4.9	3.0	4.6	8.6	5.9	6.2
Rain	18.4	17.5	13.5	22.8	16.3	20.5	15.7	9.9	10.4	14.3	12.6	12.0	15.9	14.7
Squalls	—	0.3	—	0.4	—	—	—	—	—	0.4	—	—	0.1	0.1
Thunder	—	1.3	1.1	0.4	0.4	—	—	0.7	0.7	—	1.7	—	0.4	0.7
Hazy	1.5	3.1	2.1	3.1	0.4	0.7	2.4	8.3	3.9	6.0	4.0	1.7	3.1	3.1
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	272	394	377	259	276	293	420	314	308	268	175	351	1870	1837

XL. CERAM SEA.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XLI. NORTH-WEST COAST OF NEW GUINEA, AND GEELVINK-BAY.

TABLE A. DAY-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	51	—74	N 55° W	N W	90 %	1.9	14
February	—	—	—	—	—	—	—
March	33	—31	N 43° W	N W	45	1.4	44
April	10	—15	N 54° W	N W	18	1.3	36
May	16	45	N 72° E	E N E	48	1.5	8
June	0	65	E	E	65	1.6	36
July	—18	27	S 56° E	S E	32	0.9	38
August	—	—	—	—	—	—	—
September	0	—25	W	W	25	1.4	9
October	6	45	N 82° E	E	45	1.4	9
November	40	—58	N 56° W	N W	70	1.3	9
December	—	—	—	—	—	—	—
Year	16	— 2	N 7° W	N	16	1.41	203

TABLE B. NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	58	—75	N 52° W	N W	95 %	2.0	12
February	—	—	—	—	—	—	—
March	4	—41	N 84° W	W	41	1.5	45
April	— 4	—43	S 85° W	W	43	1.2	29
May	—25	32	S 52° E	S E	41	1.6	78
June	—17	66	S 75° E	E S E	68	1.5	35
July	— 1	26	S 88° E	E	26	1.0	38
August	—	—	—	—	—	—	—
September	—22	—55	S 69° W	W S W	59	1.9	7
October	5	74	N 87° E	E	74	1.6	8
November	39	—55	N 54° W	N W	67	1.7	6
December	—	—	—	—	—	—	—
Year	4	— 8	N 63° W	W N W	9	1.56	258

TABLE C. DAY AND NIGHT-HOURS.

	Components.		Mean Direction of the Wind.		Steadiness of mean Direction.	Mean Force.	Number of Observations.
	N	E					
January	55	—75	N 54° W	N W	93 %	2.0	26
February	—	—	—	—	—	—	—
March	19	—36	N 62° W	W N W	41	1.5	89
April	3	—29	N 84° W	W	29	1.3	65
May	— 5	39	S 83° E	E	39	1.6	86
June	— 9	66	S 82° E	E	67	1.6	71
July	—10	27	S 70° E	E S E	29	1.0	76
August	—	—	—	—	—	—	—
September	—11	—40	S 75° W	W S W	41	1.7	16
October	6	60	N 84° E	E	60	1.5	17
November	40	—57	N 54° W	N W	70	1.5	15
December	—	—	—	—	—	—	—
May—October	— 6	30	S 79° E	E S E	31	1.48	266
November—April	29	—49	N 60° W	W N W	57	1.58	195
Year	10	— 5	N 27° W	N N W	11	1.52	461

As is shown in the last column of table C, the observations made in these regions are not very numerous; consequently a monsoon-chart, exhibiting by graphical method the winds to be expected in the different months, cannot be given.

The observations extant however are of no ordinary importance, because the monsoons and the seasons (with respect to rainfall), as observed at coast-places, show notable differences even at stations situated in apparently equal conditions; observations made in the offing therefore are of greater value for the knowledge of the monsoons, as the climate prevailing at sea is far less dependent on local circumstances than that experienced at coast-places.

The E monsoon in these parts sets in in May with prevailing E winds; in this month the monsoon does not blow steadily: from June to October the E monsoon appears to blow with pretty high percentages of steadiness, but, owing to the shelter from the S E Australian monsoonwind afforded by the isle and its large mountainranges, these percentages never attain to very high values.

The W monsoon, during which N W winds dominate, is far steadier and stronger than the E monsoon; it sets in in November, almost immediately comes to full vigour and lasts till March, whilst in April N W winds still appear to prevail, but with low percentages.

April is to be considered as the transition-epoch of the monsoons when the force of the wind is minimum and calms often are experienced.

As far as the not very numerous observations go the results of the observations given in table D appear to show that the rainy season is from July to September, the dry season from December to June.

Generally the rain comes down in showers; throughout the whole year heavy squalls however are seldom experienced. This result of the observations made in the offing at the western parts of the N coast is not in conformity with the outcome of the observations made on the more eastern parts of the isle viz. the German possessions.

From a four-yearly series of rain-observations it appears that at *Hatzfield*-harbour at 145° E. Long. and 4 S. Lat. the maximum of rainfall occurs in January, at *Constantin*-harbour at 146° E. Long and 5°30′ S. Lat. in March, and near *Finschhaven* at 148° E. Long. and 6°34′ S. Lat. in July.

From this it would appear that at places which are open to the S E monsoon and sheltered from the influence of the N W monsoon, such as *Finschhaven*, it is the S E monsoon which causes the heaviest rainfall, whereas at the N coast, which is open to N W winds, it are these periodic aircurrents which bring rain.

At *Mansiname*, situated on the western shore of *Geelvink-bay*, observations of rainfall have been made during six years; the outcome is, that here the rainy season is from December to April, with a maximum in February.

September and October are the driest months; for further details the reader is referred to the chapter on rainfall.

The wind-observations, made also at this station at 9 a. m., 2 p. m. and 6 p. m., show that N E winds prevail from May to September and W winds from November to April and that, taken over the whole year, the W monsoon is stronger than the E monsoon; consequently the general direction of the aircurrents is to the S E ward.

The number of available observations concerning the state of the sea is very small; from the records, as far as they go, it would appear that, as might have been expected, a considerable swell is experienced at these shores in the W monsoon, whilst during the E monsoon the condition of the sea is somewhat better.

TABLE D. NORTH-WEST COAST OF NEW GUINEA, AND GEELVINK-BAY.

PERCENTAGE OF WINDS AND CALMS.

DAY.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	7.7	—	7.8	8.0	4.9	—	—	—	15.4	—	23.1	—	5.7	9.7
N N E	—	—	—	—	4.9	1.7	—	—	15.4	15.4	—	—	4.4	3.9
N E	—	—	7.8	**20.0**	9.0	22.0	9.8	—	—	—	—	—	**12.2**	2.0
E N E	—	—	9.4	—	**19.7**	11.9	2.4	—	—	—	—	—	6.8	2.4
E	—	—	—	4.0	17.2	11.9	**24.4**	—	—	**46.2**	—	—	11.5	11.3
E S E	—	—	—	—	10.7	**25.4**	—	—	—	7.7	—	—	7.2	1.9
S E	—	—	1.6	8.0	5.7	3.4	12.2	—	—	7.7	—	—	5.9	2.3
S S E	—	—	—	—	—	8.5	2.4	—	—	—	—	—	2.2	—
S	—	—	6.3	4.0	1.6	3.4	7.3	—	**30.8**	—	—	—	9.4	1.6
S S W	—	—	—	2.0	—	—	2.4	—	7.7	—	—	—	2.4	—
S W	—	—	6.3	10.0	4.1	—	4.9	—	—	7.7	—	—	3.8	3.5
W S W	—	—	1.6	6.0	2.5	—	7.3	—	—	—	7.7	—	3.2	2.3
W	30.8	—	7.8	18.0	1.6	1.7	4.9	—	15.4	—	**30.8**	—	8.3	17.4
W N W	—	—	7.8	—	0.8	—	2.4	—	7.7	15.4	15.4	—	2.2	9.7
N W	**61.5**	—	**35.9**	8.0	4.9	—	—	—	7.7	—	—	—	4.1	**24.4**
N N W	—	—	—	4.0	2.5	1.7	—	—	—	—	15.4	—	1.6	3.9
Circulating	—	—	3.1	2.0	4.1	1.7	2.4	—	—	—	—	—	2.0	0.8
Variable	—	—	1.6	2.0	4.1	5.1	2.4	—	—	—	—	—	2.7	0.4
Calm	—	—	3.1	4.0	1.6	1.7	14.6	—	—	—	7.7	—	4.4	2.7

NIGHT.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
N	—	—	3.0	10.0	0.8	1.8	—	—	—	—	**40.0**	—	2.5	10.8
N N E	—	—	—	—	3.1	—	—	—	—	—	—	—	0.6	—
N E	—	—	1.5	2.5	6.3	8.9	11.9	—	15.4	23.1	—	—	9.0	6.2
E N E	—	—	6.0	—	2.4	7.1	—	—	—	—	—	—	1.9	1.5
E	—	—	1.5	—	13.4	**28.6**	**21.4**	—	—	**38.5**	—	—	12.7	10.0
E S E	—	—	—	—	**18.1**	14.3	2.4	—	—	15.4	—	—	7.0	3.9
S E	—	—	1.5	5.0	13.4	10.7	14.3	—	—	7.7	—	—	8.8	2.3
S S E	—	—	—	—	6.3	12.5	2.4	—	—	—	—	—	4.2	—
S	—	—	13.4	5.0	5.5	1.8	2.4	—	—	—	—	—	2.9	3.4
S S W	—	—	—	—	3.9	1.8	2.4	—	15.4	—	—	—	4.7	—
S W	—	—	13.4	**25.0**	4.7	—	4.8	—	**30.8**	—	—	—	**13.1**	3.4
W S W	—	—	4.5	2.5	6.3	—	2.4	—	—	—	20.0	—	2.2	6.1
W	16.7	—	13.4	12.5	3.1	—	—	—	30.8	—	30.0	—	9.3	15.0
W N W	—	—	—	10.0	1.6	—	—	—	7.7	—	—	—	3.9	—
N W	**83.3**	—	**32.8**	10.0	3.1	—	11.9	—	—	—	10.0	—	5.0	**31.5**
N N W	—	—	—	—	—	—	4.8	—	—	—	—	—	1.0	—
Circulating	—	—	6.0	5.0	—	3.6	4.8	—	—	15.4	—	—	2.7	5.4
Variable	—	—	1.5	—	7.9	5.4	4.8	—	—	—	—	—	3.6	0.4
Calm	—	—	1.5	12.5	—	3.6	9.5	—	—	—	—	—	5.1	0.4

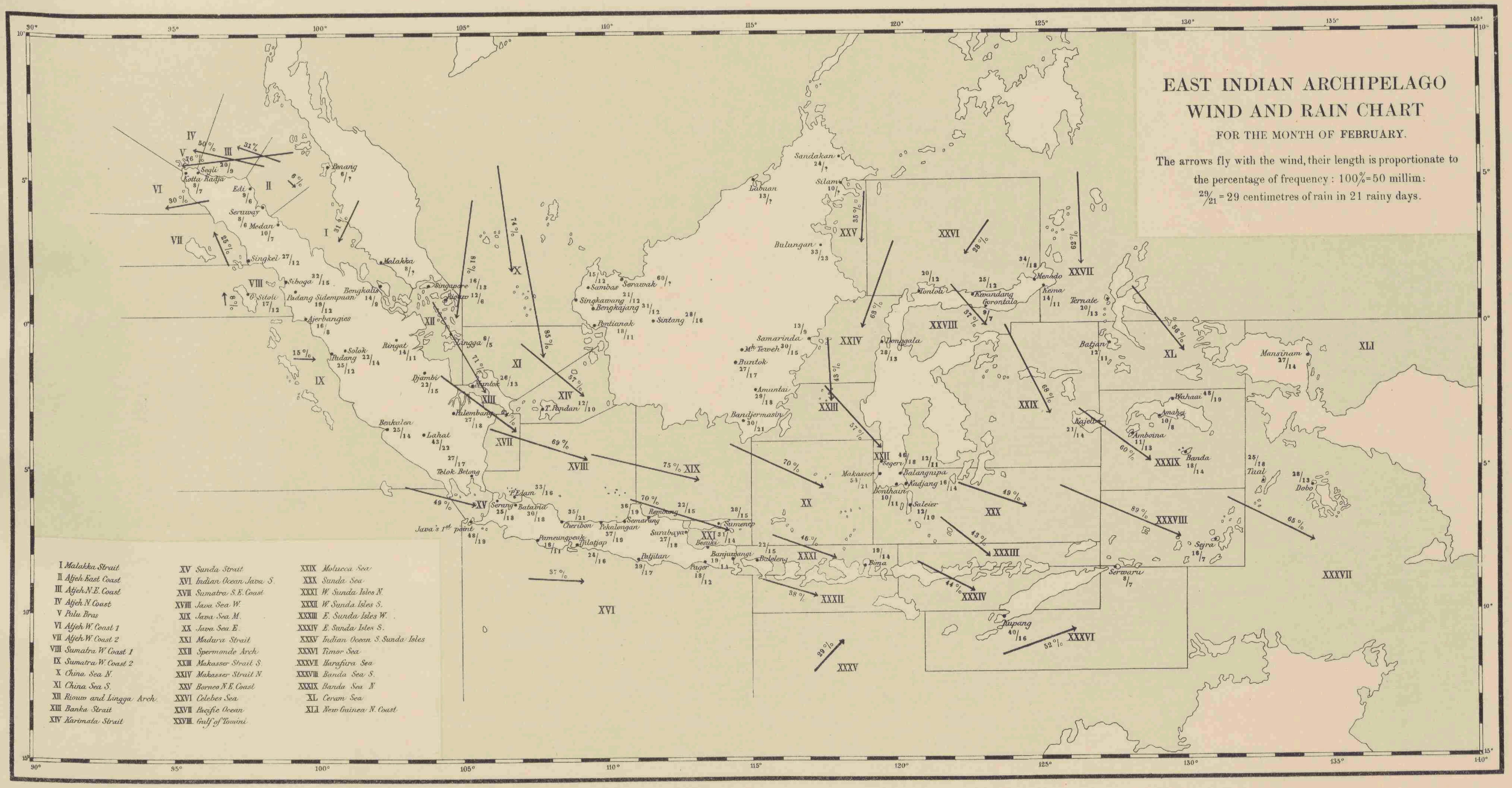
CONDITION OF THE SEA, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Swell	85.2	—	69.8	27.5	100.0	—	—	—	38.1	40.0	87.3	—	33.1	70.6
High Swell	—	—	1.2	—	—	25.0	—	—	—	—	—	—	5.0	0.3
Waves	—	—	—	—	—	—	—	—	—	6.3	—	—	—	1.6
Sea	7.2	—	7.3	11.5	—	12.5	—	—	12.7	11.3	—	—	7.3	6.5
High Sea	—	—	—	—	—	62.5	—	—	—	—	—	—	12.5	—
Calm	7.7	—	21.7	61.0	—	—	100.0	—	49.3	42.5	12.7	—	42.1	21.2
Number of Observations	26	—	83	45	3	6	19	—	16	18	16	—	89	143

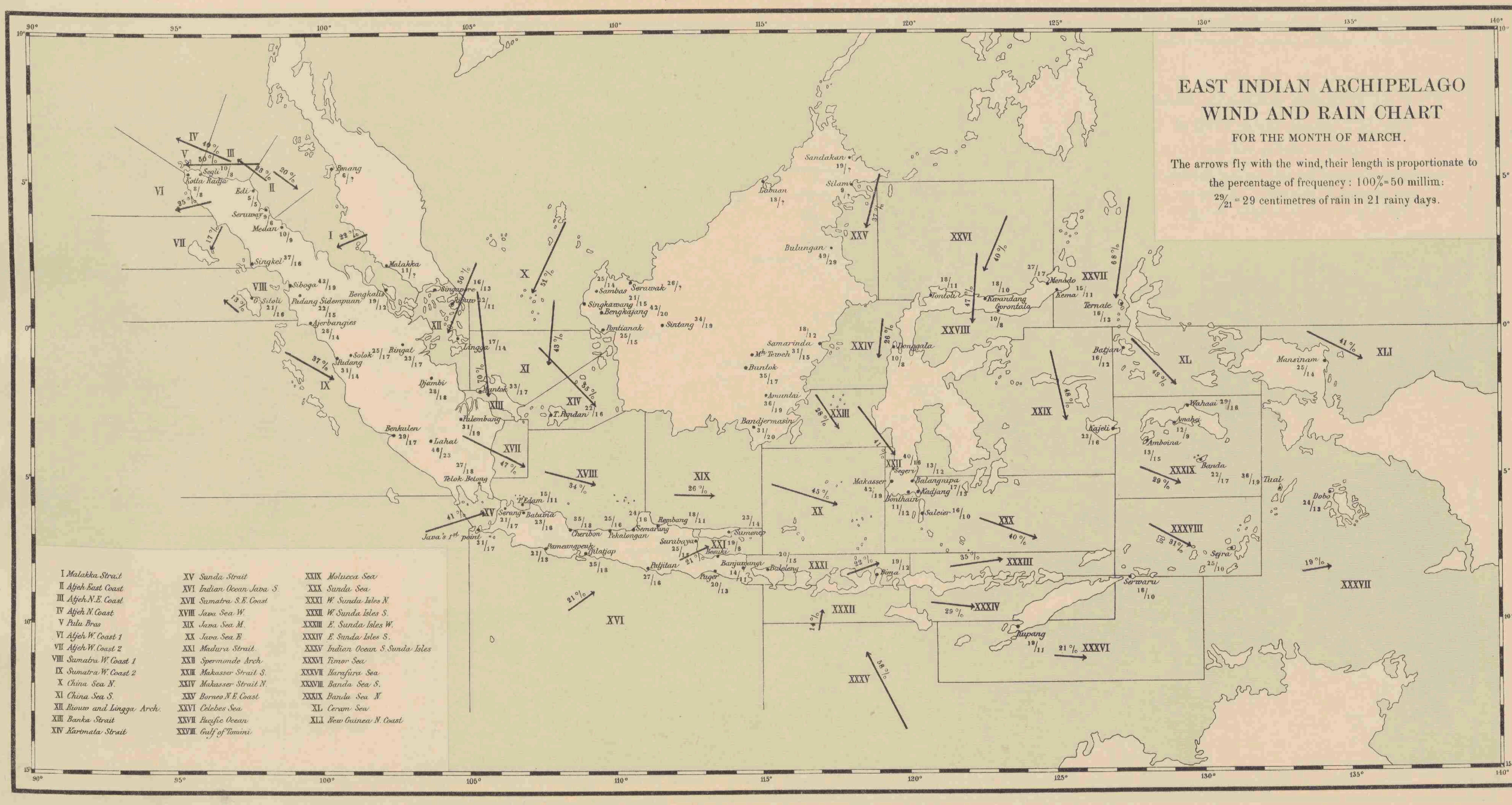
CONDITION OF THE WEATHER, PERCENTAGE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	April—September.	October—March.
Clear	30.4	—	45.1	68.8	34.8	22.6	60.9	—	56.3	70.7	69.5	—	48.7	53.9
Overcast	38.1	—	30.3	23.8	41.1	55.0	6.8	—	14.6	—	11.1	—	28.3	19.9
Showery	3.6	—	5.8	—	6.4	8.5	—	—	—	12.2	—	—	3.0	5.4
Rain	19.7	—	17.7	5.6	16.5	12.7	25.7	—	29.2	17.2	13.9	—	17.9	17.1
Squalls	—	—	—	—	—	—	2.7	—	—	—	—	—	0.5	—
Thunder	—	—	—	1.9	0.7	—	4.1	—	—	—	5.6	—	1.3	1.4
Hazy	8.4	—	1.2	—	0.7	1.4	—	—	—	—	—	—	0.4	2.4
Mist	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of Observations	26	—	86	62	158	28	74	—	14	17	15	—	336	144

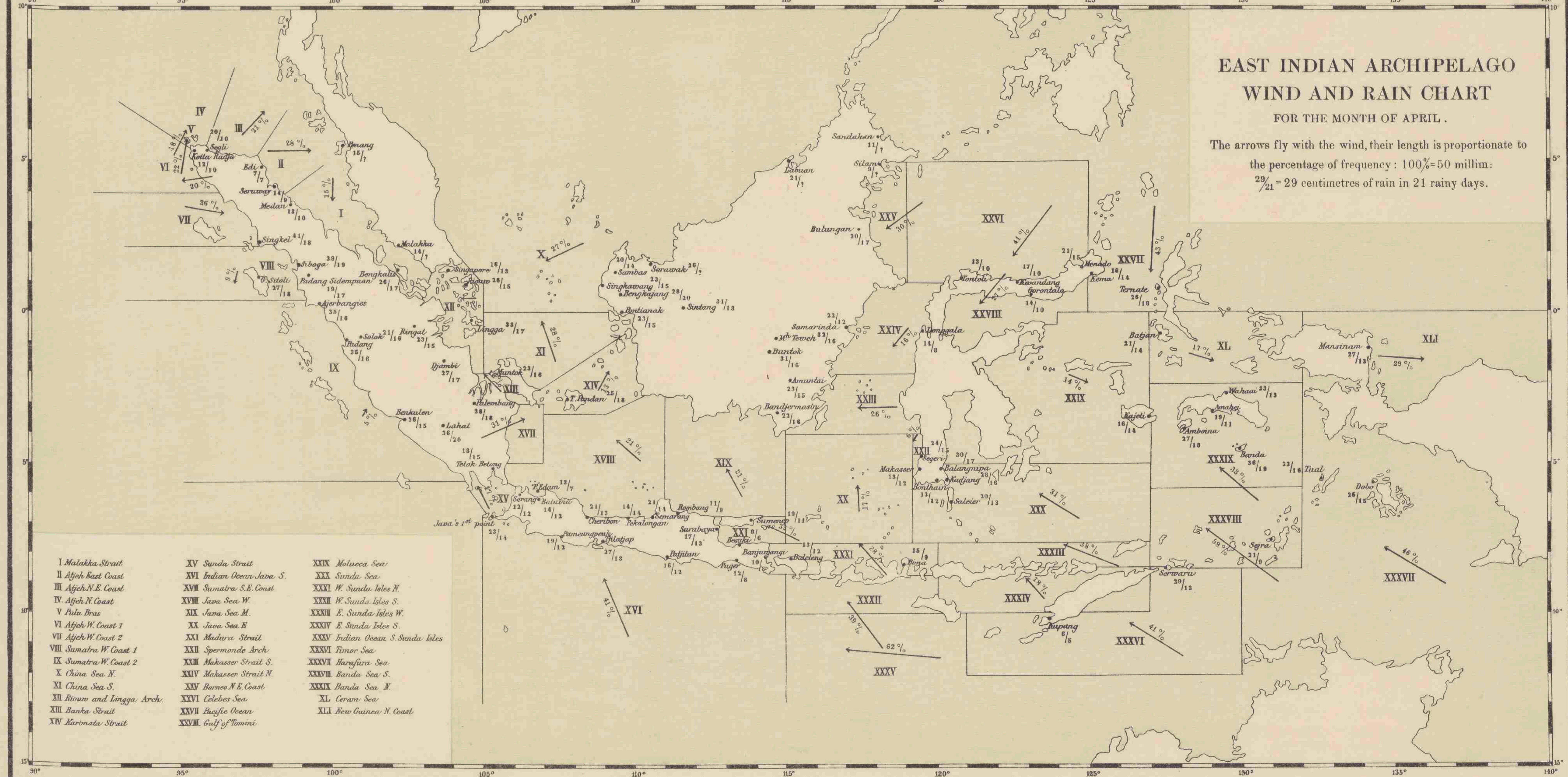

EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF JANUARY.
The arrows fly with the wind, their length is proportionate to the percentage of frequency : 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

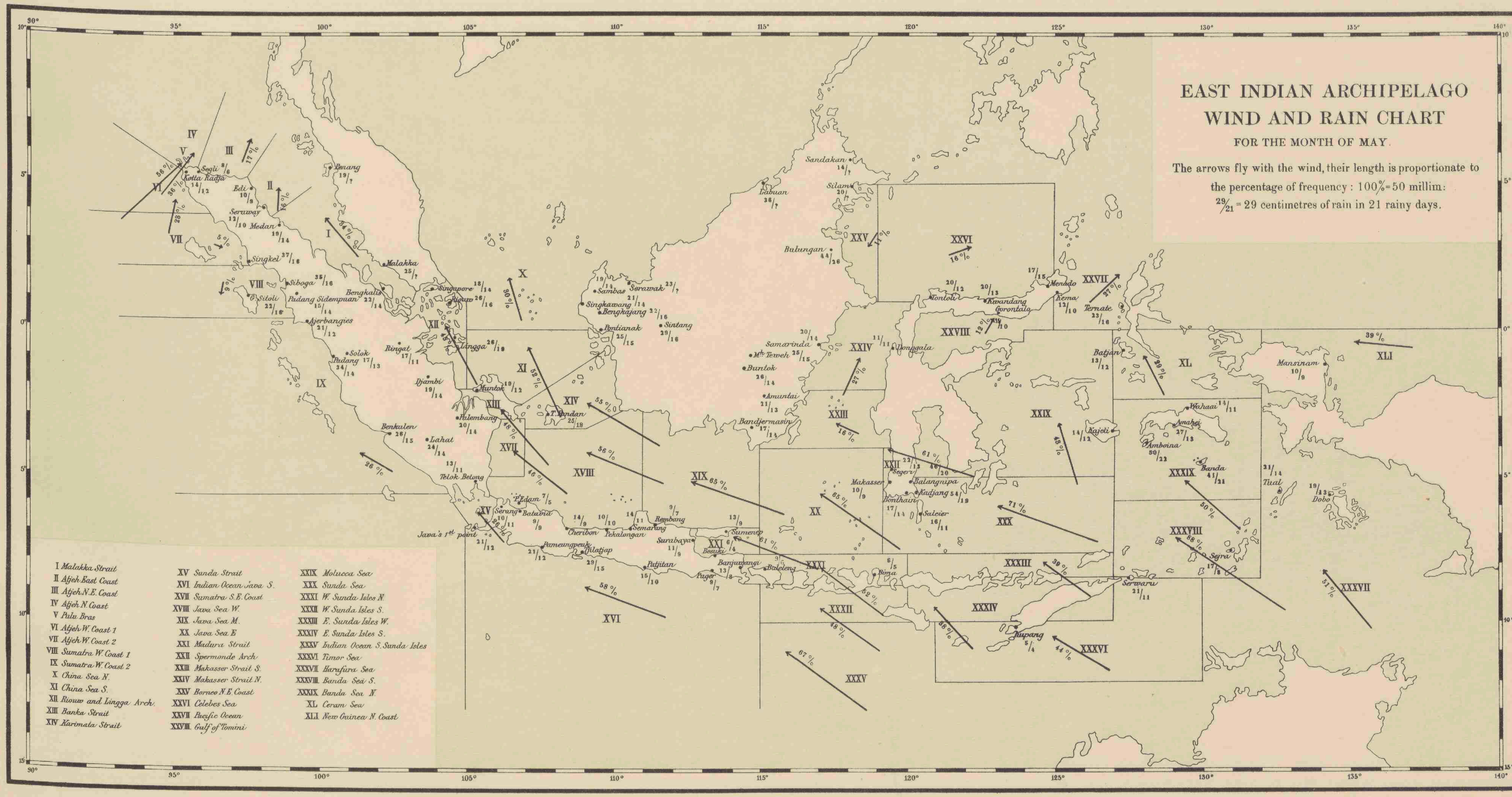


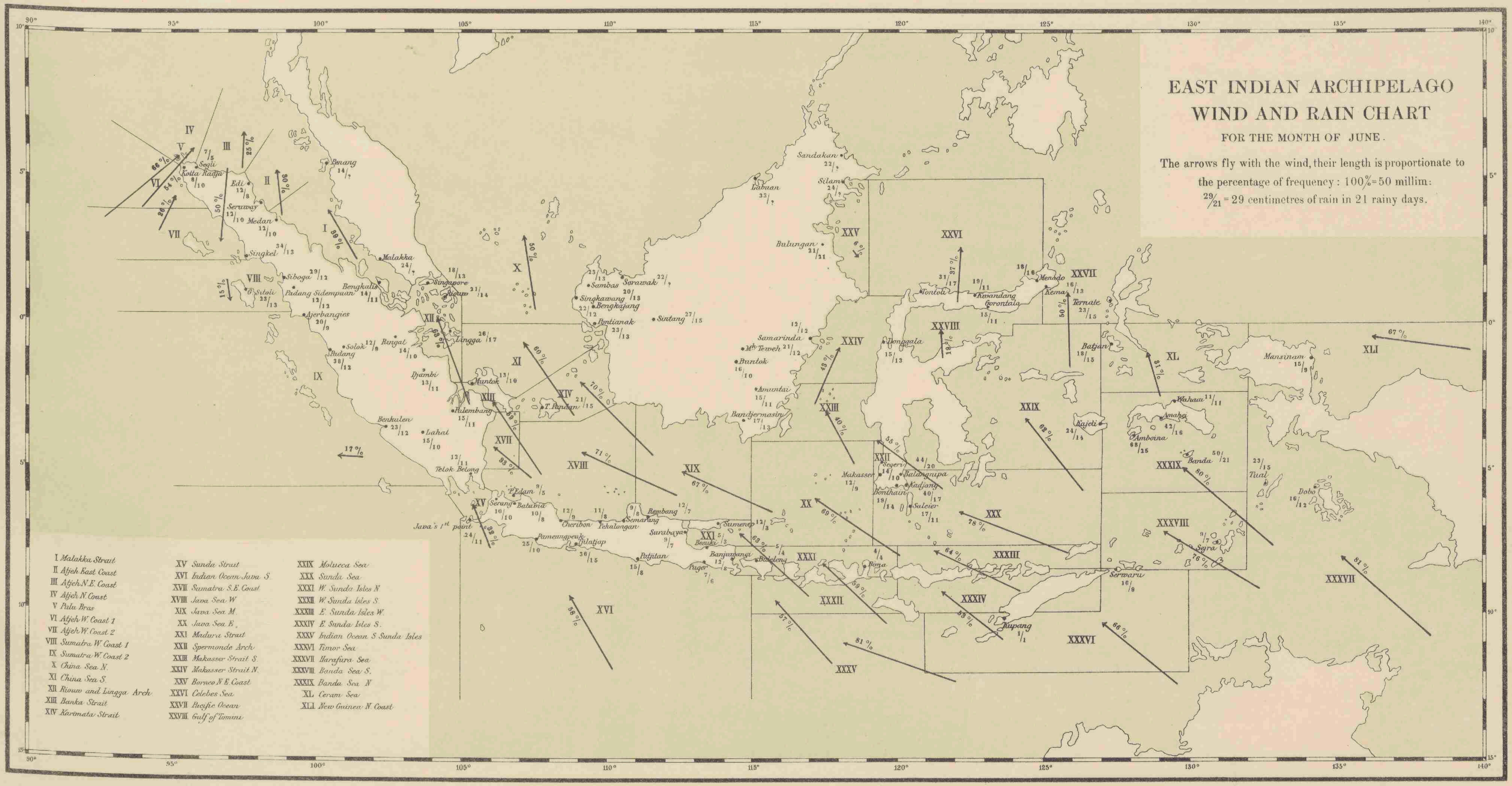
EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF FEBRUARY.
The arrows fly with the wind, their length is proportionate to the percentage of frequency : 100%=50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

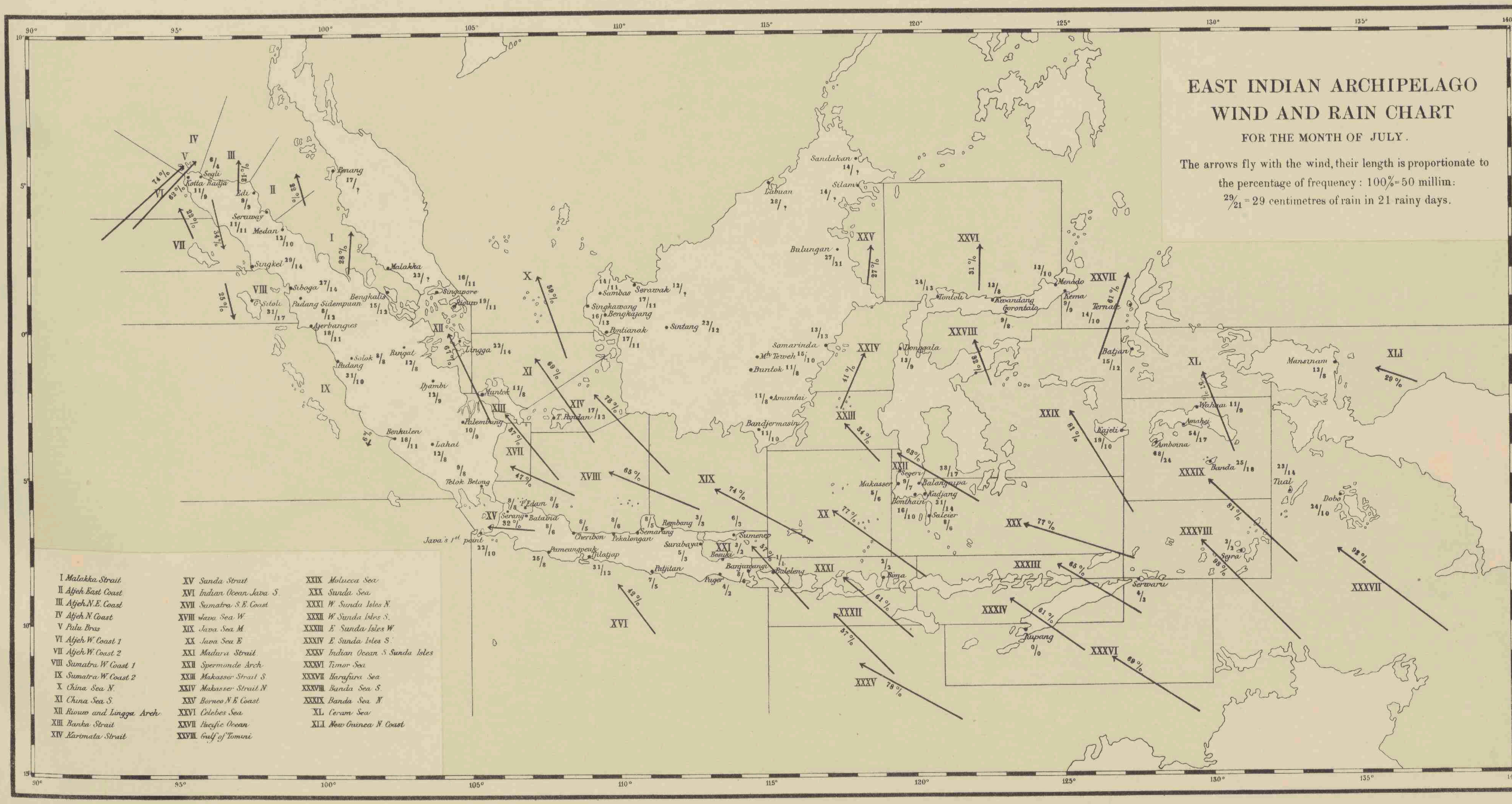


EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF MARCH.
The arrows fly with the wind, their length is proportionate to the percentage of frequency: 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait.
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

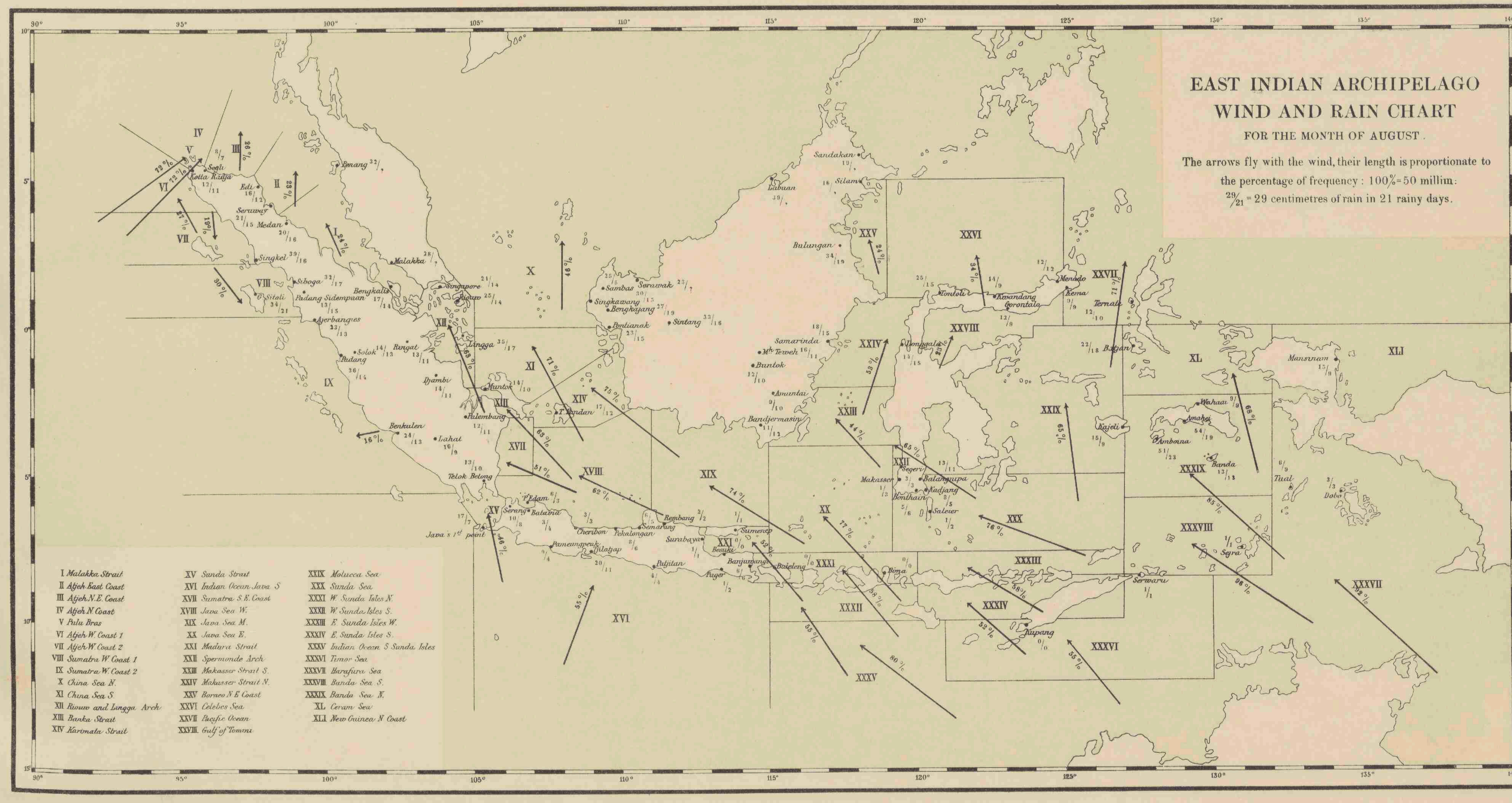

EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF APRIL.
The arrows fly with the wind, their length is proportionate to the percentage of frequency: 100% = 50 millim.
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

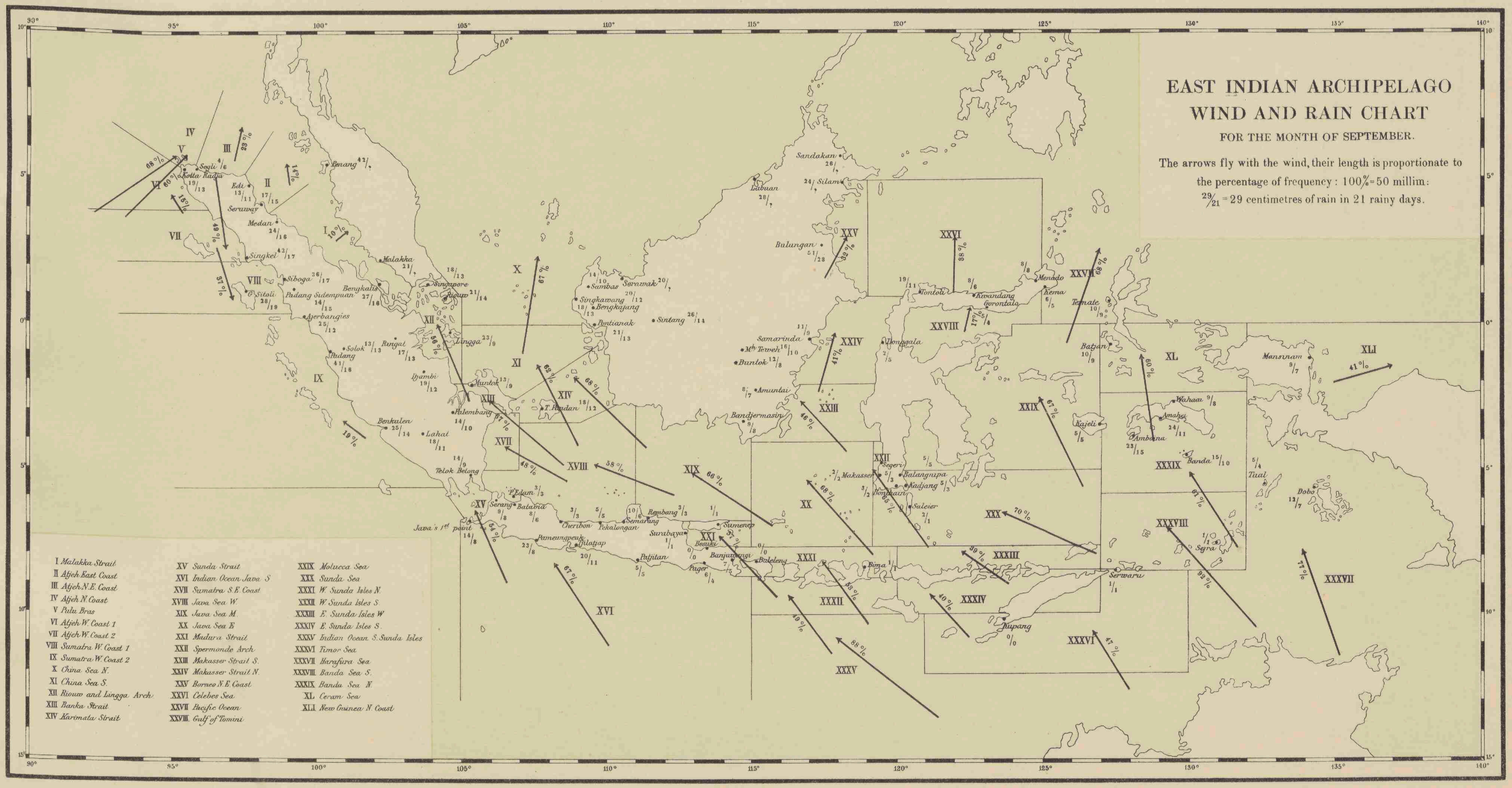

EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF MAY.
The arrows fly with the wind, their length is proportionate to the percentage of frequency: 100%=50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

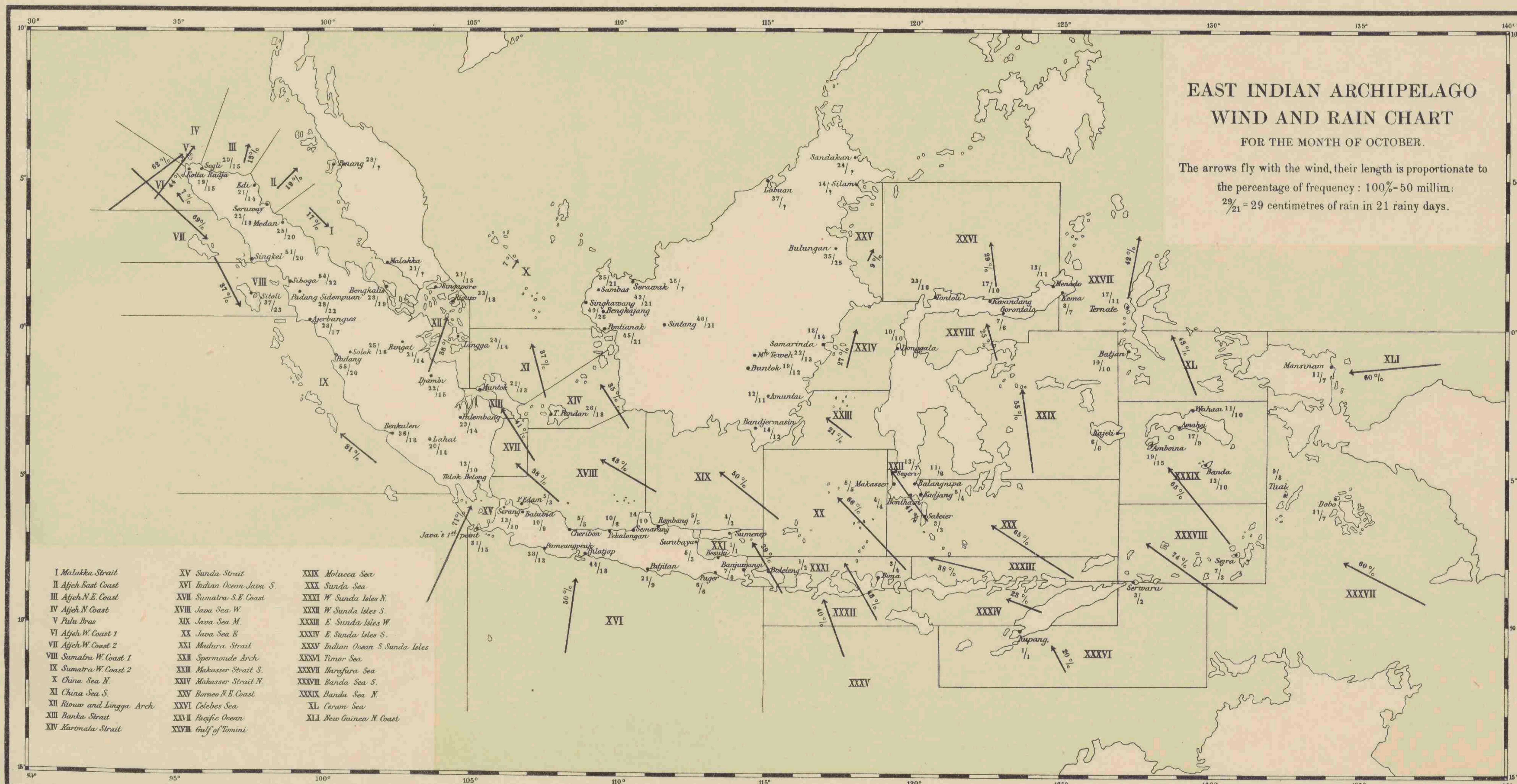

EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF JUNE.
The arrows fly with the wind, their length is proportionate to
the percentage of frequency : 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Arafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

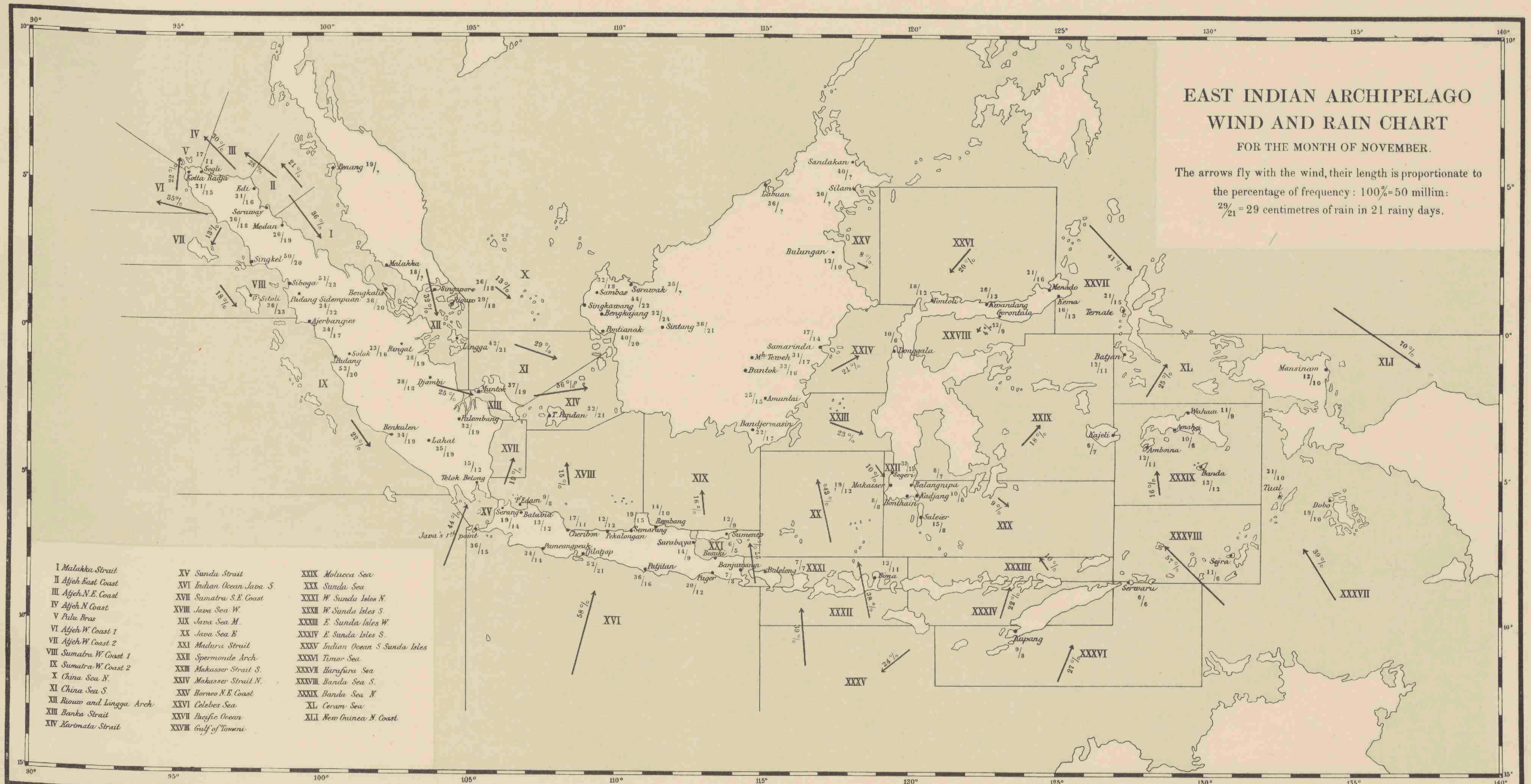


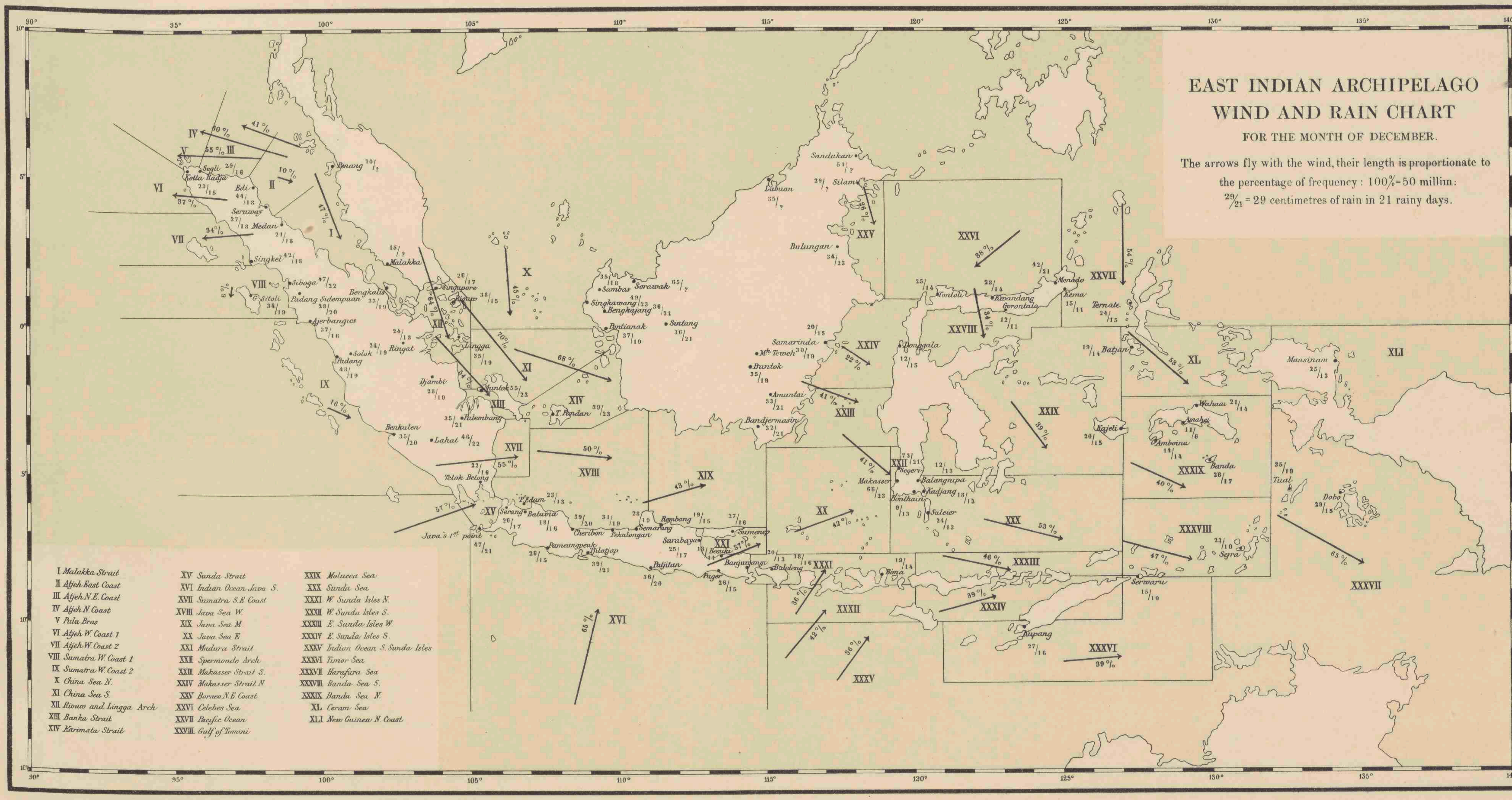
EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF JULY.
The arrows fly with the wind, their length is proportionate to
the percentage of frequency: 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

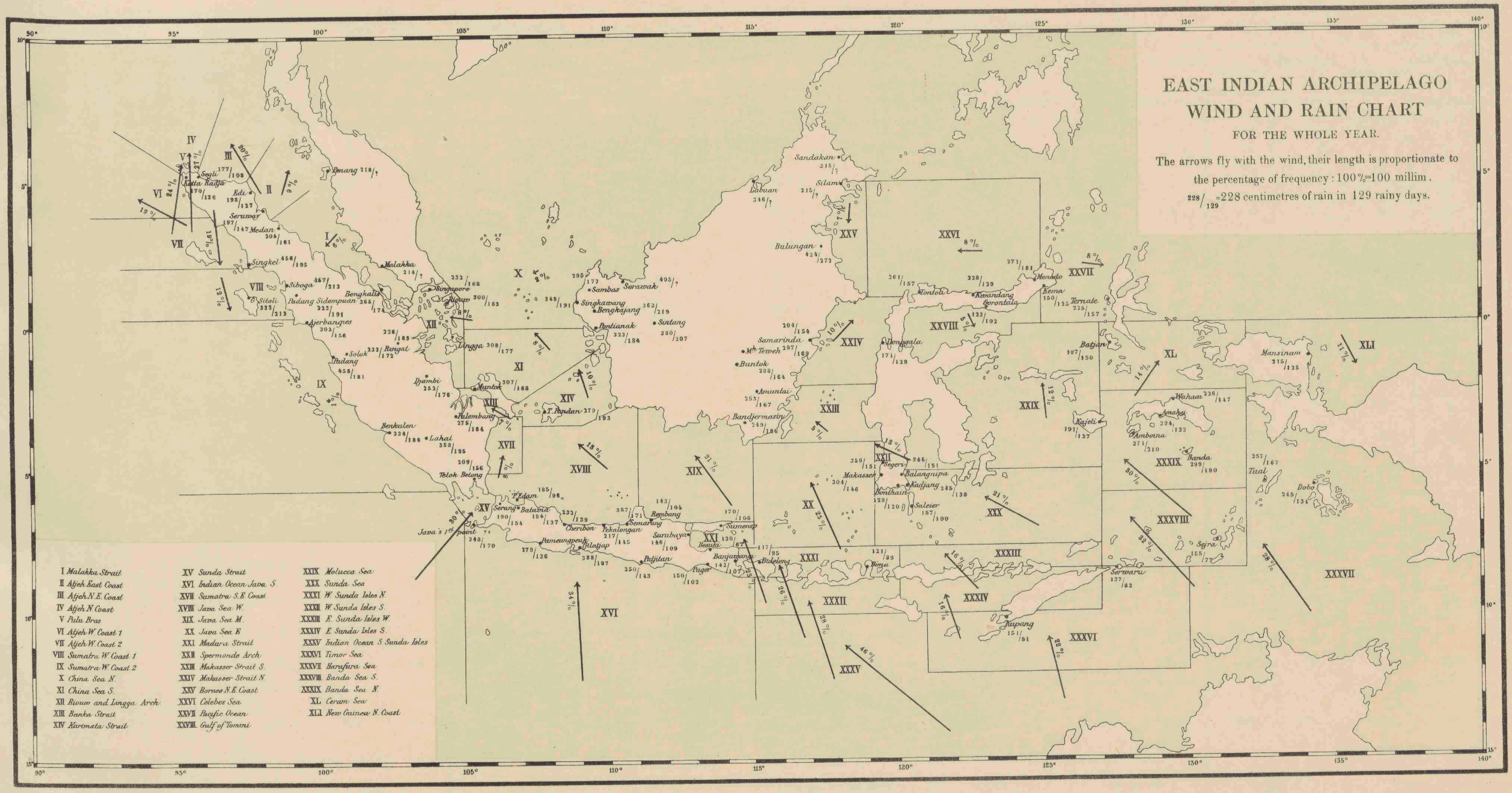

EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF AUGUST.
The arrows fly with the wind, their length is proportionate to
the percentage of frequency: 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast


EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF SEPTEMBER.
The arrows fly with the wind, their length is proportionate to the percentage of frequency: 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast


EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF OCTOBER.
The arrows fly with the wind, their length is proportionate to the percentage of frequency : 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast


EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF NOVEMBER.
The arrows fly with the wind, their length is proportionate to the percentage of frequency: 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast


EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE MONTH OF DECEMBER.
The arrows fly with the wind, their length is proportionate to the percentage of frequency: 100% = 50 millim:
29/21 = 29 centimetres of rain in 21 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast


EAST INDIAN ARCHIPELAGO
WIND AND RAIN CHART
FOR THE WHOLE YEAR.
The arrows fly with the wind, their length is proportionate to the percentage of frequency: 100%=100 millim.
228/129=228 centimetres of rain in 129 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	I. MALAKKA-STRAIT.				II. ATJEH, N AND E COAST.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	206	5 %	89	6 %	12	4 %	—	—
N N E.	115	4	120	9	—	—	—	—
N E	160	5	29	2	—	—	14	11
E N E.	103	5	148	7	—	—	—	—
E	21	2	39	2	—	—	—	—
E S E	109	4	50	4	—	—	—	—
S E	62	2	—	—	—	—	—	—
S S E	82	3	88	6	—	—	—	—
S	16	1	76	4	—	—	—	—
S S W.	12	1	17	1	10	4	—	—
S W.	66	2	20	1	21	4	12	11
W S W	33	2	38	4	24	4	21	11
W.	85	3	84	6	54	9	—	—
W N W.	92	4	23	2	48	13	36	11
N W	301	11	100	7	210	26	—	—
N N W	187	7	35	4	40	9	11	11
C (no current)	—	39	—	35	—	27	—	45
Total Amount of aggr. val. and Number of Observ. .	1650	129	956	82	419	23	94	9
Average velocity.	12.8		11.7		18.2		10.4	
Direction of Resultant . .	N 8° W		N 25° E		N 59° W		N 72° W	
Resulting velocity	5.0		2.3		8.0		6.3	
Percentage of steadiness .	38.7 %		19.3 %		83.7 %		60.7 %	
Maximum velocity.	80 to N E		60 to E N E		37 to N W		24 to W N W	

	III. ATJEH, W COAST, AJERBANGIES.				IV. SUMATRA'S W COAST, AJERBANGIES TO SUNDA-STRAIT.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	—	—	32	6 %	10	1 %	—	—
N N E.	26	3	14	3	89	2	87	3
N E	35	6	—	0	14	1	83	3
E N E.	—	—	11	3	49	2	164	5
E	74	9	52	9	148	3	155	4
E S E	93	15	11	3	285	6	436	11
S E	77	12	24	3	518	9	316	9
S S E	16	3	51	9	343	10	120	4
S	14	3	12	3	111	5	127	5
S S W.	10	3	—	—	82	4	98	3
S W.	—	—	—	—	108	5	62	2
W S W	—	—	62	9	204	8	261	5
W.	22	3	21	6	134	5	107	3
W N W.	29	6	—	—	87	2	167	6
N W	53	9	35	6	102	3	141	5
N N W	19	3	34	6	48	1	152	6
C (no current)	—	25	—	34	—	33	—	26
Total Amount of aggr. val. and Number of Observ. .	468	33	359	33	2332	171	2476	154
Average velocity.	14.2		10.9		13.6		16.1	
Direction of Resultant . .	S 39° E		N 56° W		S 25° E		S 42° E	
Resulting velocity	4.8		0.0		5.5		3.2	
Percentage of steadiness .	33.5 %		0.1 %		40.6 %		19.5 %	
Maximum velocity.	49 to E		27 to W S W		108 to W S W		42 to E	

NB. The currents set to the corresponding points of the compass in the first column; the velocities are expressed in sea-miles per 24 hours.

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	V. INDIAN OCEAN, W OF SUNDA-STRAIT.				VI. CHINA-SEA, NORTHERN PARTS.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	50	9%	41	8%	138	13%	111	4%
N N E	—	—	17	3	109	10	85	2
N E	13	2	—	—	82	6	78	4
E N E	48	5	16	3	32	4	—	—
E	36	5	25	5	19	2	9	2
E S E	19	2	78	8	—	2	14	2
S E	—	—	68	8	60	8	69	6
S S E	—	—	53	8	22	2	73	6
S	—	—	25	5	—	—	171	14
S S W	47	7	49	8	15	2	156	14
S W	88	9	41	8	10	2	111	10
W S W	116	11	41	5	—	—	86	8
W	240	20	85	13	25	2	53	4
W N W	70	9	—	—	13	2	42	4
N W	23	5	30	5	101	15	45	4
N N W	23	2	11	3	104	6	38	2
C (no current)	—	14	—	10	—	24	—	14
Total Amount of aggr. val. and Number of Observ.	773	44	580	38	730	48	1141	50
Average velocity	17.6		15.3		15.2		22.8	
Direction of Resultant	S 88° W		S 4° W		N 5° E		S 37° W	
Resulting velocity	9.3		3.9		8.2		5.5	
Percentage of steadiness	52.7%		25.5%		54.2%		24.2%	
Maximum velocity	51 to W		29 to E S E		48 to N		90 to N	

	VII. CHINA-SEA, SOUTHERN PARTS.				VIII. RIOUW AND LINGGA ARCHIPELAGO.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	104	13%	—	—	27	10%	—	—
N N E	12	3	10	3	51	20	—	—
N E	83	8	—	—	18	10	—	—
E N E	12	3	—	—	—	—	11	6
E	41	8	15	3	19	10	24	6
E S E	17	3	—	—	—	—	—	—
S E	—	—	70	9	10	10	57	13
S S E	—	—	197	22	—	—	48	6
S	—	—	89	13	—	—	23	6
S S W	—	—	—	—	—	—	13	6
S W	11	3	71	13	—	—	17	6
W S W	—	—	—	—	—	—	—	—
W	12	3	26	13	—	—	—	—
W N W	22	3	—	—	—	—	—	—
N W	25	5	—	—	45	20	—	—
N N W	76	5	—	—	25	10	—	—
C (no current)	—	43	—	24	—	—	—	50
Total Amount of aggr. val. and Number of Observ.	415	39	478	32	195	10	193	17
Average velocity	10.6		14.9		19.5		11.4	
Direction of Resultant	N 9° E		S 11° E		N 8° E		S 31° E	
Resulting velocity	6.7		11.4		13.4		8.6	
Percentage of steadiness	62.9%		76.1%		68.6%		75.9%	
Maximum velocity	43 to N E		32 to S E		29 to N W		48 to S S E	

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	IX. KARIMATA AND GASPAR PASSAGE.				X. SUNDA-STRAIT.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	—	—	—	—	—	—	18	5%
N N E.	—	—	—	—	—	—	15	5
N E.	—	—	33	4	—	—	23	5
E N E.	20	2	—	—	—	—	17	5
E	—	—	50	4	—	—	15	5
E S E	48	4	112	12	—	—	63	14
S E	63	5	279	25	142	15	117	24
S S E	38	5	225	24	80	11	28	5
S	10	2	75	6	34	11	54	5
S S W.	—	—	—	—	16	4	—	—
S W.	—	—	—	—	67	15	32	5
W S W	50	4	—	—	—	—	—	—
W.	20	2	19	2	126	19	10	5
W N W.	113	11	12	2	—	—	41	5
N W	234	16	58	4	38	7	—	—
N N W	116	11	10	2	20	4	—	—
C (no current)	—	38	—	15	—	14	—	12
Total Amount of aggr. val. and Number of Observ. .	712	55	873	51	523	27	433	21
Average velocity.	12.9		17.1		19.4		20.6	
Direction of Resultant . .	N 37° W		S 41° E		S 20° W		S 44° E	
Resulting velocity	6.3		11.5		8.8		9.1	
Percentage of steadiness .	54.8%		67.0%		45.3%		44.3%	
Maximum velocity.	52 to N W		35 to S E		48 to S E		54 to S	

	XI. INDIAN OCEAN, SOUTH OF JAVA.				XII. JAVA-SEA, S E COAST SUMATRA.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	13	6%	—	—	69	7%	35	2%
N N E.	—	—	19	3	12	1	16	1
N E.	—	—	—	—	—	—	24	3
E N E.	17	6	37	5	—	—	69	6
E	100	25	151	13	31	1	66	5
E S E	23	—	106	8	45	4	46	4
S E	13	—	89	11	36	4	279	22
S S E	88	19	45	5	23	3	256	13
S	32	6	—	—	60	3	123	8
S S W.	—	—	37	3	13	1	41	4
S W.	—	—	19	3	62	4	—	—
W S W	54	19	29	3	56	6	10	1
W.	27	6	156	18	110	9	18	1
W N W.	—	—	35	5	60	4	—	—
N W	—	—	22	3	41	4	65	5
N N W	—	—	10	3	31	3	—	3
C (no current)	—	13	—	17	—	46	—	22
Total Amount of aggr. val. and Number of Observ. .	367	16	755	38	649	68	1048	77
Average velocity.	22.9		19.9		9.5		13.6	
Direction of Resultant . .	S 39° E		S 39° E		S 78° W		S 39° E	
Resulting velocity	10.5		4.5		2.9		8.4	
Percentage of steadiness. .	45.8%		22.6%		30.5%		61.3%	
Maximum velocity.	52 to S S E		37 to E and S S W		36 to S		46 to S S E	

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	XIII. JAVA-SEA, WESTERN PARTS.				XIV. JAVA-SEA, MIDDLE PARTS.			
	APRIL.—SEPTEMBER.		OCTOBER—MARCH.		APRIL.—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	112	2 %	46	1 %	20	1 %	94	2 %
N N E.	30	1	145	4	24	1	141	3
N E.	114	3	252	6	60	2	240	6
E N E.	43	1	199	5	45	1	240	5
E	202	3	680	14	104	3	914	18
E S E	167	3	215	6	160	4	495	12
S E	39	1	221	5	109	1	151	4
S S E	47	1	217	4	41	1	158	3
S	46	1	115	3	28	1	48	1
S S W.	64	1	79	2	48	1	162	3
S W.	91	2	33	1	189	5	134	3
W S W.	277	5	190	3	305	7	85	2
W.	908	16	188	4	593	14	70	1
W N W.	952	16	118	3	421	11	140	2
N W	351	7	68	2	432	11	100	2
N N W	152	3	69	2	90	3	81	3
C (no current)	—	34	—	35	—	33	—	30
Total Amount of aggr. val. and Number of Observ. .	3595	312	2835	254	2669	237	3253	233
Average velocity.	11.5		11.2		11.3		14.0	
Direction of Resultant . .	N 53° W		S 82° E		N 83° W		S 87° E	
Resulting velocity	5.7		3.7		5.5		6.2	
Percentage of steadiness .	43.8 %		33.2 %		49.1 %		44.2 %	
Maximum velocity.	114 to S		54 to E and W S W		90 to S E		62 to W N W	

	XV. JAVA-SEA, EASTERN PARTS.				XVI. MADURA-STRAIT.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	63	3 %	104	2 %	—	—	—	—
N N E.	33	2	70	2	10	3	—	—
N E.	95	1	125	3	21	3	13	3
E N E.	115	3	255	5	13	3	18	3
E	169	6	397	8	30	3	115	16
E S E	82	2	327	9	—	—	27	5
S E	20	2	345	9	—	—	—	—
S S E	90	4	175	5	31	8	10	3
S	199	3	213	5	—	—	—	—
S S W.	303	4	129	3	—	—	13	3
S W.	334	4	168	5	26	5	—	—
W S W.	563	2	131	4	45	8	18	3
W.	744	5	168	4	110	16	66	10
W N W.	198	3	149	3	106	14	88	8
N W	240	3	85	3	37	5	53	8
N N W	154	3	91	2	12	3	—	—
C (no current)	—	50	—	28	—	29	—	38
Total Amount of aggr. val. and Number of Observ. .	3402	278	2932	221	441	37	421	39
Average velocity.	12.2		13.3		11.9		10.8	
Direction of Resultant . .	S 73° W		S 38° E		N 79° W		S 84° E	
Resulting velocity	5.8		3.3		6.1		0.3	
Percentage of steadiness .	48.4 %		24.6 %		51.3 %		2.7 %	
Maximum velocity.	51 to W S W		41 to E		34 to W N W		51 to W N W	

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	XVII. SPERMONDE ARCHIPELAGO.				XVIII. MAKASSER-STRAIT, SOUTHERN PARTS.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	28	3 %	12	4 %	16	1 %	113	6 %
N N E.	—	—	—	—	22	1	108	4
N E	—	—	—	—	18	1	159	7
E N E.	—	—	39	9	19	1	84	2
E	40	6	—	—	48	2	119	7
E S E	—	—	17	4	20	1	50	2
S E	15	3	65	13	110	4	97	6
S S E	26	3	69	17	166	6	260	11
S	84	12	102	17	348	15	193	8
S S W.	41	6	—	—	279	12	204	11
S W.	106	18	—	—	238	9	51	2
W S W	59	9	—	—	72	4	23	1
W.	63	9	—	—	218	8	16	1
W N W.	10	3	—	—	10	1	38	1
N W	23	3	12	4	65	4	15	1
N N W	38	6	—	—	19	1	—	—
C (no current)	—	19	—	32	—	29	—	30
Total Amount of aggr. val. and Number of Observ. .	533	34	316	23	1668	95	1530	90
Average velocity.	15.7		13.7		17.6		17.0	
Direction of Resultant . .	S 48° W		S 3° E		S 22° W		S 45° E	
Resulting velocity	7.4		10.0		10.3		5.7	
Percentage of steadiness .	47.3 %		72.5 %		58.8 %		33.7 %	
Maximum velocity. . . .	36 to S and S W		36 to S and S E		58 to S		56 to S S E	

	XIX. MAKASSER-STRAIT, NORTHERN PARTS.				XX. BORNEO, N E COAST.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	146	8 %	83	3 %	69	5 %	13	2 %
N N E.	206	9	64	4	—	—	41	2
N E	167	6	249	10	45	4	39	5
E N E.	72	4	98	4	53	4	131	6
E	65	4	48	3	45	4	66	6
E S E	51	3	43	3	90	9	100	8
S E	122	5	129	5	126	9	101	5
S S E	177	7	98	5	263	20	183	11
S	144	7	319	12	55	5	128	8
S S W.	150	4	430	13	74	4	190	14
S W.	225	8	301	12	48	5	67	6
W S W	55	4	67	3	14	2	—	—
W.	43	3	12	1	—	—	107	8
W N W.	—	—	—	—	—	—	—	—
N W	—	—	49	2	—	—	18	2
N N W	117	3	25	2	—	—	—	—
C (no current)	—	25	—	18	—	29	—	17
Total Amount of aggr. val. and Number of Observ. .	1740	113	2015	101	882	56	1184	63
Average velocity.	15.4		20.0		15.8		18.8	
Direction of Resultant . .	S 50° E		S		S 39° E		S 74° E	
Resulting velocity	2.0		7.2		9.2		8.4	
Percentage of steadiness .	12.7 %		36.3 %		58.3 %		44.5 %	
Maximum velocity.	57 to S S W		56 to S W		54 to S S W		58 to S E	

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	XXI. CELEBES-SEA.				XXII. PACIFIC OCEAN.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	29	8 %	36	7 %	103	11 %	26	2 %
N N E.	—	—	23	7	267	15	64	4
N E.	25	8	18	3	153	11	60	4
E N E.	—	—	—	—	64	5	206	7
E	11	4	23	3	103	6	190	9
E S E.	41	13	57	7	—	—	202	9
S E	19	4	71	10	—	—	151	8
S S E	—	—	17	3	—	—	218	13
S	—	—	58	7	46	3	192	11
S S W.	—	—	52	7	12	2	34	2
S W.	26	8	87	14	14	2	137	6
W S W	18	4	28	3	17	2	82	4
W.	—	—	69	7	86	8	34	2
W N W.	13	4	—	—	69	6	41	2
N W	—	—	17	3	77	5	—	—
N N W	—	—	55	7	68	5	—	—
C (no current)	—	47	—	12	—	19	—	17
Total Amount of aggr. val. and Number of Observ. .	182	24	611	29	1079	66	1637	85
Average velocity.	7.6		21.1		16.3		19.3	
Direction of Resultant . .	S 84° E		S 69° W		N 12° E		S 48° E	
Resulting velocity	1.4		2.1		8.4		8.9	
Percentage of steadiness .	18.0 %		10.1 %		51.6 %		46.4 %	
Maximum velocity. . . .	19 to N and S E		57 to W		48 to N N E		59 to E N E	

	XXIII. GULF OF TOMINI.				XXIV. MOLUCCA-SEA.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	47	9 %	15	5 %	146	6 %	105	4 %
N N E.	17	4	—	—	75	4	98	3
N E.	41	9	—	—	53	3	31	1
E N E.	65	17	49	16	25	2	95	4
E	17	4	64	16	80	3	82	4
E S E.	—	—	—	—	39	2	198	6
S E	14	4	21	5	44	2	138	4
S S E	—	—	—	—	32	2	271	9
S	—	—	—	—	10	1	194	9
S S W.	26	9	62	11	61	4	144	5
S W.	12	4	12	5	55	4	76	3
W S W	20	4	12	5	158	7	45	2
W.	21	4	—	—	171	8	171	6
W N W.	14	4	—	—	242	11	96	4
N W	—	—	—	—	182	9	113	4
N N W	—	—	20	5	138	5	61	3
C (no current)	—	28	—	32	—	27	—	29
Total Amount of aggr. val. and Number of Observ. .	294	23	255	19	1511	113	1918	136
Average velocity.	12.8		13.4		13.4		14.1	
Direction of Resultant . .	N 35° E		S 63° E		N 57° W		S 14° E	
Resulting velocity	3.9		3.6		6.6		3.0	
Percentage of steadiness .	30.1 %		26.9 %		49.0 %		21.0 %	
Maximum velocity. . . .	22 to N E and E N E		37 to S S W		31 to E		78 to S S E	

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	XXV. SUNDA-SEA.				XXVI. WESTERN SUNDA ISLES, NORTHERN COASTS.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	95	3%	74	3%	61	2%	29	2%
N N E.	91	2	140	4	27	1	67	3
N E.	40	1	177	6	84	2	51	3
E N E.	201	4	100	4	115	3	130	4
E	265	5	283	9	180	4	303	10
E S E	126	3	351	11	176	4	226	10
S E	180	4	128	4	146	3	122	6
S S E	160	3	25	1	74	2	38	3
S	120	3	25	1	156	4	51	3
S S W.	133	3	69	3	128	3	83	4
S W.	178	4	91	3	251	5	78	4
W S W	446	9	109	4	453	10	87	5
W.	452	9	146	4	528	10	40	2
W N W.	416	8	144	5	251	5	82	3
N W	101	3	94	3	236	6	14	1
N N W	72	2	108	3	120	3	52	3
C (no current)	—	34	—	32	—	33	—	34
Total Amount of aggr. val. and Number of Observ. .	3076	246	2064	158	2986	251	1453	116
Average velocity.	12.5		13.1		11.9		12.5	
Direction of Resultant . .	S 68° W		N 71° E		S 72° W		S 72° E	
Resulting velocity	3.0		2.7		4.0		4.3	
Percentage of steadiness .	24.2%		20.2%		33.7%		34.6%	
Maximum velocity.	53 to W N W		38 to N N W		42 to E and N W		45 to E S E	

	XXVII. WESTERN SUNDA ISLES, SOUTHERN COASTS.				XXVIII. EASTERN SUNDA ISLES, NORTHERN COASTS.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	—	—	13	2%	24	1%	22	2%
N N E.	12	1	23	5	83	2	—	—
N E.	—	—	20	—	63	2	61	3
E N E.	13	1	80	10	176	4	121	7
E	33	3	69	10	325	8	191	11
E S E	131	6	125	14	273	6	418	21
S E	136	7	90	9	163	4	67	4
S S E	25	2	21	5	108	2	12	1
S	34	3	—	—	57	2	20	1
S S W.	27	2	27	5	110	3	—	—
S W.	238	10	22	2	628	9	38	1
W S W	291	14	50	7	658	9	102	6
W.	199	8	—	—	397	8	72	4
W N W.	184	8	—	—	173	4	18	1
N W	94	6	—	—	—	—	24	2
N N W	11	1	—	—	36	1	52	2
C (no current)	—	28	—	31	—	35	—	34
Total Amount of aggr. val. and Number of Observ. .	1428	107	540	42	3274	226	1218	97
Average velocity.	13.3		12.9		14.5		12.6	
Direction of Resultant . .	S 60° W		S 68° E		S 38° W		S 57° E	
Resulting velocity	6.5		7.1		4.9		6.5	
Percentage of steadiness. .	48.6%		55.3%		33.5%		51.4%	
Maximum velocity.	36 to E S E		45 to E S E		76 to W S W		41 to E S E	

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	XXIX. EASTERN SUNDA ISLES, SOUTHERN COASTS.				XXX. INDIAN OCEAN, SOUTH OF SUNDA ISLES.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	24	1 %	19	2 %	—	—	25	14 %
N N E	11	1	15	2	—	—	—	—
N E	57	1	21	2	—	—	—	—
E N E	42	1	45	5	—	—	19	14
E	88	4	108	10	—	—	—	—
E S E	162	5	208	18	—	—	—	—
S E	43	2	42	3	—	—	—	—
S S E	46	1	—	—	—	—	30	14
S	42	2	35	3	—	—	13	14
S S W	165	6	27	2	20	9	—	—
S W	863	18	164	8	—	—	—	—
W S W	700	12	183	11	48	9	—	—
W	461	13	61	5	93	36	—	—
W N W	225	6	46	3	53	18	—	—
N W	92	2	10	2	28	9	—	—
N N W	46	2	41	5	—	—	—	—
C (no current)	—	23	—	19	—	19	—	44
Total Amount of aggr. val. and Number of Observ.	3067	168	1025	62	242	11	87	7
Average velocity	18.3		16.5		22.0		12.4	
Direction of Resultant	S 61° W		S 28° W		N 89° W		S 77° E	
Resulting velocity	11.4		4.3		19.2		4.6	
Percentage of steadiness	62.5 %		25.7 %		87.4 %		37.3 %	
Maximum velocity	76 to W S W		52 to W S W		39 to W N W		30 to S S E	

	XXXI. TIMOR-SEA.				XXXII. HARAFURA-SEA.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	—	—	—	—	8	4 %	—	—
N N E	—	—	—	—	—	—	—	—
N E	—	—	—	—	10	4	—	—
E N E	—	—	—	—	10	4	—	—
E	24	6	—	—	21	7	11	6
E S E	—	—	—	—	—	—	19	6
S E	21	6	—	—	—	—	21	6
S S E	—	—	11	20	11	4	10	6
S	18	6	—	—	27	7	—	—
S S W	—	—	—	—	29	7	—	—
S W	54	17	25	20	—	—	—	—
W S W	73	17	—	—	11	4	28	13
W	83	17	14	20	58	7	33	19
W N W	16	6	—	—	92	15	12	6
N W	—	—	—	—	49	7	—	—
N N W	10	6	—	—	21	4	—	—
C (no current)	—	19	—	40	—	26	—	38
Total Amount of aggr. val. and Number of Observ.	299	18	50	5	347	27	134	16
Average velocity	16.6		10.0		12.9		8.4	
Direction of Resultant	S 63° W		S 45° W		N 76° W		S 31° W	
Resulting velocity	10.4		7.7		6.3		2.7	
Percentage of steadiness	62.3 %		77.1 %		48.6 %		32.6 %	
Maximum velocity	38 to W S W		25 to S W		48 to W		21 to S E	

RESULTS OF CURRENT-OBSERVATIONS

COMPUTED BY MEANS OF THE DIFFERENCES BETWEEN ASTRONOMICAL AND DEAD RECKONINGS.

	XXXIII. BANDA-SEA, SOUTHERN PARTS.				XXXIV. BANDA-SEA, NORTHERN PARTS.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	85	4%	—	—	23	1%	43	3%
N N E	—	—	36	5	—	—	53	3
N E	33	2	—	—	50	2	55	5
E N E	100	6	30	10	13	1	118	7
E	—	—	183	24	37	2	216	10
E S E	—	—	—	—	—	—	61	3
S E	26	2	12	5	47	2	73	3
S S E	22	2	12	5	117	3	36	2
S	—	—	—	—	37	2	48	2
S S W	27	4	—	—	—	—	17	1
S W	47	4	—	—	144	8	44	3
W S W	79	6	34	10	256	14	15	1
W	111	11	29	10	168	10	67	3
W N W	92	9	—	—	115	7	93	5
N W	75	9	—	—	100	5	43	3
N N W	86	9	—	—	67	3	50	4
C (no current)	—	32	—	31	—	40	—	42
Total Amount of aggr. val. and Number of Observ.	783	47	336	21	1174	92	1032	91
Average velocity	16.7		16.0		12.8		11.3	
Direction of Resultant	N 54° W		N 86° E		S 75° W		N 73° E	
Resulting velocity	6.7		8.5		6.0		2.9	
Percentage of steadiness	40.5%		53.1%		47.2%		25.5%	
Maximum velocity	53 to E N E and N		46 to E		56 to S S E		38 to E	

	XXXV. CERAM-SEA.				XXXVI. NEW GUINEA, NORTHERN COASTS.			
	APRIL—SEPTEMBER.		OCTOBER—MARCH.		APRIL—SEPTEMBER.		OCTOBER—MARCH.	
	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.	Aggregate velocities.	Percentage of occurrence.
N	74	6%	19	2%	19	3%	—	—
N N E	—	—	35	2	—	—	—	—
N E	43	3	44	5	—	—	30	13
E N E	129	10	149	10	36	6	—	—
E	14	1	155	10	—	—	11	13
E S E	23	3	146	10	34	3	29	25
S E	10	1	257	19	—	—	—	—
S S E	—	—	95	6	—	—	18	13
S	59	4	28	3	—	—	—	—
S S W	—	—	—	—	16	3	—	—
S W	74	6	—	—	—	—	—	—
W S W	58	4	—	—	14	3	—	—
W	137	10	12	2	229	34	—	—
W N W	125	9	27	2	165	19	—	—
N W	83	6	58	3	—	—	20	13
N N W	52	4	33	3	—	—	—	—
C (no current)	—	33	—	23	—	29	—	23
Total Amount of aggr. val. and Number of Observ.	881	70	1058	63	513	32	108	8
Average velocity	12.6		16.8		16.0		13.5	
Direction of Resultant	N 57° W		S 78° E		N 79° W		S 82° E	
Resulting velocity	4.2		9.7		8.7		6.4	
Percentage of steadiness	33.2%		57.4%		54.0%		47.6%	
Maximum velocity	35 to N W		45 to S S E		45 to W		30 to N E	

RESULTS OF CURRENT-OBSERVATIONS.

WESTERN PARTS OF THE JAVA-SEA.

AGGREGATE VALUES; MILES PER 24 HOURS.																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
January	—	—	37	15	**108**	56	35	61	24	—	—	—	—	12	21	—
February	—	64	16	23	**133**	—	28	42	—	—	—	—	—	—	—	—
March	—	—	26	19	**157**	30	30	50	18	—	—	70	83	—	17	—
April	—	14	42	43	**123**	60	—	—	18	23	—	52	98	71	29	31
May	—	32	—	11	—	—	83	—	—	—	—	23	59	159	**162**	47
June	—	13	10	—	19	—	15	16	—	32	10	23	170	**179**	46	35
July	12	—	41	—	21	10	24	—	14	—	39	37	167	**245**	125	33
August	68	—	10	—	—	14	—	10	—	—	19	37	**167**	77	42	12
September	—	16	—	—	39	—	—	21	114	—	—	69	124	**143**	60	11
October	28	21	18	23	—	12	60	19	—	40	—	12	77	**82**	30	—
November	—	33	90	92	**106**	88	51	26	75	26	17	35	—	24	25	47
December	18	11	51	27	**186**	48	17	—	26	13	16	63	—	—	—	16

WESTERN PARTS OF THE JAVA-SEA.

	Number of Observations.	Average Velocity.	Direction of Resultant.	Resulting Velocity.	Percentage of Steadiness.	Percentage „no current".
January	27	13.6	S 60° E	9.4	69 %	19 %
February	15	20.4	N 85° E	15.2	74	7
March	45	11.1	S 47° E	3.1	28	49
April	56	10.8	N 25° E	0.9	8	34
May	58	10.3	N 75° W	5.9	58	41
June	41	13.9	N 77° W	9.3	67	24
July	61	12.6	N 69° W	8.3	66	34
August	41	11.1	N 67° W	6.4	58	37
September	42	14.2	S 81° W	7.4	52	24
October	63	6.7	N 80° W	1.6	23	57
November	68	10.8	S 86° E	4.1	38	34
December	36	13.6	S 86° E	6.3	46	31
May—October	306	11.5	N 78° W	6.4	54	36
November—April	247	13.4	S 82° E	6.1	33	29

MIDDLE PARTS OF THE JAVA-SEA.

AGGREGATE VALUES; MILES PER 24 HOURS.																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
January	32	41	15	20	**198**	80	—	—	—	20	28	14	24	62	—	—
February	—	—	33	19	11	**97**	56	41	—	—	—	—	—	—	—	—
March	—	—	43	—	**330**	91	47	—	24	40	17	17	—	20	—	33
April	—	—	—	12	56	99	90	—	—	—	10	13	**130**	19	37	10
May	10	10	10	—	10	12	19	24	14	17	19	114	134	**150**	—	—
June	10	—	10	—	12	14	—	17	—	—	37	58	47	**78**	42	14
July	—	14	30	—	12	—	—	—	—	16	58	61	129	85	**154**	37
August	—	—	—	—	14	—	—	—	—	—	20	28	104	34	**138**	13
September	—	—	—	29	—	29	—	15	14	—	45	31	25	**55**	53	16
October	24	—	**61**	28	12	26	—	—	24	17	53	—	30	47	49	48
November	—	49	52	105	**174**	71	—	77	—	53	30	12	—	11	51	—
December	38	51	45	68	**200**	130	48	40	—	44	36	42	40	—	—	—

MIDDLE PARTS OF THE JAVA-SEA.

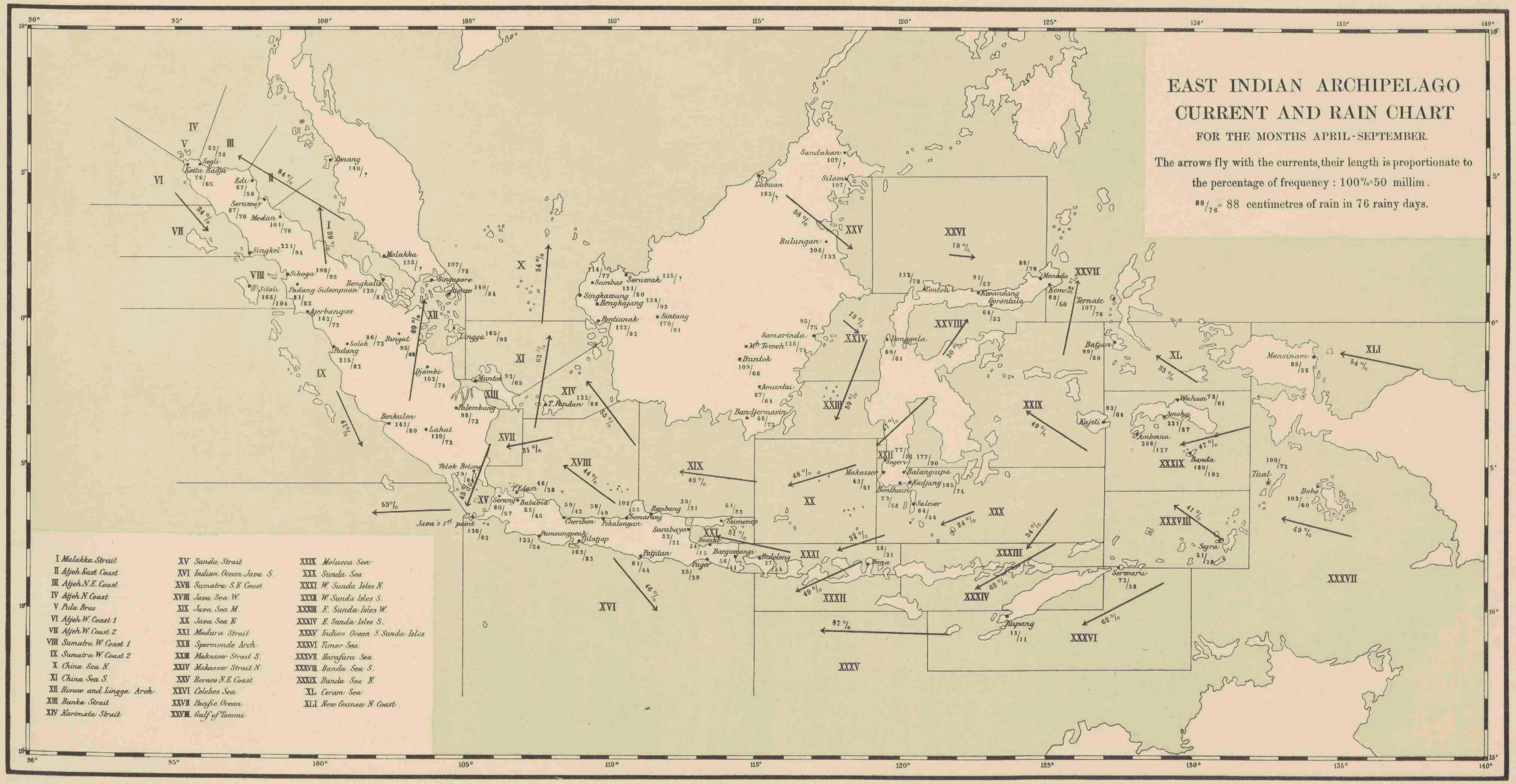
	Number of Observations.	Average Velocity.	Direction of Resultant.	Resulting Velocity.	Percentage of Steadiness.	Percentage „no current".
January	28	18.8	N 79° E	7.1	38 %	7 %
February	22	11.7	S 71° E	9.4	80	41
March	45	14.7	S 79° E	9.1	62	24
April	38	12.5	S 19° E	3.0	15	37
May	49	11.1	S 83° W	7.0	63	39
June	26	13.0	N 84° W	7.4	96	27
July	52	11.5	N 72° W	7.9	69	31
August	38	9.2	N 70° W	7.3	79	42
September	32	9.8	S 89° W	3.6	37	47
October	42	10.0	N 37° W	2.6	26	45
November	55	12.5	S 73° W	0.5	4	36
December	47	16.6	S 80° E	7.8	47	19
May—October	239	10.8	N 79° W	5.8	41	39
November—April	235	14.5	S 77° E	5.6	32	27

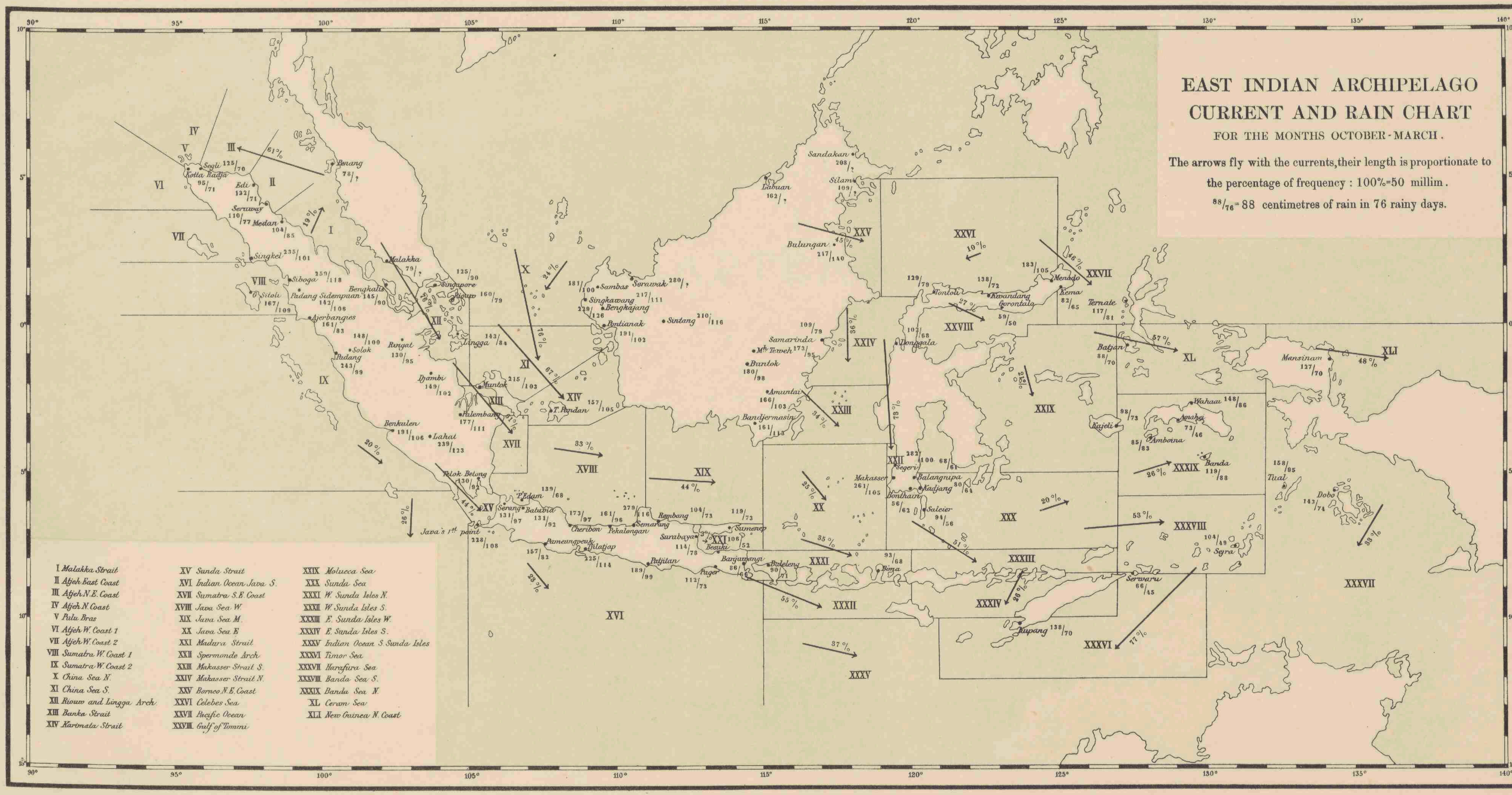
EASTERN PARTS OF THE JAVA-SEA.

AGGREGATE VALUES; MILES PER 24 HOURS.																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
January	—	—	—	29	**130**	77	31	—	—	—	—	12	—	—	—	20
February	—	—	—	—	63	69	**79**	31	36	20	—	14	—	—	—	—
March	11	26	—	25	38	14	**115**	—	16	—	24	15	—	—	21	—
April	—	—	—	46	**119**	27	10	32	39	—	67	-32	50	14	43	—
May	—	—	11	12	—	—	—	11	33	18	24	**84**	32	31	24	—
June	—	—	12	—	—	—	—	—	41	22	74	135	**136**	65	53	17
July	—	12	17	18	—	—	—	21	—	41	70	137	**243**	57	57	39
August	—	11	16	14	—	32	10	—	33	21	18	47	**217**	14	—	32
September	31	—	39	—	32	12	—	15	10	**148**	57	90	123	17	—	34
October	30	11	26	43	53	11	54	28	91	51	27	28	**106**	83	31	32
November	16	33	11	52	28	58	—	52	11	—	**104**	51	53	49	—	—
December	47	—	74	**106**	26	46	28	51	59	58	—	—	—	—	33	39

EASTERN PARTS OF THE JAVA-SEA.

	Number of Observations.	Average Velocity.	Direction of Resultant.	Resulting Velocity.	Percentage of Steadiness.	Percentage „no current".
January	17	17.6	S 78° E	7.7	44 %	29 %
February	20	15.6	S 45° E	12.2	78	10
March	28	10.9	S 57° E	4.3	40	29
April	31	15.4	S 63° E	6.4	41	20
May	37	7.6	S 66° W	4.5	59	59
June	44	12.6	S 79° W	9.5	76	34
July	53	13.4	S 86° W	9.4	70	28
August	34	13.7	S 80° W	7.2	53	26
September	45	13.5	S 61° W	6.5	49	29
October	57	12.4	S 55° W	2.3	18	35
November	39	13.3	S 68° W	2.2	17	31
December	43	13.2	N 89° E	4.5	34	33
May—October	309	12.4	S 75° W	5.9	52	34
November—April	139	14.5	S 63° E	6.7	35	25


EAST INDIAN ARCHIPELAGO
CURRENT AND RAIN CHART
FOR THE MONTHS APRIL-SEPTEMBER.
The arrows fly with the currents, their length is proportionate to
the percentage of frequency : 100%=50 millim.
88/76 = 88 centimetres of rain in 76 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E
XXI Madura Strait
XXII Spermonde Arch
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast


EAST INDIAN ARCHIPELAGO
CURRENT AND RAIN CHART
FOR THE MONTHS OCTOBER-MARCH.
The arrows fly with the currents, their length is proportionate to the percentage of frequency : 100%=50 millim.
88/76 = 88 centimetres of rain in 76 rainy days.
I Malakka Strait
II Atjeh East Coast
III Atjeh N.E. Coast
IV Atjeh N. Coast
V Pulu Bras
VI Atjeh W. Coast 1
VII Atjeh W. Coast 2
VIII Sumatra W. Coast 1
IX Sumatra W. Coast 2
X China Sea N.
XI China Sea S.
XII Riouw and Lingga Arch.
XIII Banka Strait
XIV Karimata Strait
XV Sunda Strait
XVI Indian Ocean Java S.
XVII Sumatra S.E. Coast
XVIII Java Sea W.
XIX Java Sea M.
XX Java Sea E.
XXI Madura Strait
XXII Spermonde Arch.
XXIII Makasser Strait S.
XXIV Makasser Strait N.
XXV Borneo N.E. Coast
XXVI Celebes Sea
XXVII Pacific Ocean
XXVIII Gulf of Tomini
XXIX Molucca Sea
XXX Sunda Sea
XXXI W. Sunda Isles N.
XXXII W. Sunda Isles S.
XXXIII E. Sunda Isles W.
XXXIV E. Sunda Isles S.
XXXV Indian Ocean S. Sunda Isles
XXXVI Timor Sea
XXXVII Harafura Sea
XXXVIII Banda Sea S.
XXXIX Banda Sea N.
XL Ceram Sea
XLI New Guinea N. Coast

CHAPTER II.

RESULTS OF OBSERVATIONS OF WIND AND RAINFALL MADE AT COAST-PLACES AND SOME INLAND STATIONS.

RESULTS OF WIND-OBSERVATIONS.

BENGKALIS.

1886—1894.	Components in percentages. 9 a. m. N	9 a. m. E	2 p. m. N	2 p. m. E	6 p. m. N	6 p. m. E	Mean direction and steadiness. 9 a. m.		2 p. m.		6 p. m.	
January	50	—10	26	— 8	35	1	N 11° W	51 %	N 17° W	27 %	N 2° E	35 %
February	45	0	26	— 6	16	—11	N	45	N 13 W	27	N 35 W	19
March	26	—13	7	— 8	9	—16	N 27 W	29	N 49 W	11	N 61 W	18
April	— 9	—17	0	—21	1	— 7	S 62 W	19	W	21	N 82 W	7
May	—38	—21	— 9	—17	1	—13	S 29 W	43	S 62 W	19	N 86 W	13
June	—39	2	—19	— 8	10	17	S 3 E	39	S 23 W	21	N 60 E	20
July	—59	—11	—25	— 9	—10	21	S 11 W	60	S 20 W	27	S 64 E	23
August	—50	—15	—32	—10	— 1	16	S 17 W	52	S 17 W	34	S 86 E	16
September	—43	—15	—25	—13	6	10	S 19 W	46	S 27 W	28	N 59 E	12
October	—43	—33	—17	—21	5	16	S 37 W	54	S 51 W	27	N 73 E	17
November	—12	—46	2	—26	26	9	S 75 W	48	N 86 W	26	N 19 E	28
December	29	—27	17	— 5	41	— 2	N 43 W	40	N 16 W	18	N 3 W	41
April—September	—40	—13	—18	—13	1	7	S 18 W	42	S 36 W	22	N 82 E	7
October—March	16	—22	10	—12	22	— 1	N 54 W	27	N 50 W	16	N 3 W	22
Year	—12	—18	— 4	—13	12	3	S 56 W	22	S 73 W	14	N 14 E	12

PULU BRAS.

1886—1894.	Components in percentages. 9 a. m. N	9 a. m. E	2 p. m. N	2 p. m. E	6 p. m. N	6 p. m. E	Mean direction and steadiness. 9 a. m.		2 p. m.		6 p. m.	
January	—20	82	1	84	6	81	S 76° E	84 %	E	84 %	N 86° E	81 %
February	—12	71	2	63	13	59	S 80 E	72	N 88° E	63	N 78 E	60
March	—11	66	10	53	15	47	S 81 E	67	N 79 E	54	N 72 E	49
April	—27	— 4	—16	—25	—14	—25	S 8 W	27	S 57 W	30	S 61 W	29
May	—51	—42	—40	—61	—37	—55	S 39 W	66	S 57 W	73	S 56 W	66
June	—55	—54	—40	—68	—33	—72	S 44 W	77	S 60 W	79	S 66 W	79
July	—57	—53	—46	—61	—34	—67	S 43 W	78	S 53 W	76	S 63 W	75
August	—44	—62	—41	—64	—34	—72	S 55 W	76	S 57 W	76	S 65 W	80
September	—51	—56	—38	—63	—27	—72	S 48 W	76	S 59 W	74	S 69 W	77
October	—46	—23	—33	—40	—25	—49	S 27 W	51	S 50 W	52	S 63 W	55
November	—38	6	—26	—25	—24	—22	S 9 E	38	S 44 W	36	S 43 W	33
December	—26	61	—16	53	—14	51	S 67 E	66	S 73 E	55	S 75 E	53
April—September	—48	—45	—37	—57	—30	—61	S 43 W	66	S 57 W	68	S 64 W	68
October—March	—26	44	—10	31	— 5	28	S 59 E	51	S 72 E	33	S 80 E	28
Year	—37	— 1	—24	—13	—18	—17	S 2 W	37	S 28 W	27	S 43 W	25

OLEH-LEH.

1886—1894.	Components in percentages. 9 a. m. N	9 a. m. E	2 p. m. N	2 p. m. E	6 p. m. N	6 p. m. E	Mean direction and steadiness. 9 a. m.		2 p. m.		6 p. m.	
January	—30	71	14	71	25	61	S 67° E	77 %	N 79° E	72 %	N 68° E	66 %
February	—28	71	17	59	22	51	S 68 E	76	N 74 E	61	N 67 E	56
March	—27	70	22	52	34	38	S 69 E	75	N 67 E	56	N 48 E	51
April	—13	1	9	—27	— 2	—33	S 4 E	13	N 72 W	28	S 86 W	33
May	—35	—49	—29	—62	—42	—59	S 54 W	60	S 65 W	68	S 55 W	72
June	—49	—54	—32	—71	—38	—69	S 48 W	73	S 66 W	78	S 61 W	79
July	—47	—59	—31	—72	—29	—69	S 51 W	75	S 67 W	78	S 67 W	75
August	—37	—56	—23	—72	—26	—71	S 57 W	67	S 72 W	76	S 70 W	76
September	—41	—56	—28	—71	—25	—70	S 54 W	69	S 68 W	76	S 70 W	74
October	—29	—17	—19	—35	—16	—40	S 30 W	34	S 62 W	40	S 68 W	43
November	—37	24	—13	— 9	—13	—15	S 33 E	44	S 35 W	16	S 49 W	20
December	—28	55	3	46	7	40	S 63 E	62	N 86 E	46	N 80 E	41
April—September	—37	—46	—22	—63	—27	—62	S 51 W	59	S 71 W	67	S 66 W	68
October—March	—30	46	4	31	10	23	S 57 E	55	N 83 E	31	N 67 E	25
Year	—34	0	— 9	—16	— 9	—20	S	34	S 61 W	18	S 66 W	22

SINGKEL.

1889—1894.	Components in percentages. 9 a. m. N	9 a. m. E	2 p. m. N	2 p. m. E	6 p. m. N	6 p. m. E	Mean direction and steadiness. 9 a. m.		2 p. m.		6 p. m.	
January	11	23	—19	—16	— 2	—20	N 64° E	25 %	S 40° W	25 %	S 84° W	20 %
February	20	16	—28	—19	—27	—22	N 39 E	26	S 34 W	34	S 39 W	35
March	12	9	—26	—30	—18	—22	N 37 E	15	S 49 W	40	S 51 W	28
April	10	8	— 9	—29	—17	—16	N 39 E	13	S 73 W	30	S 43 W	23
May	38	— 7	0	—34	5	—32	N 10 W	39	W	34	N 81 W	32
June	42	9	18	—34	19	—30	N 12 E	43	N 62 W	38	N 58 W	36
July	37	6	19	—37	19	—32	N 9 E	37	N 63 W	42	N 59 W	37
August	30	11	23	—42	11	—35	N 20 E	32	N 61 W	48	N 73 W	37
September	10	12	5	—43	— 6	—37	N 50 E	16	N 83 W	43	S 81 W	37
October	17	—16	7	—37	13	—44	N 43 W	23	N 79 W	38	N 74 W	46
November	20	—12	6	—42	14	—39	N 31 W	23	N 82 W	42	N 70 W	41
December	9	9	—10	—28	— 6	—34	N 45 E	13	S 70 W	30	S 80 W	35
April—September	28	7	9	—37	5	—30	N 14 E	29	N 76 W	38	N 81 W	30
October—March	15	5	—12	—29	— 4	—30	N 18 E	16	S 68 W	31	S 82 W	30
Year	22	6	— 2	—33	— 1	—30	N 15 E	23	S 86 W	33	S 88 W	30

NB. The geographical position of these places is given in the index.

RESULTS OF WIND-OBSERVATIONS.

BAROS.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—38	—11	—49	—40	32	—31	S 16° W	40 %	S 39° W	63 %	N 44° W	45 %
February	—47	29	—51	—23	8	—38	S 32 E	55	S 24 W	56	N 78 W	39
March	—40	14	—42	—35	—17	—40	S 19 E	42	S 40 W	55	S 67 W	43
April	—20	6	—51	—25	— 3	—50	S 17 E	21	S 26 W	57	S 87 W	50
May	—13	—20	—41	—29	12	—54	S 57 W	24	S 35 W	50	N 77 W	55
June	—14	—19	—33	—41	15	—69	S 54 W	24	S 51 W	53	N 78 W	71
July	—38	— 5	—34	—36	4	—16	S 7 W	38	S 47 W	50	N 76 W	16
August	—24	4	—40	—29	21	—59	S 9 E	24	S 36 W	49	N 70 W	63
September	—31	23	—35	0	14	—60	S 37 E	39	S	35	N 77 W	62
October	—35	19	—21	—32	3	—49	S 28 E	40	S 57 W	38	N 86 W	49
November	—15	13	—49	—23	14	—60	S 41 E	20	S 25 W	54	N 77 W	62
December	—25	41	—49	—18	— 1	—41	S 59 E	48	S 20 W	52	S 89 W	41
April—September	—23	— 2	—39	—27	11	—51	S 5 W	23	S 35 W	47	N 78 W	52
October—March	—33	18	—44	—28	7	—43	S 29 E	38	S 33 W	52	N 81 W	44
Year	—28	8	—42	—28	9	—47	S 16 E	29	S 34 W	50	N 79 W	48

NATAL.

1891—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	5	22	—43	—42	— 5	37	N 77° E	23 %	S 44° W	60 %	S 82° E	37 %
February	5	34	—11	—40	— 8	37	N 82 E	34	S 75 W	41	S 78 E	38
March	—26	58	—24	—59	6	— 1	S 66 E	64	S 68 W	64	N 9 W	6
April	— 2	49	— 7	—60	20	4	S 88 E	49	S 83 W	60	N 11 E	20
May	1	51	—13	—64	14	35	N 89 E	51	S 79 W	65	N 68 E	38
June	7	46	7	—64	37	3	N 81 E	47	N 84 W	64	N 5 E	37
July	9	38	— 2	—62	25	35	N 77 E	39	S 88 W	62	N 54 E	43
August	7	35	15	—60	18	35	N 79 E	36	N 76 W	62	N 63 E	39
September	16	30	4	—52	14	31	N 62 E	34	N 86 W	52	N 66 E	34
October	22	41	— 4	—36	14	49	N 62 E	47	S 84 W	36	N 74 E	51
November	10	28	— 7	—54	25	24	N 70 E	30	S 83 W	54	N 44 E	35
December	— 9	42	— 9	—39	3	44	S 78 E	43	S 77 W	40	N 86 E	44
April—September	6	42	1	—60	21	24	N 82 E	42	N 89 W	60	N 49 E	32
October—March	1	38	—16	—45	6	32	N 88 E	38	S 70 W	48	N 79 E	33
Year	4	40	— 8	—53	14	28	N 84 E	40	S 81 W	54	N 63 E	31

GUNUNG SITOLI.

1891—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—13	1	— 4	— 4	—44	—38	S 4° E	13 %	S 45° W	6 %	S 41° W	58 %
February	—21	36	— 6	45	—66	—50	S 60 E	42	S 82 E	45	S 37 W	83
March	— 9	21	0	30	—51	—54	S 67 E	23	E	30	S 47 W	74
April	—18	15	8	9	—50	—56	S 40 E	23	N 48 E	12	S 48 W	75
May	—12	1	39	—10	—41	—57	S 5 E	12	N 14 W	40	S 54 W	70
June	23	—10	59	—22	—16	—70	N 23 W	25	N 20 W	63	S 77 W	72
July	8	—24	39	—23	—29	—67	N 72 W	25	N 31 W	45	S 67 W	73
August	—12	— 5	36	—15	—45	—44	S 22 W	13	N 23 W	39	S 44 W	63
September	13	— 5	43	— 7	—37	—58	N 21 W	14	N 9 W	44	S 57 W	69
October	3	—10	16	—15	—43	—54	N 73 W	10	N 43 W	22	S 51 W	69
November	24	—12	7	—15	—35	—55	N 27 W	27	N 65 W	17	S 57 W	65
December	—10	— 9	15	4	—46	—49	S 42 W	13	N 15 E	16	S 47 W	67
April—September	0	— 5	37	—11	—36	—59	W	5	N 17 W	39	S 59 W	69
October—March	— 4	5	5	8	—48	—50	S 51 E	6	N 59 E	9	S 46 W	69
Year	— 2	0	21	— 2	—42	—55	S	2	N 5 W	21	S 52 W	69

PADANG.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	1	85	—48	—28	—15	53	E	85 %	S 30° W	56 %	S 74° E	55 %
February	4	70	—50	—31	—18	38	N 87° E	70	S 32 W	59	S 65 E	42
March	3	73	—52	—33	—12	33	N 88 E	73	S 32 W	62	S 70 E	35
April	1	72	—47	—31	— 9	23	E	72	S 33 W	56	S 69 E	25
May	5	76	—47	—41	— 4	31	N 86 E	76	S 41 W	62	S 83 E	31
June	10	70	—39	—48	— 3	34	N 82 E	71	S 51 W	62	S 85 E	34
July	6	82	—37	—47	0	27	N 86 E	82	S 52 W	60	E	27
August	— 2	63	—42	—39	— 7	33	S 88 E	63	S 43 W	57	S 78 E	34
September	4	74	—36	—47	2	13	N 87 E	74	S 53 W	59	N 81 E	13
October	3	67	—30	—45	— 5	5	N 87 E	67	S 56 W	54	S 45 E	7
November	4	57	—32	—43	—17	16	N 86 E	57	S 53 W	54	S 43 E	23
December	5	80	—34	—45	— 8	26	N 86 E	80	S 53 W	56	S 73 E	27
April—September	4	73	—41	—42	— 4	27	N 87 E	73	S 46 W	59	S 82 E	27
October—March	3	72	—41	—38	—13	29	N 88 E	72	S 43 W	56	S 66 E	32
Year	4	73	—41	—40	— 9	28	N 87 E	73	S 44 W	57	S 72 E	29

RESULTS OF WIND-OBSERVATIONS.

EMMA-HAVEN.

1893—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	55	19	—29	—59	40	21	N 19° E	58 %	S 64° W	66 %	N 28° E	45 %
February	49	16	—31	—66	30	21	N 18 E	52	S 65 W	73	N 35 E	37
March	45	15	—32	6	13	—12	N 18 E	47	S 11 E	33	N 43 W	18
April	22	32	—14	—34	18	47	N 55 E	39	S 68 W	37	N 69 E	50
May	58	16	—15	—62	19	3	N 15 E	60	S 76 W	64	N 9 E	19
June	49	18	—34	—72	25	18	N 20 E	52	S 65 W	80	N 36 E	31
July	52	10	—32	—77	19	19	N 11 E	53	S 67 W	83	N 45 E	27
August	53	2	—16	—85	— 2	0	N 2 E	53	S 79 W	86	S	2
September	50	— 2	—26	—78	11	1	N 2 W	50	S 72 W	82	N 5 E	11
October	63	20	—26	—85	22	2	N 18 E	66	S 73 W	89	N 5 E	22
November	46	— 6	—30	—81	4	—10	N 7 W	46	S 70 W	86	N 68 W	11
December	56	— 6	—24	—76	22	2	N 6 W	56	S 72 W	80	N 5 E	22
April—September	47	13	—23	—68	15	15	N 15 E	49	S 71 W	72	N 45 E	21
October—March	52	10	—29	—60	22	4	N 11 E	53	S 64 W	67	N 10 E	22
Year	50	12	—26	—64	19	10	N 14 E	51	S 68 W	69	N 28 E	21

PULU BODJO.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	26	— 8	14	—23	19	—51	N 17° W	27 %	N 59° W	27 %	N 70° W	54 %
February	20	0	14	— 6	6	—34	N	20	N 23 W	15	N 80 W	35
March	7	— 4	— 6	—21	— 7	—49	N 80 W	8	S 74 W	22	S 82 W	49
April	3	— 1	— 3	—20	2	—46	N 18 W	3	S 81 W	20	N 87 W	46
May	26	8	15	— 5	24	—24	N 17 E	27	N 18 W	16	N 45 W	34
June	22	3	14	6	19	—19	N 8 E	22	N 23 E	15	N 45 W	27
July	15	7	12	— 2	15	—19	N 25 E	17	N 9 W	12	N 52 W	24
August	18	14	7	3	9	—11	N 38 E	23	N 23 E	8	N 51 W	14
September	27	5	15	—15	20	—27	N 10 E	27	N 45 W	21	N 53 W	34
October	26	— 2	23	—24	22	—49	N 4 W	26	N 46 W	33	N 66 W	54
November	35	—13	24	—23	29	—50	N 20 W	37	N 44 W	33	N 60 W	58
December	38	—25	27	—46	29	—57	N 33 W	45	N 60 W	53	N 63 W	64
April—September	19	6	10	— 6	15	—24	N 18 E	20	N 31 W	12	N 58 W	28
October—March	25	— 9	16	—24	16	—47	N 20 W	27	N 56 W	29	N 71 W	50
Year	22	— 2	13	—15	16	—36	N 5 W	22	N 49 W	20	N 66 W	39

PULU PANDAN.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	19	27	—14	—55	— 4	—27	N 55° E	33 %	S 76° W	57 %	S 82° W	27 %
February	18	22	—29	—52	—26	—21	N 51 E	28	S 61 W	60	S 39 W	33
March	24	18	—18	—55	—14	—30	N 37 E	30	S 72 W	58	S 65 W	33
April	26	34	—11	—62	— 5	—23	N 53 E	43	S 80 W	63	S 78 W	24
May	32	29	0	—56	— 6	—34	N 42 E	43	W	56	S 80 W	35
June	22	37	3	—55	2	—41	N 59 E	43	N 87 W	55	N 87 W	41
July	32	40	— 3	—48	—10	—40	N 51 E	51	S 86 W	48	S 76 W	41
August	19	34	—12	—52	—17	—34	N 61 E	39	S 77 W	53	S 63 W	38
September	29	31	3	—54	6	—39	N 47 E	42	N 87 W	54	N 81 W	39
October	27	22	— 7	—53	— 1	—34	N 39 E	35	S 82 W	53	S 88 W	34
November	36	21	10	—21	9	—32	N 30 E	42	N 64 W	23	N 74 W	33
December	23	14	4	—62	6	—44	N 31 E	27	N 86 W	62	N 82 W	44
April—September	27	34	— 3	—55	— 5	—35	N 51 E	43	S 87 W	55	S 82 W	35
October—March	25	21	— 9	—50	— 5	—31	N 40 E	33	S 80 W	51	S 81 W	31
Year	26	28	— 6	—53	— 5	—33	N 47 E	38	S 84 W	53	S 82 W	33

VLAKKE HOEK.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	41	—35	1	—59	— 6	—51	N 40° W	54 %	N 89° W	59 %	S 83° W	51 %
February	32	—43	3	—53	11	—51	N 53 W	54	N 87 W	53	N 78 W	52
March	36	—19	1	—39	1	—39	N 28 W	41	N 88 W	39	N 88 W	39
April	22	— 6	—21	—24	—14	—24	N 15 W	23	S 49 W	32	S 60 W	28
May	20	12	—30	4	—32	5	N 31 E	23	S 8 E	30	S 9 E	32
June	9	21	—30	19	—27	16	N 67 E	23	S 32 E	36	S 31 E	31
July	0	44	—31	43	—19	40	E	44	S 54 E	53	S 65 E	44
August	—13	61	—44	53	—42	47	S 78 E	62	S 50 E	69	S 48 E	63
September	—21	39	—40	36	—48	32	S 62 E	44	S 42 E	54	S 34 E	58
October	—29	37	—49	24	—52	26	S 52 E	47	S 26 E	55	S 27 E	58
November	— 8	— 8	—30	—24	—26	—18	S 45 W	11	S 39 W	38	S 35 W	32
December	15	—26	—13	—44	—14	—48	N 60 W	30	S 74 W	46	S 74 W	50
April—September	3	29	—33	22	—30	19	N 44 E	29	S 34 E	40	S 32 E	36
October—March	15	—16	—15	—33	—14	—30	N 47 W	22	S 65 W	36	S 65 W	33
Year	9	7	—24	— 6	—22	— 6	N 38 E	11	S 14 W	25	S 15 W	23

RESULTS OF WIND-OBSERVATIONS.

SINGKAWANG.

1889—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	42	40	37	—37	48	— 7	N 44° E	58 %	N 45° W	52 %	N 8° W	49 %
February	37	43	44	—25	48	0	N 49 E	57	N 30 W	51	N	48
March	22	45	16	—39	26	—10	N 64 E	50	N 68 W	42	N 21 W	28
April	— 9	36	—12	—52	— 6	— 7	S 76 E	37	S 77 W	53	S 49 W	9
May	—21	31	—25	—43	—22	—18	S 56 E	37	S 60 W	50	S 39 W	28
June	—31	25	—36	—28	—29	—19	S 39 E	40	S 38 W	46	S 33 W	35
July	—28	38	—45	—42	—51	— 4	S 54 E	47	S 43 W	62	S 5 W	51
August	—26	48	—40	—31	—44	6	S 62 E	55	S 38 W	51	S 8 E	44
September	—37	48	—43	—29	—51	5	S 52 E	61	S 34 W	52	S 6 E	51
October	—14	43	—13	—37	—18	— 9	S 72 E	45	S 71 W	39	S 27 W	20
November	— 5	22	— 8	—49	—12	—17	S 77 E	23	S 81 W	50	S 55 W	21
December	15	25	13	—44	25	—23	N 59 E	29	N 74 W	46	N 43 W	34
April—September	—25	38	—34	—38	—34	— 6	S 57 E	45	S 48 W	51	S 10 W	35
October—March	16	36	15	—39	20	—11	N 66 E	39	N 69 W	42	N 29 W	23
Year	— 5	37	—10	—39	— 7	— 9	S 82 E	37	S 76 W	40	S 52 W	11

MUNTOK.

1891—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	47	—49	71	—44	83	—14	N 46° W	68 %	N 32° W	84 %	N 10° W	84 %
February	47	—33	72	—40	87	—11	N 35 W	57	N 29 W	82	N 7 W	88
March	17	—39	61	—41	83	— 3	N 66 W	43	N 34 W	73	N 2 W	83
April	—40	—17	— 1	—14	53	14	S 23 W	43	S 86 W	14	N 15 E	55
May	—60	20	—39	26	1	44	S 18 E	63	S 34 E	47	N 89 E	44
June	—63	40	—48	41	—20	55	S 32 E	75	S 41 E	63	S 70 E	59
July	—69	45	—64	51	—42	63	S 33 E	82	S 39 E	82	S 56 E	76
August	—74	35	—60	58	—38	64	S 25 E	82	S 44 E	83	S 59 E	74
September	—73	27	—62	49	—29	62	S 20 E	78	S 38 E	79	S 65 E	68
October	—69	0	—35	28	4	54	S	69	S 39 E	45	N 86 E	54
November	—24	—37	17	—26	65	10	S 57 W	44	N 57 W	31	N 9 E	66
December	22	—41	62	—53	84	—14	N 62 W	47	N 41 W	82	N 9 W	85
April—September	—63	25	—46	35	—13	50	S 22 E	68	S 37 E	58	S 75 E	52
October—March	7	—33	41	—29	68	4	N 78 W	34	N 35 W	50	N 3 E	68
Year	28	— 4	— 3	3	28	27	S 8 W	28	S 45 E	4	N 44 E	39

PULU BESAR.

1892—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	68	—65	62	—68	33	—48	N 44° W	94 %	N 48° W	92 %	N 56° W	58 %
February	33	—73	22	—76	39	—38	N 66 W	80	N 74 W	79	N 44 W	54
March	46	—47	33	—25	62	—20	N 46 W	66	N 37 W	41	N 18 W	65
April	7	—40	— 6	— 2	33	— 1	N 80 W	41	S 18 W	6	N 2 W	33
May	—39	25	—54	35	—40	44	S 33 E	46	S 33 E	64	S 48 E	59
June	—35	29	3	53	—47	64	S 40 E	45	N 87 E	53	S 54 E	79
July	—39	48	—60	50	6	68	S 51 E	62	S 40 E	78	N 85 E	68
August	—60	40	—63	54	—58	59	S 34 E	72	S 41 E	83	S 46 E	83
September	—74	34	—76	46	—62	48	S 25 E	81	S 31 E	89	S 38 E	78
October	—40	5	—51	44	—51	51	S 7 E	40	S 41 E	67	S 45 E	72
November	— 9	—33	—14	3	5	19	S 75 W	34	S 12 E	14	N 76 E	20
December	33	—66	15	—64	24	—41	N 64 W	74	N 77 W	66	N 60 W	48
April—September	—40	23	—43	39	—28	47	S 30 E	46	S 42 E	58	S 59 E	55
October—March	22	—47	11	—31	19	—13	N 65 W	52	N 70 W	33	N 34 W	23
Year	— 9	—12	—16	4	— 5	17	S 53 W	15	S 14 E	16	S 74 E	18

TANDJONG KALEAN.

1891—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	38	—58	59	—50	80	—11	N 57° W	69 %	N 40° W	77 %	N 8° W	81 %
February	41	—50	52	—37	77	— 3	N 50 W	65	N 35 W	64	N 2 W	77
March	13	—30	35	—33	61	1	N 67 W	33	N 43 W	48	N 1 E	61
April	—27	—12	— 8	—14	25	23	S 24 W	30	S 60 W	16	N 43 E	34
May	—62	16	—44	12	— 4	39	S 14 E	64	S 15 E	46	S 84 E	39
June	—63	31	—45	35	—33	55	S 26 E	70	S 38 E	57	S 59 E	64
July	—78	50	—55	49	—48	59	S 33 E	93	S 42 E	74	S 51 E	76
August	—81	32	—62	47	—44	60	S 22 E	87	S 37 E	78	S 54 E	74
September	—78	21	—56	39	—26	63	S 15 E	81	S 35 E	68	S 68 E	68
October	—68	0	—35	35	2	57	S	68	S 45 E	49	N 88 E	57
November	—22	—46	6	—41	52	9	S 64 W	51	N 82 W	41	N 10 E	53
December	15	—58	46	—51	78	6	N 75 W	60	N 48 W	69	N 4 E	78
April—September	—65	23	—45	28	—22	50	S 19 E	69	S 32 E	53	S 66 E	55
October—March	3	—40	27	—30	58	10	N 86 W	40	N 48 W	40	N 10 E	59
Year	—31	— 9	— 9	— 1	18	30	S 16 W	32	S 6 W	9	N 59 E	35

RESULTS OF WIND-OBSERVATIONS.

ONDIEPWATER ISLE.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	50	—68	55	—64	65	—59	N 54° W	84 %	N 49° W	84 %	N 42° W	88 %
February.	54	—55	57	—54	61	—45	N 46 W	77	N 43 W	79	N 36 W	76
March	43	—46	38	—49	48	—30	N 47 W	63	N 52 W	62	N 32 W	57
April.	—11	3	—23	— 5	—20	18	S 15 E	11	S 12 W	24	S 42 E	27
May	—31	24	—44	31	—45	39	S 38 E	39	S 35 E	54	S 41 E	60
June	—44	42	—53	32	—54	40	S 44 E	61	S 31 E	62	S 37 E	67
July	—41	71	—46	65	—46	65	S 60 E	82	S 55 E	80	S 55 E	80
August.	—48	74	—45	69	—49	71	S 57 E	88	S 57 E	82	S 55 E	86
September	—55	51	—57	47	—58	60	S 43 E	75	S 40 E	74	S 46 E	83
October	—27	42	—49	31	—48	38	S 57 E	50	S 32 E	58	S 38 E	61
November	—26	—37	—27	—40	—19	—10	S 55 W	45	S 56 W	48	S 28 W	21
December	11	—63	20	—56	26	—29	N 80 W	64	N 70 W	59	N 48 W	39
April—September. .	—38	44	—45	40	—45	49	S 49 E	58	S 42 E	60	S 47 E	67
October—March. . .	18	—38	16	—39	22	—23	N 65 W	42	N 68 W	42	N 46 W	32
Year.	—10	3	—15	1	—12	13	S 17 E	10	S 4 E	15	S 47 E	18

PULU LANGKUAS.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	51	—41	58	—48	65	—41	N 39° W	65 %	N 40° W	75 %	N 32° W	77 %
February.	54	—38	58	—43	63	—41	N 35 W	66	N 37 W	72	N 33 W	75
March	21	—38	33	—46	38	—35	N 61 W	43	N 55 W	57	N 43 W	52
April.	—18	25	—11	— 4	—11	11	S 54 E	31	S 20 W	12	S 45 E	16
May	—36	42	—13	25	—33	26	S 49 E	55	S 63 E	28	S 38 E	42
June	—39	51	—29	25	—37	27	S 53 E	64	S 41 E	38	S 36 E	46
July	—14	53	3	39	— 8	37	S 75 E	55	N 86 E	39	S 78 E	38
August.	—35	66	— 9	54	—16	47	S 62 E	75	S 81 E	55	S 71 E	50
September	—50	42	—25	37	—38	26	S 40 E	65	S 56 E	45	S 34 E	46
October	—35	39	—23	25	—45	13	S 48 E	52	S 47 E	34	S 16 E	47
November	—23	—34	— 9	—43	—19	—25	S 56 W	41	S 78 W	44	S 53 W	31
December	12	—53	26	—52	22	—48	N 77 W	54	N 63 W	58	N 65 W	53
April—September. .	—32	47	—14	29	—24	29	S 56 E	57	S 64 E	32	S 50 E	38
October—March. . .	13	—28	24	—35	21	—30	N 65 W	31	N 56 W	42	N 55 W	37
Year.	—10	10	5	— 3	— 2	— 1	S 45 E	14	N 31 W	6	S 27 W	2

PULU MENDANAU.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	48	—57	57	—57	62	—52	N 50° W	75 %	N 45° W	81 %	N 40° W	81 %
February.	55	—45	62	—40	62	—34	N 39 W	71	N 33 W	74	N 29 W	71
March	38	—37	45	—42	46	—18	N 44 W	53	N 43 W	62	N 21 W	49
April.	—11	16	— 9	—20	1	24	S 56 E	19	S 66 W	22	N 88 E	24
May	—23	53	—27	20	—21	44	S 67 E	58	S 37 E	34	S 64 E	49
June	—33	55	—43	24	—46	49	S 59 E	64	S 29 E	49	S 47 E	67
July	—38	68	—46	39	—40	50	S 61 E	78	S 40 E	60	S 51 E	64
August.	—38	72	—51	52	—45	69	S 62 E	81	S 46 E	73	S 57 E	82
September	—52	53	—56	40	—44	55	S 46 E	74	S 36 E	69	S 51 E	70
October	—37	49	—34	29	—28	50	S 53 E	61	S 40 E	45	S 61 E	57
November	—19	—12	—26	—16	—14	— 2	S 32 W	22	S 32 W	31	S 8 W	14
December	13	—50	17	—50	25	—37	N 75 W	52	N 71 W	53	N 56 W	45
April—September. .	—33	53	—39	26	—33	49	S 58 E	63	S 34 E	47	S 56 E	59
October—March. . .	16	—25	20	—29	26	—16	N 57 W	30	N 55 W	35	N 32 W	31
Year.	— 9	14	—10	— 2	— 4	17	S 57 E	17	S 11 W	10	S 77 E	17

JAVA'S 4TH POINT.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	4	—38	4	—54	2	—57	N 84° W	38 %	N 86° W	54 %	N 88° W	57 %
February.	17	—19	17	—31	12	—24	N 48 W	25	N 61 W	35	N 63 W	27
March	— 3	—26	— 1	—42	—12	—42	S 83 W	26	S 89 W	42	S 74 W	44
April.	—13	— 9	15	—28	3	—19	S 35 W	16	N 62 W	32	N 81 W	19
May	— 8	—11	8	—21	7	—15	S 54 W	14	N 69 W	22	N 65 W	17
June	— 9	— 5	8	—24	4	—24	S 29 W	10	N 72 W	25	N 81 W	24
July	6	8	15	—27	8	—24	N 53 E	10	N 61 W	31	N 72 W	25
August.	2	— 6	8	—23	— 4	—11	N 72 W	6	N 71 W	24	S 70 W	12
September	— 2	—13	— 1	—39	—11	—30	S 81 W	13	S 88 W	39	S 70 W	32
October	—28	—23	—35	—52	—43	—42	S 39 W	36	S 56 W	63	S 44 W	60
November	—23	—27	—31	—56	—39	—49	S 50 W	35	S 61 W	64	S 51 W	63
December	—16	—38	—10	—62	—20	—56	S 67 W	41	S 81 W	63	S 70 W	59
April—September. .	— 4	— 6	9	—27	1	—21	S 56 W	7	N 72 W	28	N 87 W	21
October—March. . .	— 8	—29	— 9	—50	—17	—45	S 75 W	30	S 80 W	51	S 69 W	48
Year.	— 6	—18	0	—39	— 8	—33	S 72 W	19	W	39	S 76 W	34

RESULTS OF WIND-OBSERVATIONS.

JAVA'S 1ST POINT.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	14	—37	8	—42	10	—47	N 69° W	40 %	N 79° W	43 %	N 78° W	48 %
February	17	—27	12	—31	9	—38	N 58 W	32	N 69 W	33	N 77 W	39
March	7	—12	2	—23	— 8	—29	N 60 W	14	N 85 W	23	S 75 W	30
April	—31	— 5	—28	—13	—33	—20	S 9 W	31	S 25 W	31	S 31 W	39
May	—35	41	—36	31	—40	29	S 50 E	54	S 41 E	48	S 36 E	49
June	—42	45	—38	35	—44	29	S 47 E	62	S 43 E	52	S 33 E	53
July	—44	58	—47	51	—50	47	S 43 E	73	S 47 E	69	S 43 E	69
August	—58	60	—59	51	—67	45	S 46 E	83	S 41 E	78	S 34 E	81
September	—65	52	—65	40	—74	37	S 39 E	83	S 32 E	76	S 27 E	83
October	—66	41	—73	26	—74	24	S 32 E	78	S 19 E	77	S 18 E	78
November	—52	— 5	—56	— 7	—60	—12	S 5 W	52	S 7 W	56	S 11 W	61
December	—27	—19	—30	— 8	—31	—29	S 35 W	33	S 15 W	31	S 43 W	42
April—September	—46	42	—46	33	—51	28	S 42 E	62	S 36 E	57	S 29 E	58
October—March	—18	—10	—23	—14	—26	—22	S 29 W	21	S 31 W	27	S 40 W	34
Year	—32	16	—35	10	—39	3	S 27 E	36	S 16 E	36	S 4 E	39

NUSA KEMBANGAN.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	16	—64	—18	—67	—31	—65	N 76° W	66 %	S 75° W	69 %	S 65° W	72 %
February	31	—59	—21	—77	—27	—56	N 62 W	67	S 75 W	80	S 64 W	62
March	50	—32	—21	—33	—32	—26	N 33 W	59	S 57 W	39	S 39 W	41
April	33	25	—36	38	—55	26	N 37 E	41	S 47 E	52	S 25 E	61
May	32	38	—43	52	—58	48	N 50 E	50	S 50 E	67	S 40 E	75
June	25	63	—36	69	—56	61	N 68 E	68	S 62 E	78	S 47 E	83
July	10	83	—34	82	—49	77	N 83 E	84	S 67 E	89	S 58 E	91
August	—14	84	—43	80	—52	79	S 81 E	85	S 62 E	91	S 57 E	95
September	—20	84	—57	51	—67	63	S 77 E	86	S 42 E	76	S 43 E	92
October	—31	75	—58	64	—66	53	S 68 E	81	S 48 E	86	S 39 E	85
November	—16	31	—53	23	—55	20	S 63 E	35	S 23 E	58	S 20 E	59
December	— 9	—32	—50	32	—53	—28	S 74 W	33	S 33 E	59	S 28 W	60
April—September	11	63	—42	62	—56	59	N 80 E	64	S 56 E	75	S 47 E	81
October—March	7	—14	—37	—10	—44	—17	N 63 W	16	S 15 W	38	S 21 W	47
Year	9	25	—40	26	—50	21	N 70 E	27	S 33 E	48	S 23 E	54

PATJITAN.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	4	— 4	—17	—10	— 5	— 6	N 45° W	6 %	S 31° W	20 %	S 51° W	8 %
February	3	— 9	—21	—22	—12	—18	N 72 W	9	S 46 W	30	S 56 W	22
March	—17	5	—16	—10	—16	— 4	S 16 E	18	S 32 W	19	S 14 W	16
April	—20	16	—30	11	—29	13	S 39 E	26	S 20 E	32	S 24 E	32
May	—18	17	—19	4	—32	24	S 43 E	25	S 12 E	19	S 37 E	40
June	—26	33	—45	27	—49	21	S 51 E	42	S 31 E	52	S 23 E	53
July	—39	21	—49	19	—47	29	S 28 E	44	S 21 E	53	S 32 E	55
August	—44	34	—48	46	—47	44	S 38 E	56	S 44 E	66	S 43 E	64
September	—52	37	—46	37	—49	39	S 35 E	64	S 39 E	59	S 39 E	63
October	—57	22	—58	34	—53	37	S 21 E	61	S 30 E	67	S 35 E	65
November	—53	7	—63	1	—54	6	S 8 E	53	S 1 E	63	S 6 E	54
December	—30	— 1	—46	— 2	—46	0	S 2 W	30	S 2 W	46	S	46
April—September	—33	26	—40	24	—42	28	S 38 E	42	S 31 E	47	S 34 E	50
October—March	—25	3	—37	— 2	—31	3	S 7 E	25	S 3 W	37	S 6 E	31
Year	—29	15	—39	11	—37	16	S 27 E	33	S 16 E	41	S 23 E	40

TJILATJAP.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	— 2	—47	—22	—34	—32	—46	S 88° W	47 %	S 57° W	40 %	S 55° W	56 %
February	7	—68	—20	—33	—33	—58	N 84 W	68	S 59 W	39	S 60 W	67
March	11	—56	—29	3	—37	— 1	N 79 W	57	S 6 E	29	S 2 W	37
April	19	—41	—32	52	—41	36	N 65 W	45	S 58 E	61	S 41 E	55
May	25	—20	—35	64	—38	48	N 39 W	32	S 61 E	73	S 51 E	61
June	10	23	—37	66	—41	63	N 67 E	25	S 61 E	76	S 57 E	75
July	11	34	—36	83	—47	73	N 72 E	36	S 67 E	90	S 57 E	87
August	18	50	—36	63	—54	67	N 70 E	53	S 60 E	73	S 51 E	86
September	19	44	—47	78	—56	66	N 67 E	48	S 59 E	91	S 50 E	87
October	5	2	—37	14	—36	7	N 22 E	5	S 21 E	40	S 11 E	37
November	9	—32	—22	— 9	—28	—17	N 74 W	33	S 22 W	24	S 31 W	33
December	4	—55	—12	—42	—12	—50	N 86 W	55	S 74 W	44	S 77 W	51
April—September	17	15	—37	68	—46	59	N 41 E	23	S 62 E	77	S 52 E	75
October—March	6	—43	—24	—17	—30	—28	N 82 W	43	S 35 W	29	S 43 W	41
Year	12	—14	—31	26	—38	16	N 49 W	18	S 40 E	40	S 23 E	41

RESULTS OF WIND-OBSERVATIONS.

TEBING TINGGI.

1891—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	8	— 1	14	—18	7	—19	N 51° W	8%	N 52° W	23%	N 70° W	20%
February	2	— 3	10	—13	4	—16	N 56 W	4	N 52 W	16	N 76 W	16
March	14	10	22	0	2	— 8	N 36 E	17	N	22	N 76 W	8
April	12	20	14	4	11	—20	N 59 E	23	N 16 E	15	N 61 W	23
May	8	24	11	1	—11	—12	N 72 E	25	N 5 E	11	S 48 W	16
June	18	9	12	1	— 9	— 5	N 27 E	20	N 5 E	12	S 29 W	10
July	6	29	8	18	6	8	N 78 E	30	N 66 E	20	N 53 E	10
August	16	9	12	8	3	— 8	N 29 E	18	N 34 E	14	N 69 W	9
September	16	2	8	5	— 3	—10	N 7 E	16	N 31 E	9	S 73 W	10
October	17	14	8	5	4	— 7	N 40 E	22	N 31 E	9	N 60 W	8
November	16	— 1	6	— 2	— 3	—17	N 4 W	16	N 18 W	6	S 80 W	17
December	22	5	15	—10	— 2	—22	N 13 E	23	N 34 W	18	S 85 W	22
April—September	13	16	11	6	— 1	— 8	N 51 E	21	N 29 E	13	S 83 W	8
October—March	13	4	12	— 6	2	—15	N 17 E	14	N 27 E	13	N 82 W	15
Year	13	10	12	0	1	—12	N 38 E	16	N	12	N 85 W	12

MUARA DUA.

1891—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	35	11	29	9	21	—16	N 17° E	37%	N 17° E	30%	N 37° W	26%
February	31	— 8	21	—11	23	—35	N 14 W	32	N 28 W	24	N 57 W	42
March	37	32	34	24	21	6	N 41 E	49	N 35 E	42	N 16 E	22
April	12	34	18	17	14	9	N 71 E	36	N 43 E	25	N 33 E	17
May	23	41	23	29	22	27	N 61 E	47	N 51 E	37	N 51 E	35
June	27	31	27	24	29	30	N 49 E	41	N 42 E	36	N 46 E	42
July	17	53	21	47	17	40	N 72 E	56	N 66 E	51	N 67 E	43
August	23	54	17	41	24	34	N 67 E	59	N 68 E	44	N 55 E	42
September	10	37	15	36	11	17	N 75 E	38	N 67 E	39	N 57 E	20
October	33	57	32	44	31	28	N 60 E	66	N 54 E	54	N 42 E	42
November	21	—10	14	—20	15	—18	N 25 W	23	N 55 W	24	N 50 W	23
December	32	5	31	— 1	30	—15	N 9 E	32	N 2 W	31	N 27 W	34
April—September	19	42	20	32	20	26	N 66 E	46	N 58 E	38	N 52 E	33
October—March	32	15	27	8	24	— 8	N 25 E	35	N 17 E	28	N 18 W	25
Year	26	29	24	20	22	9	N 48 E	39	N 40 E	31	N 22 E	24

SEKAJU.

1889—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	42	—58	44	—57	10	—14	N 54° W	72%	N 52° W	72%	N 54° W	17%
February	44	—61	52	—59	11	— 8	N 54 W	75	N 49 W	79	N 36 W	14
March	28	—65	33	—51	2	— 9	N 67 W	71	N 57 W	61	N 77 W	9
April	—16	—29	8	—52	— 6	— 7	S 61 W	33	N 81 W	53	S 49 W	9
May	—46	—22	—26	—24	— 3	0	S 26 W	51	S 43 W	35	S	3
June	—59	— 9	—43	—11	— 6	— 5	S 9 W	60	S 14 W	44	S 39 W	8
July	—77	5	—55	4	—13	1	S 4 E	77	S 4 E	55	S 4 E	13
August	—81	5	—66	7	—13	3	S 4 E	81	S 6 E	66	S 13 E	13
September	—70	—10	—50	6	— 4	3	S 8 W	71	S 7 E	50	S 37 E	5
October	—55	—33	—41	—24	—13	0	S 31 W	64	S 30 W	48	S	13
November	—21	—49	— 3	—51	— 3	— 6	S 67 W	53	S 87 W	51	S 63 W	7
December	11	—77	26	—68	8	—22	N 82 W	78	N 69 W	73	N 70 W	23
April—September	—58	—10	—39	—12	— 8	— 1	S 10 W	59	S 17 W	41	S 7 W	8
October—March	8	—57	19	—52	3	—10	N 82 W	58	N 70 W	55	N 73 W	10
Year	—25	—34	—10	—32	— 3	— 6	S 54 W	42	S 73 W	34	S 63 W	7

BATU RADJA.

1890—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	43	— 1	55	—36	51	—45	N 1° W	43%	N 33° W	66%	N 41° W	68%
February	49	—12	56	—30	51	—38	N 14 W	50	N 28 W	64	N 37 W	64
March	30	13	24	—25	36	—47	N 23 E	33	N 46 W	35	N 53 W	59
April	7	31	15	— 7	37	—42	N 77 E	32	N 25 W	17	N 49 W	56
May	—15	67	6	24	20	—14	S 77 E	69	N 76 E	25	N 35 W	24
June	—39	58	—12	40	14	34	S 56 E	70	S 73 E	42	N 68 E	37
July	—34	48	1	20	24	20	S 55 E	59	N 87 E	20	N 40 E	31
August	—27	68	— 4	36	19	16	S 68 E	73	S 84 E	36	N 40 E	25
September	—31	66	— 3	31	18	13	S 65 E	73	S 84 E	31	N 36 E	22
October	—20	62	— 5	11	— 2	— 6	S 72 E	65	S 66 E	12	S 72 W	6
November	—18	44	16	4	25	— 6	S 68 E	48	N 14 E	16	N 14 W	26
December	— 2	17	32	— 8	35	—37	S 83 E	17	N 14 W	33	N 47 W	51
April—September	—23	56	1	24	22	5	S 68 E	61	N 88 E	24	N 13 E	23
October—March	14	21	30	—14	33	—30	N 56 E	25	N 25 W	33	N 42 W	45
Year	— 5	39	16	5	28	—13	S 83 E	39	N 17 E	17	N 25 W	31

RESULTS OF WIND-OBSERVATIONS.

TANDJONG RADJA.

1890—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	33	—35	36	—41	51	—46	N 47° W	48%	N 49° W	55%	N 42° W	69%
February.	45	—35	42	—50	53	—41	N 38 W	57	N 50 W	65	N 38 W	67
March	47	—34	41	—41	45	—44	N 36 W	58	N 45 W	58	N 44 W	63
April.	— 2	—11	13	— 5	7	—13	S 80 W	11	N 21 W	14	N 62 W	15
May	—28	32	—28	34	—12	22	S 49 E	43	S 50 E	44	S 61 E	25
June.	—50	54	—54	45	—40	38	S 47 E	74	S 40 E	70	S 43 E	55
July	—55	46	—67	39	—60	45	S 40 E	72	S 30 E	78	S 37 E	75
August.	—63	46	—66	40	—61	36	S 36 E	78	S 31 E	77	S 31 E	71
September	—65	44	—59	39	—20	33	S 34 E	78	S 33 E	71	S 59 E	39
October	—55	48	—56	34	—34	36	S 41 E	73	S 31 E	66	S 47 E	50
November	— 2	—16	6	—14	18	—20	S 83 W	16	N 67 W	15	N 48 W	27
December	18	—20	20	—22	18	—34	N 48 W	27	N 48 W	30	N 62 W	38
April—September. .	—44	35	—44	32	—31	27	S 39 E	56	S 36 E	54	S 41 E	41
October—March. . .	14	—15	15	—22	25	—25	N 47 W	21	N 56 W	27	N 45 W	35
Year.	—15	10	—15	5	— 3	1	S 34 E	18	S 18 E	16	S 18 E	3

BATAVIA.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—10	—52	77	—30	39	—37	S 79° W	53%	N 21° W	83%	N 43° W	54%
February.	— 5	—53	72	—27	40	—31	S 85 W	53	N 20 W	77	N 38 W	51
March	—25	—26	72	— 8	19	—26	S 46 W	36	N 6 W	72	N 54 W	32
April.	—35	— 8	69	15	19	— 5	S 13 W	36	N 12 E	71	N 14 W	20
May	—41	22	58	44	31	26	S 28 E	47	N 37 E	73	N 40 E	40
June.	—45	22	49	46	33	33	S 26 E	50	N 43 E	67	N 45 E	47
July	—43	30	65	47	55	41	S 35 E	52	N 36 E	80	N 37 E	69
August.	—56	15	58	36	47	39	S 15 E	58	N 32 E	68	N 40 E	61
September	—57	10	60	30	46	27	S 10 E	58	N 27 E	67	N 30 E	53
October	—50	2	73	26	28	14	S 2 E	50	N 19 E	77	N 27 E	31
November	—41	—22	66	— 1	16	—25	S 28 W	47	N 1 W	66	N 57 W	30
December	—15	—50	64	—20	11	—34	S 73 W	52	N 17 W	67	N 72 W	36
April—September. .	—46	15	60	36	39	27	S 18 E	48	N 31 E	70	N 35 E	47
October—March. . .	—24	—34	71	—10	26	—23	S 55 W	42	N 8 W	72	N 42 W	35
Year.	—35	—10	66	13	33	2	S 16 W	36	N 11 E	67	N 4 E	33

NOORDWACHTER-ISLAND.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	28	—59	37	—55	37	—60	N 65° W	65%	N 56° W	60%	N 58° W	70%
February.	36	—73	47	—68	40	—51	N 64 W	81	N 55 W	83	N 52 W	65
March	18	—47	32	—50	30	—32	N 69 W	50	N 57 W	59	N 47 W	44
April.	—17	—13	—10	—12	—12	— 9	S 37 W	21	S 50 W	16	S 37 W	15
May	—31	33	—26	33	—24	38	S 47 E	45	S 51 E	42	S 58 E	45
June.	—30	41	—25	42	—25	36	S 54 E	51	S 59 E	49	S 55 E	44
July	—24	66	—19	66	—15	64	S 70 E	70	S 74 E	69	S 77 E	66
August.	—25	62	—24	65	— 5	60	S 68 E	67	S 70 E	69	S 85 E	60
September	—26	54	—25	54	—13	58	S 64 E	60	S 65 E	60	S 77 E	59
October	—34	41	—28	39	—20	38	S 50 E	53	S 54 E	48	S 62 E	43
November	—33	—27	—32	—21	—20	—25	S 39 W	43	S 33 W	38	S 51 W	32
December	— 1	—62	4	—64	7	—56	S 89 W	62	N 86 W	64	N 83 W	56
April—September. .	—26	41	—22	41	—16	41	S 58 E	49	S 62 E	47	S 69 E	44
October—March. . .	3	—38	10	—37	12	—31	N 85 W	38	N 75 W	38	N 69 W	33
Year.	—12	2	— 6	2	— 2	5	S 9 E	12	S 18 E	6	S 68 E	5

BOOMPJES-ISLAND.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	8	—71	31	—73	38	—78	N 84° W	71%	N 67° W	79%	N 64° W	87%
February.	12	—62	39	—62	33	—59	N 79 W	63	N 58 W	73	N 61 W	68
March	— 1	—43	33	—32	23	—53	S 89 W	43	N 44 W	46	N 67 W	58
April.	—34	18	7	32	16	25	S 28 E	38	N 78 E	33	N 57 E	30
May	—38	47	—14	49	7	60	S 51 E	60	S 74 E	51	N 83 E	60
June.	—37	63	—23	65	5	65	S 60 E	73	S 71 E	69	N 86 E	65
July	—58	63	—27	82	7	79	S 47 E	86	S 72 E	86	N 85 E	79
August.	—69	60	—18	89	27	84	S 41 E	91	S 79 E	91	N 72 E	88
September	—62	57	—19	84	15	76	S 43 E	84	S 77 E	86	N 79 E	77
October	—64	43	—11	69	29	54	S 34 E	77	S 81 E	70	N 62 E	61
November	—45	— 3	17	10	27	— 8	S 4 W	45	N 31 E	20	N 17 W	28
December	—12	—39	26	—47	26	—45	S 73 W	41	N 61 W	54	N 60 W	52
April—September. .	—50	51	—16	67	13	65	S 46 E	71	S 77 E	69	N 79 E	66
October—March. . .	—17	—29	23	—23	29	—32	S 60 W	34	N 45 W	33	N 48 W	43
Year.	—34	11	4	22	21	17	S 18 E	36	N 80 E	22	N 39 E	27

RESULTS OF WIND-OBSERVATIONS.

EDAM ISLE.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	5	—51	37	—52	37	—44	N 85° W	51 %	N 55° W	64 %	N 50° W	57 %
February	21	—43	45	—34	42	—31	N 64 W	48	N 37 W	56	N 36 W	52
March	—31	—33	39	—42	34	—19	S 47 W	45	N 47 W	57	N 29 W	39
April	—42	3	38	2	28	— 5	S 4 E	42	N 3 E	38	N 10 W	28
May	—49	9	22	28	21	22	S 10 E	50	N 52 E	36	N 46 E	30
June	—50	32	37	38	31	35	S 33 E	59	N 46 E	53	N 49 E	47
July	—61	31	28	53	30	54	S 27 E	68	N 62 E	60	N 61 E	62
August	—60	24	25	52	28	57	S 22 E	65	N 64 E	58	N 64 E	64
September	—52	33	41	52	53	39	S 32 E	62	N 52 E	66	N 36 E	66
October	—45	7	43	35	42	23	S 9 E	46	N 39 E	55	N 29 E	48
November	—52	—26	32	—10	29	—25	S 27 W	58	N 17 W	34	N 41 W	38
December	—14	—50	29	—31	24	—34	S 74 W	52	N 47 W	42	N 55 W	42
April—September	—52	22	32	38	32	34	S 23 E	56	N 50 E	50	N 47 E	47
October—March	—19	—33	38	—22	35	—22	S 60 W	38	N 30 W	44	N 32 W	41
Year	—36	— 6	35	8	34	6	S 9 W	36	N 13 E	36	N 10 E	35

PULU MANDELIEKE.

1887—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	6	—70	20	—80	10	—80	N 85° W	70 %	N 76° W	82 %	N 83° W	81 %
February	4	—55	28	—63	21	—67	N 86 W	55	N 66 W	69	N 73 W	70
March	—23	—16	19	—22	11	—43	S 35 W	28	N 49 W	29	N 76 W	44
April	—54	34	12	35	11	19	S 32 E	64	N 71 E	37	N 60 E	22
May	—54	45	— 6	50	—13	39	S 40 E	70	S 83 E	50	S 72 E	41
June	—55	48	—19	58	—25	51	S 41 E	73	S 72 E	61	S 64 E	57
July	—49	49	—23	64	—31	55	S 45 E	69	S 70 E	68	S 61 E	63
August	—60	59	—20	73	—18	71	S 45 E	84	S 75 E	76	S 76 E	73
September	—56	47	7	68	18	60	S 40 E	73	N 84 E	68	N 73 E	63
October	—58	44	6	63	13	49	S 37 E	73	N 85 E	63	N 75 E	51
November	—25	19	9	8	3	—16	S 37 E	31	N 42 E	12	N 79 W	16
December	— 7	— 9	29	—36	15	—52	S 52 W	11	N 51 W	46	N 74 W	54
April—September	—55	47	— 8	58	—10	49	S 41 E	72	S 82 E	59	S 78 E	50
October—March	—17	—15	19	—22	12	—35	S 41 W	23	N 49 W	29	N 71 W	37
Year	—36	16	6	18	1	7	S 24 E	39	N 72 E	19	N 82 E	7

SEMARANG.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	— 2	—14	42	—74	12	—69	S 82° W	14 %	N 60° W	85 %	N 80° W	70 %
February	5	—15	40	—61	8	—66	N 72 W	16	N 57 W	73	N 83 W	66
March	—18	44	47	—11	18	—45	S 68 E	48	N 13 W	48	N 68 W	48
April	—38	52	26	33	15	—19	S 54 E	64	N 51 E	42	N 52 W	24
May	—52	55	11	45	21	— 2	S 47 E	76	N 76 E	46	N 5 W	21
June	—45	63	7	43	19	18	S 54 E	77	N 81 E	44	N 43 E	26
July	—55	68	— 2	62	41	19	S 51 E	87	S 88 E	62	N 25 E	45
August	—47	59	5	58	29	20	S 51 E	75	N 85 E	58	N 35 E	35
September	—36	45	20	27	34	—12	S 51 E	58	N 53 E	34	N 19 W	36
October	—49	54	23	30	40	—27	S 48 E	73	N 53 E	38	N 34 W	48
November	—24	44	52	— 7	28	—45	S 61 E	50	N 8 W	52	N 58 W	53
December	—27	44	55	—23	14	—57	S 58 E	52	N 23 W	60	N 76 W	59
April—September	—46	57	11	45	27	4	S 51 E	73	N 76 E	46	N 8 E	27
October—March	—19	26	43	—24	20	—52	S 54 E	32	N 29 W	49	N 69 W	56
Year	—33	42	27	11	24	—24	S 52 E	53	N 22 E	29	N 45 W	34

DE BRIL.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	20	—81	17	—90	26	—85	N 76° W	83 %	N 79° W	92 %	N 73° W	89 %
February	20	—70	13	—75	14	—76	N 74 W	73	N 80 W	76	N 80 W	77
March	12	—42	11	—55	11	—56	N 74 W	44	N 79 W	56	N 79 W	57
April	— 3	23	5	21	— 4	12	S 83 E	23	N 77 E	22	S 72 E	13
May	—34	54	—35	56	—43	51	S 58 E	64	S 58 E	66	S 50 E	67
June	—26	70	—33	62	—35	56	S 70 E	75	S 62 E	70	S 58 E	66
July	—45	75	—39	75	—48	71	S 59 E	87	S 63 E	85	S 56 E	86
August	—44	80	—46	80	—30	76	S 61 E	91	S 60 E	92	S 68 E	82
September	—58	64	—61	59	—66	54	S 48 E	86	S 44 E	85	S 39 E	85
October	—47	60	—50	53	—57	44	S 52 E	76	S 47 E	73	S 38 E	72
November	—27	5	—28	—20	—42	—27	S 10 E	27	S 36 W	34	S 33 W	50
December	1	—55	4	—64	— 9	—70	N 89 W	55	N 86 W	64	S 83 W	71
April—September	—35	61	—35	59	—38	53	S 60 E	70	S 59 E	69	S 54 E	65
October—March	— 4	—31	— 6	—42	—10	—45	S 83 W	31	S 82 W	42	S 77 W	46
Year	—20	15	—21	9	—24	4	S 37 E	25	S 23 E	23	S 9 E	24

RESULTS OF WIND-OBSERVATIONS.

SEMBILANGAN.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—44	—62	35	—66	31	—57	S 55° W	76 %	N 62° W	75 %	N 62° W	65 %
February.	—44	—61	31	—70	26	—59	S 54 W	75	N 66 W	77	N 66 W	64
March	—50	—32	50	—34	29	—22	S 33 W	59	N 34 W	60	N 37 W	36
April.	—51	— 2	33	11	42	10	S 2 W	51	N 19 E	35	N 13 E	43
May	—56	16	12	48	46	35	S 16 E	58	N 76 E	49	N 37 E	58
June	—68	14	13	44	45	35	S 12 E	69	N 74 E	46	N 38 E	57
July	—76	4	6	62	58	35	S 3 E	76	N 84 E	62	N 31 E	68
August.	—76	— 8	9	65	75	29	S 6 W	76	N 82 E	66	N 21 E	80
September	—75	—10	23	48	73	25	S 8 W	76	N 64 E	53	N 19 E	77
October	—71	—11	39	34	63	22	S 9 W	72	N 41 E	52	N 19 E	67
November	—66	—30	36	4	44	— 4	S 24 W	72	N 6 E	36	N 5 W	44
December	—55	—46	39	—31	27	—32	S 40 W	72	N 39 W	50	N 50 W	42
April—September. .	—67	2	16	46	57	28	S 2 E	67	N 71 E	49	N 26 E	64
October—March. . .	—55	—40	38	—27	37	—25	S 36 W	68	N 35 W	47	N 34 W	45
Year	—61	—19	27	10	47	2	S 17 W	64	N 20 E	29	N 2 E	47

SUMENEP.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	— 5	—64	12	—52	34	—58	S 86° W	64 %	N 77° W	53 %	N 60° W	67 %
February.	2	—55	19	—37	47	—54	N 88 W	55	N 63 W	42	N 49 W	72
March	—18	—10	7	— 6	34	—11	S 29 W	21	N 41 W	9	N 18 W	36
April.	—15	41	4	45	36	36	S 70 E	44	N 85 E	45	N 45 E	51
May	—25	52	— 8	58	38	54	S 64 E	58	S 82 E	59	N 55 E	66
June	—35	57	—27	63	39	64	S 58 E	67	S 67 E	69	N 59 E	75
July	—46	61	—34	74	31	80	S 53 E	76	S 65 E	81	N 69 E	86
August.	—56	61	—31	76	33	79	S 47 E	83	S 68 E	82	N 69 E	85
September	—52	61	—37	71	37	77	S 50 E	80	S 62 E	80	N 64 E	85
October	—57	37	—33	63	39	63	S 33 E	68	S 62 E	71	N 58 E	74
November	—38	12	—27	33	41	25	S 18 E	40	S 50 E	43	N 31 E	48
December	—11	—28	3	—13	51	—19	S 69 W	30	N 77 W	13	N 20 W	54
April—September. .	—38	56	—22	65	35	65	S 56 E	68	S 71 E	69	N 62 E	74
October—March. . .	—21	—18	— 3	— 2	41	— 9	S 41 W	28	S 34 W	4	N 12 W	42
Year	—30	19	—13	32	38	28	S 32 E	36	S 68 E	35	N 36 E	47

ZWAANTJES-DROOGTE.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—14	—44	31	—36	— 2	—24	S 72° W	46 %	N 49° W	48 %	S 85° W	24 %
February.	—13	—49	13	—40	—10	—27	S 75 W	51	N 72 W	42	S 70 W	29
March	—22	—13	25	—14	8	—11	S 31 W	26	N 29 W	29	N 54 W	14
April.	—40	19	26	44	12	43	S 25 E	44	N 59 E	51	N 74 E	45
May	—51	37	16	56	— 7	52	S 36 E	63	N 74 E	58	S 82 E	52
June	—58	37	2	56	— 9	54	S 33 E	69	N 88 E	56	S 81 E	55
July	—71	23	1	61	—23	69	S 18 E	75	N 89 E	61	S 72 E	73
August.	—73	33	— 1	70	—25	62	S 24 E	80	E	70	S 68 E	67
September	—61	32	21	60	—11	61	S 28 E	69	N 71 E	64	S 80 E	62
October	—56	22	15	42	— 6	53	S 21 E	60	N 70 E	45	S 84 E	53
November	—40	17	8	20	—32	22	S 23 E	43	N 68 E	22	S 35 E	39
December	—27	—11	4	— 6	—13	—10	S 22 W	29	N 56 W	7	S 38 W	16
April—September. .	—59	30	11	58	—11	57	S 27 E	66	N 79 E	59	S 79 E	58
October—March. . .	—29	—13	16	— 6	— 9	1	S 24 W	32	N 20 W	17	S 6 E	9
Year	—44	9	14	26	—10	29	S 12 E	45	N 62 E	30	S 71 E	31

SURABAYA.

1887—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—37	—32	24	—52	36	—22	S 41° W	49 %	N 65° W	57 %	N 31° W	42 %
February.	— 6	—67	32	—75	45	—38	S 85 W	67	N 67 W	82	N 40 W	59
March	—42	—25	40	—29	28	—16	S 31 W	49	N 36 W	49	N 30 W	32
April.	—27	12	54	—23	17	—18	S 24 E	30	N 23 W	59	N 47 W	25
May	—61	25	17	43	13	56	S 22 E	66	N 68 E	46	N 77 E	57
June	—49	13	0	62	1	58	S 15 E	51	E	62	N 89 E	58
July	—53	7	—19	86	— 3	79	S 8 E	53	S 78 E	88	S 88 E	79
August.	—41	9	—17	92	— 5	74	S 12 E	42	S 80 E	94	S 86 E	74
September	—51	— 9	—22	76	— 5	78	S 10 W	52	S 74 E	79	S 86 E	78
October	—50	5	— 3	70	2	70	S 6 E	50	S 87 E	70	N 88 E	70
November	—48	—19	10	35	12	43	S 22 W	52	N 74 E	36	N 74 E	45
December	—43	—27	25	26	17	35	S 32 W	51	N 46 E	36	N 64 E	39
April—September. .	—47	10	2	55	3	55	S 12 E	48	N 88 E	55	N 87 E	55
October—March. . .	—38	—28	21	— 4	23	12	S 36 W	47	N 11 W	21	N 28 E	26
Year	—43	— 9	12	26	13	34	S 12 W	44	N 65 E	29	N 69 E	36

RESULTS OF WIND-OBSERVATIONS.

MAKASSER.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	41	1	31	—69	17	—34	N 1° E	41 %	N 66° W	76 %	N 63° W	38 %
February.	31	13	30	—63	19	—42	N 23 E	34	N 65 W	70	N 66 W	46
March	28	19	3	—73	10	—28	N 34 E	34	N 88 W	73	N 70 W	30
April.	18	29	—12	—67	—10	2	N 58 E	34	S 80 W	68	S 11 E	10
May	— 4	42	—29	—57	—26	11	S 85 E	42	S 63 W	64	S 23 E	28
June	— 4	24	—34	—52	—34	26	S 81 E	24	S 57 W	62	S 37 E	43
July	—16	36	—30	—46	—24	33	S 66 E	39	S 57 W	55	S 54 E	41
August.	—35	12	—30	—48	—18	6	S 19 E	37	S 58 W	57	S 18 E	19
September	—52	— 4	—36	—39	—23	10	S 4 W	52	S 47 W	53	S 23 E	25
October	—31	—10	—42	—29	—26	12	S 18 W	33	S 35 W	51	S 25 E	29
November	9	—11	—23	—61	—23	— 1	N 51 W	14	S 69 W	65	S 3 W	23
December	40	—19	18	—73	18	—20	N 25 W	44	N 76 W	75	N 48 W	27
April—September. .	—16	23	—29	—52	—23	15	S 55 E	28	S 61 W	60	S 33 E	27
October—March. . .	20	— 1	3	—61	3	—19	N 3 W	20	N 87 W	61	N 81 W	19
Year.	2	11	—13	—57	—10	— 2	N 80 E	11	S 77 W	58	S 11 W	10

KEMA.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	33	—48	18	—29	9	—63	N 56° W	58 %	N 58° W	34 %	N 82° W	64 %
February.	46	—24	37	—11	29	—64	N 28 W	52	N 17 W	39	N 66 W	70
March	48	—25	42	— 8	33	—54	N 28 W	54	N 11 W	43	N 59 W	63
April.	27	—16	8	— 3	7	—56	N 31 W	31	N 20 W	9	N 83 W	56
May	12	— 3	—30	22	—33	—25	N 14 W	12	S 36 E	37	S 37 W	41
June	—12	17	—50	27	—47	—15	S 55 E	21	S 28 E	57	S 18 W	49
July	—64	18	—89	9	—91	— 1	S 16 E	66	S 6 E	89	S	91
August.	—72	10	—88	6	—97	— 2	S 8 E	73	S 4 E	88	S 1 W	97
September	—48	17	—81	5	—87	— 5	S 19 E	51	S 4 E	81	S 3 W	87
October	— 5	23	—66	23	—63	— 6	S 78 E	24	S 19 E	70	S 5 W	63
November	10	—27	—26	2	—24	—53	N 70 W	29	S 4 E	26	S 66 W	58
December	11	—55	—10	—40	—19	—80	N 79 W	56	S 76 W	41	S 77 W	82
April—September. .	—26	7	—55	11	—58	—17	S 15 E	27	S 11 E	56	S 16 W	60
October—March. . .	24	—26	— 1	—11	— 6	—53	N 47 W	35	S 85 W	11	S 84 W	53
Year.	— 1	—10	—28	0	—32	—35	S 84 W	10	S	28	S 48 W	47

DONGGALA.

1894—1895.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—43	21	10	—75	2	—54	S 26° E	48 %	N 82° W	76 %	N 88° W	54 %
February.	—73	25	25	—76	39	—63	S 19 E	77	N 72 W	80	N 58 W	74
March	—63	—11	—28	—55	— 9	—49	S 10 W	64	S 63 W	62	S 80 W	50
April.	—70	33	5	—59	—22	—76	S 25 E	77	N 85 W	59	S 74 W	79
May	—68	28	7	—73	23	—70	S 22 E	74	N 84 W	73	N 72 W	74
June	—69	7	27	—63	22	—68	S 6 E	69	N 67 W	69	N 72 W	71
July	—70	2	11	—41	17	—46	S 2 E	70	N 75 W	42	N 70 W	49
August.	—82	26	10	—67	36	—66	S 18 E	86	N 81 W	68	N 61 W	75
September	—81	21	2	—61	— 7	—57	S 15 E	84	N 88 W	61	S 83 W	57
October	—72	19	— 2	—79	1	—74	S 15 E	74	S 88 W	79	N 89 W	74
November	—80	22	12	—64	4	—62	S 15 E	83	N 79 W	65	N 86 W	62
December	—54	—10	36	—72	40	—66	S 11 W	55	N 63 W	80	N 59 W	77
April—September. .	—73	20	10	—61	11	—64	S 15 E	76	N 81 W	62	N 80 W	65
October—March. . .	—64	11	9	—70	13	—61	S 10 E	65	N 83 W	71	N 78 W	62
Year.	—69	16	10	—66	12	—63	S 13 E	71	N 81 W	67	N 79 W	64

TONTOLI.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	1	— 6	28	—76	12	57	N 81° W	6 %	N 70° W	81 %	N 78° E	58 %
February.	8	5	39	—61	— 2	58	N 31 E	9	N 57 W	72	S 88 E	58
March	21	9	49	—55	— 2	72	N 23 E	23	N 48 W	74	S 88 E	72
April.	17	14	44	—40	2	77	N 39 E	22	N 42 W	59	N 88 E	77
May	17	13	34	—37	2	63	N 37 E	21	N 47 W	50	N 88 E	63
June	7	19	31	—28	4	64	N 70 E	20	N 42 W	42	N 86 E	64
July	7	27	8	—43	3	57	N 75 E	28	N 79 W	44	N 87 E	57
August.	2	34	0	—39	— 8	72	N 87 E	34	W	39	S 84 E	72
September	— 3	8	—12	—45	— 2	53	S 69 E	9	S 75 W	47	S 88 E	53
October	— 4	2	— 7	—36	— 4	49	S 26 E	4	S 79 W	37	S 85 E	49
November	6	—14	27	—56	— 3	62	N 67 W	15	N 64 W	62	S 87 E	62
December	9	0	20	—69	4	51	N	9	N 74 W	72	N 85 E	51
April—September. .	8	19	18	—39	0	64	N 67 E	21	N 65 W	43	E	64
October—March. . .	7	— 1	26	—59	1	58	N 8 W	7	N 66 W	64	N 89 E	58
Year.	8	9	22	—49	1	61	N 48 E	12	N 66 W	54	N 89 E	61

RESULTS OF WIND-OBSERVATIONS.

GAMSUNGI.

1889—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	11	—15	9	—19	28	—19	N 54° W	19 %	N 65° W	21 %	N 34° W	34 %
February	47	—18	39	18	59	— 8	N 21 W	50	N 25 E	43	N 8 W	60
March	55	— 1	48	3	40	— 3	N 1 W	55	N 4 E	48	N 4 W	40
April	5	—16	10	—18	21	—18	N 73 W	17	N 61 W	21	N 41 W	28
May	—19	— 9	—25	— 3	—14	— 7	S 25 W	21	S 7 W	25	S 27 W	16
June	—19	—24	—25	— 7	— 9	— 3	S 52 W	31	S 16 W	26	S 18 W	9
July	—33	— 9	—41	—13	—36	— 3	S 15 W	34	S 18 W	43	S 5 W	36
August	—48	5	—56	5	—55	5	S 6 E	48	S 5 E	56	S 5 E	55
September	—39	— 2	—54	— 1	—53	— 1	S 3 W	39	S 1 W	54	S 1 W	53
October	—28	—16	—33	—15	—23	—16	S 30 W	32	S 25 W	36	S 35 W	28
November	—19	—33	—17	—34	—13	—31	S 60 W	38	S 63 W	38	S 67 W	34
December	7	—22	20	—28	19	—23	N 72 W	23	N 54 W	34	N 50 W	30
April—September	—26	— 9	—32	— 6	—24	— 5	S 19 W	28	S 11 W	33	S 12 W	25
October—March	12	—18	11	—13	18	—17	N 56 W	22	N 50 W	17	N 43 W	25
Year	— 7	—14	—11	—10	— 3	—11	S 63 W	16	S 42 W	15	S 75 W	11

BONTHAIN.

1886—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—45	—28	—27	—63	2	—62	S 32° W	53 %	S 67° W	69 %	N 88° W	62 %
February	—46	—11	—17	—54	5	—60	S 13 W	47	S 73 W	57	N 85 W	60
March	—50	27	—44	—13	9	—26	S 28 E	57	S 16 W	46	N 71 W	28
April	—43	33	—36	15	18	— 8	S 37 E	54	S 23 E	39	N 24 W	20
May	— 2	55	—16	59	39	28	S 88 E	55	S 75 E	61	N 36 E	48
June	7	57	— 7	67	38	48	N 83 E	57	S 84 E	67	N 51 E	61
July	26	70	4	82	39	68	N 70 E	75	N 87 E	82	N 60 E	78
August	33	71	0	87	31	75	N 65 E	78	E	87	N 68 E	81
September	17	70	—10	86	21	74	N 76 E	72	S 83 E	87	N 74 E	77
October	— 7	57	—23	70	4	61	S 83 E	57	S 72 E	74	N 86 E	61
November	—37	15	—44	4	— 6	— 6	S 22 E	40	S 5 E	44	S 45 W	8
December	—51	— 4	—40	—42	1	—53	S 4 W	51	S 46 W	58	N 89 W	53
April—September	6	59	—11	66	31	48	N 84 E	59	S 81 E	67	N 57 E	57
October—March	—39	9	—33	—17	3	—24	S 13 E	40	S 27 W	37	N 83 W	24
Year	—17	34	—22	25	17	12	S 63 E	38	S 49 E	33	N 35 E	21

BATJAN.

1889—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—22	—15	—27	—29	—10	— 6	S 34° W	27 %	S 47° W	40 %	S 31° W	12 %
February	—23	— 8	—23	—12	— 6	— 1	S 19 W	24	S 28 W	26	S 9 W	6
March	—20	— 9	—35	—19	—14	— 4	S 24 W	22	S 28 W	40	S 16 W	15
April	—27	— 4	—32	—14	—10	— 2	S 8 W	27	S 24 W	35	S 11 W	10
May	—17	— 7	—29	—15	—15	— 5	S 22 W	18	S 27 W	33	S 18 W	16
June	—26	— 1	—51	—20	—17	— 7	S 2 W	26	S 21 W	55	S 22 W	18
July	—31	1	—42	— 7	—26	— 1	S 2 E	31	S 9 W	43	S 2 W	26
August	—31	— 1	—49	— 9	—20	3	S 2 W	31	S 10 W	50	S 9 E	20
September	—29	— 4	—41	—14	—22	— 4	S 8 W	29	S 19 W	43	S 10 W	22
October	—27	— 4	—35	—15	—22	— 6	S 8 W	27	S 23 W	38	S 15 W	23
November	—24	— 7	—28	—18	—16	— 8	S 16 W	25	S 33 W	33	S 27 W	18
December	—23	—20	—37	—30	—13	— 5	S 41 W	30	S 39 W	48	S 21 W	14
April—September	—27	— 3	—41	—13	—18	— 3	S 6 W	27	S 18 W	43	S 9 W	18
October—March	—23	—11	—31	—21	—14	— 5	S 26 W	25	S 34 W	37	S 19 W	15
Year	—25	— 7	—36	—17	—16	— 4.	S 16 W	26	S 25 W	40	S 14 W	16

DUIVEN-ISLAND.

1889—1894.	Components in percentages.						Mean direction and steadiness.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—31	0	12	— 1	—21	—17	S	31 %	N 5° W	12 %	S 39° W	27 %
February	—16	8	30	3	— 7	— 7	S 27° E	18	N 6 E	30	S 45 W	10
March	—37	6	20	15	—20	8	S 9 E	37	N 37 E	25	S 22 E	22
April	—68	4	— 9	25	—37	9	S 3 E	68	S 70 E	27	S 14 E	38
May	—67	1	—33	15	—46	2	S	67	S 25 E	36	S 3 E	46
June	—75	— 5	—45	6	—46	—10	S 4 W	75	S 8 E	45	S 12 W	47
July	—90	—20	—80	—11	—82	—19	S 13 W	92	S 8 W	81	S 13 W	84
August	—88	—24	—81	—19	—83	—26	S 15 W	91	S 13 W	83	S 17 W	87
September	—89	—30	—80	—22	—87	—24	S 19 W	94	S 15 W	83	S 15 W	90
October	—92	—10	—82	— 7	—86	— 7	S 6 W	93	S 5 W	82	S 5 W	86
November	—80	—13	—58	— 4	—72	— 7	S 9 W	81	S 4 W	58	S 6 W	72
December	—59	— 9	—14	6	—53	—12	S 9 W	60	S 23 E	15	S 13 W	54
April—September	—80	—12	—55	— 1	—64	—11	S 9 W	81	S 1 W	55	S 10 W	65
October—March	—53	— 3	—15	2	—43	— 7	S 3 W	53	S 8 E	15	S 9 W	44
Year	—67	— 8	—35	1	—54	— 9	S 7 W	67	S 2 E	35	S 9 W	55

RESULTS OF WIND-OBSERVATIONS.

BIMA.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	0	77	42	—74	42	—60	E	77%	N 60° W	85%	N 55° W	73%
February.	4	74	48	—71	36	—42	N 87° E	74	N 56 W	86	N 49 W	55
March	— 9	81	44	—34	39	—15	S 84 E	81	N 38 W	56	N 21 W	42
April.	—22	78	6	0	3	19	S 74 E	81	N	6	N 81 E	19
May	—31	61	—14	26	—21	30	S 63 E	68	S 62 E	30	S 55 E	37
June	—35	66	—45	23	—50	33	S 62 E	75	S 27 E	51	S 33 E	60
July	—54	42	—76	14	—74	17	S 38 E	68	S 10 E	77	S 13 E	76
August.	—59	44	—48	26	—57	24	S 37 E	74	S 28 E	55	S 23 E	62
September	—59	47	—25	31	—38	26	S 39 E	75	S 51 E	40	S 34 E	46
October	—64	37	17	45	—16	35	S 30 E	74	N 69 E	48	S 65 E	38
November	—27	62	33	3	11	25	S 66 E	68	N 5 E	33	N 66 E	27
December	— 3	91	52	—49	38	—22	S 88 E	91	N 43 W	71	N 30 W	44
April—September. .	—43	56	—34	20	—40	25	S 53 E	71	S 31 E	39	S 32 E	47
October—March. . .	—17	70	39	—30	25	—13	S 76 E	72	N 38 W	49	N 27 W	28
Year.	—30	63	3	— 5	— 8	6	S 65 E	70	N 59 W	6	S 37 E	10

PULU SAPUDIE.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	—12	—69	32	—69	47	—56	S 80° W	70%	N 65° W	76%	N 50° W	73%
February.	—15	—63	28	—61	40	—50	S 77 W	65	N 65 W	67	N 51 W	64
March	— 8	—31	32	—30	39	—20	S 76 W	32	N 43 W	44	N 27 W	44
April.	—45	46	— 4	34	4	51	S 46 E	64	S 83 E	34	N 85 E	51
May	—51	55	—17	62	—21	68	S 47 E	75	S 75 E	64	S 73 E	71
June	—63	56	—30	62	—22	71	S 42 E	84	S 64 E	69	S 73 E	74
July	—75	49	—51	71	—35	85	S 33 E	90	S 54 E	87	S 68 E	92
August.	—77	47	—53	71	—29	89	S 31 E	90	S 53 E	89	S 72 E	94
September	—85	32	—45	44	—27	88	S 20 E	91	S 44 E	63	S 73 E	92
October	—83	23	—30	54	— 6	79	S 16 E	86	S 61 E	62	S 86 E	79
November	—57	—10	—13	— 9	7	22	S 10 W	58	S 35 W	16	N 72 E	23
December	—27	—15	24	—44	27	—32	S 29 W	31	N 61 W	50	N 50 W	42
April—September. .	—66	48	—33	57	—22	75	S 36 E	82	S 60 E	66	S 74 E	78
October—March. . .	—34	—27	12	—27	26	—10	S 39 W	43	N 66 W	30	N 21 W	28
Year.	—50	11	—11	15	2	33	S 12 E	51	S 54 E	19	N 86 E	33

BULELENG.

1887—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	62	—30	55	—44	45	—21	N 26° W	69%	N 39° W	70%	N 25° W	50%
February.	48	— 4	52	—18	42	—24	N 5 W	48	N 19 W	55	N 30 W	48
March	34	28	46	12	29	6	N 40 E	44	N 15 E	48	N 12 E	30
April.	28	36	45	36	39	35	N 52 E	46	N 39 E	58	N 42 E	52
May	32	36	48	40	34	38	N 48 E	48	N 40 E	62	N 48 E	51
June	26	25	51	34	44	20	N 44 E	36	N 34 E	61	N 24 E	48
July	49	13	58	40	51	29	N 15 E	51	N 35 E	70	N 30 E	59
August.	35	18	62	47	50	36	N 27 E	39	N 37 E	78	N 36 E	62
September	46	27	60	45	49	38	N 30 E	53	N 37 E	75	N 38 E	62
October	58	24	63	37	54	30	N 23 E	63	N 30 E	73	N 29 E	62
November	59	19	53	11	49	10	N 18 E	62	N 12 E	54	N 12 E	50
December	54	8	47	— 9	37	—15	N 8 E	55	N 11 W	48	N 22 W	40
April—September. .	36	26	54	40	45	33	N 36 E	44	N 37 E	67	N 36 E	56
October—March. . .	53	8	53	— 2	43	— 2	N 9 E	54	N 2 W	53	N 3 W	43
Year.	45	17	54	19	44	16	N 21 E	48	N 19 E	57	N 20 E	47

MEINDERTS-DROOGTE.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	— 5	—48	23	—45	3	—47	S 84° W	48%	N 63° W	51%	N 86° W	47%
February.	0	—49	32	—48	8	—46	W	49	N 56 W	58	N 80 W	47
March	—15	—31	24	—18	7	—25	S 64 W	34	N 37 W	30	N 74 W	26
April.	—59	19	16	53	—28	40	S 18 E	62	N 73 E	55	S 55 E	49
May	—71	25	—40	49	—50	38	S 19 E	75	S 51 E	63	S 37 E	63
June	—74	17	—46	46	—63	31	S 13 E	76	S 45 E	65	S 26 E	70
July	—86	22	—68	45	—77	28	S 14 E	89	S 33 E	82	S 20 E	82
August.	—88	20	—70	43	—79	28	S 13 E	90	S 32 E	82	S 19 E	84
September	—82	14	—65	48	—76	33	S 10 E	83	S 36 E	81	S 23 E	83
October	—80	8	—51	54	—70	33	S 6 E	80	S 47 E	74	S 25 E	77
November	—48	— 2	— 5	24	—41	8	S 2 W	48	S 78 E	25	S 11 E	42
December	—29	—14	23	0	—14	—13	S 26 W	32	N	23	S 43 W	19
April—September. .	—77	20	—46	47	—62	33	S 15 E	80	S 46 E	66	S 28 E	70
October—March. . .	—30	—23	8	— 6	—18	—15	S 38 W	38	N 37 W	10	S 40 W	23
Year.	—54	— 2	—19	21	—40	9	S 2 W	54	S 48 E	28	S 13 E	41

RESULTS OF WIND-OBSERVATIONS.

TIMOR KUPANG.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	32	—27	18	—65	9	—46	N 40° W	42%	N 75° W	67%	N 79° W	47%
February	29	—21	26	—51	13	—35	N 36 W	36	N 63 W	57	N 70 W	37
March	36	28	19	—53	— 6	— 6	N 38 E	46	N 70 W	56	S 45 W	8
April	16	60	13	12	— 2	42	N 75 E	62	N 43 E	18	S 87 E	42
May	0	86	6	41	—11	56	E	86	N 82 E	41	S 79 E	57
June	12	88	1	52	— 6	71	N 82 E	89	N 89 E	52	S 85 E	71
July	8	92	3	58	— 5	74	N 85 E	92	N 87 E	58	S 86 E	74
August	14	80	8	16	—15	53	N 80 E	81	N 63 E	18	S 74 E	55
September	28	47	7	— 9	— 2	41	N 59 E	55	N 52 W	11	S 87 E	41
October	24	16	1	—41	—28	20	N 34 E	29	N 89 W	41	S 36 E	34
November	29	9	14	—33	—17	18	N 17 E	30	N 67 W	36	S 47 E	25
December	27	— 6	18	—55	—11	—11	N 13 W	28	N 72 W	58	S 45 W	16
April—September	13	76	6	28	— 7	56	N 80 E	77	N 78 E	29	S 83 E	56
October—March	30	0	16	—50	— 7	—10	N	30	N 72 W	52	S 55 W	12
Year	22	38	11	—11	— 7	23	N 60 E	44	N 45 W	16	S 73 E	24

AMAHEI.

1889—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	90	— 5	— 7	—11	16	20	N 3° W	90%	S 58° W	13%	N 51° E	26%
February	80	— 8	2	—10	21	3	N 6 W	80	N 79 W	10	N 8 E	21
March	79	— 8	—18	—17	13	1	N 6 W	79	S 43 W	25	N 4 E	13
April	92	— 6	—32	—19	9	—27	N 4 W	92	S 31 W	37	N 72 W	28
May	74	— 4	—46	18	—10	20	N 3 W	74	S 21 E	49	S 63 E	22
June	79	5	—52	20	—51	49	N 4 E	79	S 21 E	56	S 44 E	71
July	59	18	—41	54	—48	70	N 17 E	62	S 53 E	68	S 56 E	85
August	38	24	—57	39	—42	59	N 32 E	45	S 34 E	69	S 55 E	72
September	73	— 9	—42	36	—43	63	N 7 W	74	S 41 E	55	S 56 E	76
October	86	—11	—43	— 9	—36	9	N 7 W	87	S 12 W	44	S 14 E	37
November	94	— 9	—29	— 2	—22	17	N 5 W	94	S 4 W	29	S 38 E	28
December	94	— 9	—16	— 8	4	6	N 5 W	94	S 27 W	18	N 56 E	7
April—September	69	5	—45	25	—31	39	N 4 E	69	S 29 E	51	S 51 E	50
October—March	87	— 8	—19	—10	— 1	9	N 5 W	87	S 28 W	21	S 84 E	9
Year	78	— 2	—32	8	—16	24	N 2 W	78	S 14 E	33	S 56 E	29

SERWARU.

1886—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	18	—62	17	—64	19	—56	N 74° W	65%	N 75° W	66%	N 71° W	59%
February	16	—66	20	—67	14	—60	N 76 W	68	N 73 W	70	N 77 W	62
March	13	—43	17	—35	14	—38	N 73 W	45	N 64 W	39	N 70 W	40
April	—20	11	—15	23	— 6	1	S 29 E	23	S 57 E	27	S 9 E	6
May	—22	68	—23	65	—16	54	S 72 E	71	S 71 E	69	S 73 E	56
June	—25	67	—30	71	—26	49	S 70 E	72	S 67 E	77	S 62 E	55
July	—41	60	—48	69	—32	41	S 56 E	73	S 55 E	84	S 52 E	52
August	—44	69	—49	70	—31	52	S 58 E	82	S 55 E	85	S 59 E	61
September	—38	38	—53	41	—42	31	S 45 E	54	S 38 E	67	S 36 E	52
October	—23	22	—32	22	—28	12	S 44 E	32	S 35 E	39	S 23 E	30
November	15	—22	16	— 8	2	2	N 56 W	27	N 27 W	18	N 45 E	3
December	8	—56	13	—56	6	—43	N 82 W	57	N 77 W	57	N 82 W	43
April—September	—32	52	—36	57	—26	38	S 58 E	61	S 58 E	67	S 56 E	46
October—March	8	—38	9	—35	5	—31	N 78 W	39	N 76 W	36	N 81 W	31
Year	—12	7	—14	11	—11	4	S 30 E	14	S 38 E	18	S 20 E	12

AMBOINA.

1887—1894.	COMPONENTS IN PERCENTAGES.						MEAN DIRECTION AND STEADINESS.					
	9 a. m.		2 p. m.		6 p. m.		9 a. m.		2 p. m.		6 p. m.	
	N	E	N	E	N	E						
January	24	—36	38	—45	38	—37	N 56° W	43%	N 50° W	59%	N 44° W	53%
February	39	—22	46	—22	45	—25	N 29 W	45	N 26 W	51	N 29 W	51
March	33	—26	33	—28	41	—28	N 38 W	42	N 40 W	43	N 34 W	50
April	15	8	21	2	21	— 7	N 28 E	17	N 5 E	21	N 18 W	22
May	— 1	54	6	43	5	45	S 89 E	54	N 82 E	43	N 84 E	45
June	— 3	62	— 1	63	— 2	65	S 87 E	62	S 89 E	63	S 88 E	65
July	5	80	—13	80	—10	76	N 86 E	80	S 81 E	81	S 83 E	77
August	9	78	5	76	— 3	78	N 83 E	79	N 86 E	76	S 88 E	78
September	4	78	—23	75	—25	80	N 87 E	78	S 73 E	78	S 73 E	84
October	—10	20	— 3	19	— 6	5	S 63 E	22	S 81 E	19	S 39 E	8
November	— 1	— 5	20	—23	16	—29	S 78 W	5	N 49 W	30	N 61 W	33
December	27	—40	25	—51	27	—47	N 56 W	48	N 64 W	57	N 60 W	54
April—September	5	60	— 1	57	— 2	56	N 85 E	60	S 89 E	57	S 88 E	56
October—March	19	—18	27	—25	27	—27	N 43 W	26	N 43 W	37	N 45 W	38
Year	12	21	13	16	13	15	N 60 E	24	N 51 E	21	N 49 E	20

RESULTS OF RAIN-OBSERVATIONS.

SUMATRA.

	MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
1 Bengkalis	151	143	190	255	216	142	146	172	267	283	**358**	327	2650
2 Bekalla	193	131	152	186	274	162	149	295	295	304	**344**	239	2724
3 Medan	132	99	97	133	193	120	119	203	239	249	**255**	208	2047
4 Medan Putri	126	98	91	133	188	126	119	202	239	**246**	**246**	201	2015
5 Gedong Djohor	125	109	118	161	194	162	115	227	244	270	**271**	246	2242
6 Timbang Langkat	152	113	113	165	234	169	158	247	293	**343**	342	244	2573
7 Tandem	87	89	77	147	168	156	155	236	261	**279**	273	213	2141
8 Seruway	187	81	87	144	120	118	106	213	165	217	259	**269**	1966
9 Edi	216	91	49	70	101	115	93	159	131	207	313	**439**	1984
10 Segli	285	195	103	197	79	67	61	76	44	201	169	**294**	1771
11 Kotta Radja	151	79	84	116	141	82	111	123	185	190	209	**233**	1704
12 Gunung Sitoli	223	169	211	269	221	231	305	343	283	**367**	358	341	3321
13 Singkel	285	271	372	406	368	335	291	388	420	**512**	498	416	4562
14 Siboga	333	315	432	390	347	289	274	322	362	**536**	505	466	4571
15 Padang Sidempuan	222	188	216	187	150	119	81	134	138	278	235	**283**	2231
16 Lubu Sikaping	353	190	269	437	266	257	229	301	263	**632**	380	430	4007
17 Kotta Nopan	186	141	209	253	174	121	94	189	156	**285**	213	241	2262
18 Ajerbangies	192	155	276	346	209	203	179	230	250	280	336	**369**	3025
19 Fort de Kock	228	178	261	**274**	211	147	99	179	159	259	221	244	2460
20 Pajacombo	266	220	249	232	163	130	102	193	163	243	232	**303**	2496
21 Padang Pandjang	360	295	305	332	244	188	182	292	333	375	421	**514**	3841
22 Padang	314	247	310	353	344	376	312	355	409	**546**	526	484	4576
23 Sawah Lunto	218	154	274	**384**	170	191	92	111	93	373	275	289	2624
24 Lubu Selassi	286	200	272	263	237	194	174	232	313	400	**402**	393	3366
25 Solok	**285**	223	246	211	169	118	82	141	134	253	228	240	2330
26 Lubu Sampir	405	268	356	331	224	146	163	203	257	275	292	**408**	3328
27 Benkulen	315	249	288	263	262	233	181	241	249	**361**	344	349	3335
28 Telok Betong	**269**	265	265	183	129	123	92	125	140	134	145	224	2094

	AVERAGE NUMBER OF RAINY DAYS.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
1 Bengkalis	11	9	12	17	14	11	12	14	16	19	**20**	19	174
2 Bekalla	10	8	9	10	14	10	10	16	16	**17**	**17**	15	152
3 Medan	12	7	9	10	14	10	10	16	16	**20**	19	18	161
4 Medan Putri	12	8	9	11	15	10	10	17	16	**19**	18	17	162
5 Gedong Djohor	11	8	9	11	14	12	11	17	17	**19**	18	18	165
6 Timbang Langkat	9	7	8	10	13	10	10	16	14	**17**	16	14	144
7 Tandem	7	6	6	10	12	10	9	17	16	**17**	16	14	140
8 Seruway	11	6	6	9	10	10	11	15	15	**18**	**18**	18	147
9 Edi	12	6	5	7	9	8	9	12	11	14	16	**18**	127
10 Segli	11	9	8	10	6	5	4	7	6	15	11	**16**	108
11 Kotta Radja	11	7	8	10	12	10	9	11	13	15	**15**	15	136
12 Gunung Sitoli	16	12	16	18	16	13	17	21	19	**23**	**23**	19	213
13 Singkel	15	12	16	18	16	13	14	16	17	**20**	**20**	18	195
14 Siboga	17	15	19	19	16	12	14	17	17	22	**23**	22	213
15 Padang Sidempuan	15	12	15	17	14	12	12	15	15	**22**	**22**	20	191
16 Lubu Sikaping	19	13	20	25	19	16	17	22	19	**26**	24	22	242
17 Kotta Nopan	16	12	18	20	15	12	12	17	15	**21**	20	19	197
18 Ajerbangies	11	8	14	16	12	9	11	13	12	**17**	**17**	16	156
19 Fort de Kock	18	14	18	17	16	11	10	16	15	**20**	19	**20**	194
20 Pajacombo	19	15	18	18	14	11	11	15	14	17	19	**20**	191
21 Padang Pandjang	22	18	23	22	19	16	16	20	21	23	25	**26**	251
22 Padang	14	12	14	16	14	12	10	14	16	**20**	**20**	19	181
23 Sawah Lunto	15	13	**20**	**20**	8	11	8	12	7	17	14	18	163
24 Lubu Selassi	20	15	21	22	18	15	13	18	19	**25**	24	24	234
25 Solok	18	14	17	16	13	9	8	13	13	16	16	**19**	172
26 Lubu Sampir	22	18	**23**	21	16	12	12	15	16	18	19	22	214
27 Benkulen	18	14	17	15	15	12	11	13	14	18	19	**20**	186
28 Telok Betong	**19**	17	18	15	11	11	8	10	9	10	12	16	156

RESULTS OF RAIN-OBSERVATIONS.

SUMATRA.

	MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
29 Palembang	283	274	310	282	197	146	103	116	136	231	322	**345**	2745
30 Tebing Tingi	**450**	315	371	335	217	142	124	207	189	234	270	352	3206
31 Lahat	**493**	426	459	363	239	145	116	156	177	202	349	457	3582
32 Bandar	329	274	**344**	332	241	176	143	160	195	226	312	338	3070
33 Djambi	216	215	277	265	192	128	119	138	187	221	275	**283**	2516
34 Ringgat	217	141	226	234	171	135	117	129	168	205	**278**	235	2256
35 Tandjong Buton	**368**	116	258	269	366	305	345	298	231	290	311	282	3439
36 Penang	73	62	58	153	195	139	171	320	**422**	295	195	99	2182
37 Malakka	65	79	105	136	255	237	226	**282**	214	213	176	148	2136
38 Singapore	197	159	164	159	180	179	155	210	182	210	257	**263**	2315
39 Lingga	197	58	166	332	260	259	221	349	227	239	**417**	354	3079
40 Muntok	423	261	334	231	185	126	108	140	132	209	370	**552**	3071
41 Tandjong Pandan	261	123	218	246	245	208	173	172	178	260	322	**387**	2793

	AVERAGE NUMBER OF RAINY DAYS.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
29 Palembang	20	18	19	18	14	11	9	11	10	14	19	**21**	184
30 Tebing Tingi	**24**	21	23	19	16	11	11	13	13	15	20	22	208
31 Lahat	**23**	22	**23**	20	14	10	8	9	11	14	19	22	195
32 Bandar	**23**	20	**23**	21	18	14	12	13	14	17	21	**23**	219
33 Djambi	17	15	18	17	14	11	9	11	12	15	18	**19**	176
34 Ringgat	16	11	17	15	11	10	8	11	13	14	**19**	18	163
35 Tandjong Buton	11	6	12	12	**15**	12	13	12	11	12	13	12	141
36 Penang	—	—	—	—	—	—	—	—	—	—	—	—	—
37 Malakka	—	—	—	—	—	—	—	—	—	—	—	—	—
38 Singapore	14	13	13	13	14	13	11	14	13	15	**18**	17	168
39 Lingga	11	5	14	17	19	17	14	17	9	14	**21**	19	177
40 Muntok	18	13	17	16	12	10	8	10	9	13	19	**23**	168
41 Tandjong Pandan	17	10	16	18	18	15	13	12	12	18	21	**23**	193

BORNEO.

	MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
42 Labuan	221	132	184	213	358	333	282	**386**	275	371	357	352	3464
43 Serawak	**690**	601	257	255	231	223	121	225	198	252	345	653	4051
44 Sambas	**395**	145	247	202	188	229	141	246	138	351	320	347	2949
45 Singkawang	379	211	212	233	213	204	166	301	195	432	438	**494**	3478
46 Bengkajang	397	307	420	280	223	223	159	273	178	**493**	315	358	3626
47 Pontianak	262	179	250	230	248	234	171	237	206	**447**	398	369	3231
48 Sintang	347	283	343	314	292	272	229	327	261	**403**	362	364	3797
49 Muara Teweh	287	295	312	**321**	249	207	148	161	159	223	313	296	2971
50 Buntok	308	272	345	311	263	163	108	123	118	186	331	**354**	2882

	AVERAGE NUMBER OF RAINY DAYS.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
42 Labuan	—	—	—	—	—	—	—	—	—	—	—	—	—
43 Serawak	—	—	—	—	—	—	—	—	—	—	—	—	—
44 Sambas	17	12	14	14	14	13	11	15	10	**21**	18	18	177
45 Singkawang	19	12	15	15	14	13	11	15	12	21	**22**	**22**	191
46 Bengkajang	20	12	20	20	16	12	13	19	13	**26**	24	24	219
47 Pontianak	16	11	15	15	15	13	11	15	13	**21**	20	19	184
48 Sintang	18	16	19	18	16	15	12	16	14	**21**	**21**	**21**	207
49 Muara Teweh	16	15	15	16	15	12	10	11	10	13	17	**19**	169
50 Buntok	17	17	17	16	14	10	8	10	8	12	16	**19**	164

RESULTS OF RAIN-OBSERVATIONS.

BORNEO.

	MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
51 Amuntai	310	287	**363**	225	210	154	113	85	79	124	250	325	2525
52 Barabei	275	305	300	258	241	205	111	127	88	160	289	**350**	2709
53 Pengaron	334	289	**345**	217	242	178	111	109	80	149	242	327	2623
54 Bandjermasin	**315**	303	313	221	173	170	112	113	87	144	221	**315**	2487
55 Kutei	**226**	126	184	222	196	122	130	176	108	184	170	200	2044
56 Bulungan	**529**	330	489	304	441	214	272	342	505	352	124	341	4243
57 Sandakan	496	235	194	109	143	221	145	188	259	244	399	**514**	3147
58 Silam	198	101	92	88	199	238	138	162	242	142	258	**294**	2152

	AVERAGE NUMBER OF RAINY DAYS.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
51 Amuntai	19	18	19	15	13	11	8	10	7	11	15	**21**	167
52 Barabei	17	17	20	16	14	13	9	12	8	12	18	**21**	177
53 Pengaron	**22**	19	**22**	17	17	14	10	10	8	11	17	21	188
54 Bandjermasin	**22**	21	20	16	14	13	10	12	8	12	17	21	186
55 Kutei	**15**	9	12	12	14	12	13	**15**	9	14	14	**15**	154
56 Bulungan	**30**	23	29	17	26	21	21	19	28	25	10	23	272
57 Sandakan	—	—	—	—	—	—	—	—	—	—	—	—	—
58 Silam	—	—	—	—	—	—	—	—	—	—	—	—	—

JAVA.

	MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
59 Java's 1st Point	433	384	313	228	211	235	216	166	140	314	364	**474**	3478
60 Serang	**274**	252	207	122	104	99	79	104	89	133	186	255	1904
61 Tangerang	**316**	294	208	125	109	101	74	48	70	115	162	224	1846
62 Onrust	**385**	300	304	83	78	108	57	66	77	63	92	230	1843
63 Pulu Edam	**538**	330	152	125	69	90	84	59	31	50	91	229	1848
64 Batavia	**353**	304	234	137	98	101	77	31	84	104	129	184	1836
65 Mr. Cornelis	**350**	276	213	164	103	99	76	36	63	115	153	201	1849
66 Buitenzorg	**476**	407	455	428	359	282	263	233	362	415	377	370	4427
67 Purwakarta	**391**	323	368	305	214	185	91	66	114	197	309	291	2854
68 Indramaju	**315**	264	155	158	105	80	55	19	40	62	120	214	1587
69 Cheribon	**411**	354	354	206	143	122	64	25	33	53	168	385	2318
70 Tegal	**318**	285	224	121	85	97	54	38	41	44	120	265	1692
71 Pekalongan	**473**	371	246	142	102	113	76	76	53	96	117	307	2172
72 Kendal	**412**	331	216	157	98	68	48	46	50	111	121	213	1871

	AVERAGE NUMBER OF RAINY DAYS.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
59 Java's 1st Point	**21**	19	17	14	12	11	10	7	8	15	15	**21**	170
60 Serang	**21**	18	17	12	11	10	8	8	8	10	14	17	154
61 Tangerang	**21**	18	15	11	9	7	6	5	6	9	12	16	135
62 Onrust	**19**	17	14	7	7	6	5	5	5	5	7	13	110
63 Pulu Edam	**17**	16	11	7	5	5	5	3	3	3	8	13	96
64 Batavia	**21**	18	16	12	9	8	6	4	6	9	12	16	137
65 Mr. Cornelis	**20**	16	15	11	8	8	5	4	5	9	13	15	129
66 Buitenzorg	**25**	23	24	20	17	13	12	12	15	18	20	22	221
67 Purwakarta	**20**	18	**20**	16	11	9	6	4	7	10	16	18	155
68 Indramaju	**17**	14	14	12	11	7	5	2	3	6	10	15	116
69 Cheribon	**22**	21	18	13	9	9	5	3	3	5	11	20	139
70 Tegal	**17**	15	12	9	7	6	5	2	3	4	8	14	102
71 Pekalongan	**22**	19	16	14	10	8	6	6	5	8	12	19	145
72 Kendal	**19**	16	13	11	7	6	5	5	4	7	11	15	119

RESULTS OF RAIN-OBSERVATIONS.

JAVA.

	MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
73 Semarang	604	**673**	451	345	276	160	101	108	93	181	322	559	3873
74 Kudus	**544**	408	286	143	97	48	36	18	36	85	164	376	2241
75 Pati	**304**	219	201	118	106	69	48	17	37	50	121	276	1566
76 Rembang	**263**	217	178	107	90	115	29	19	25	53	138	193	1427
77 Tuban	**234**	205	174	123	69	68	36	13	25	39	124	212	1322
78 Grissee	**322**	263	225	141	84	59	31	7	16	38	149	291	1626
79 Surabaya	**265**	251	207	141	77	61	26	5	9	51	138	229	1460
80 Bangkalan	250	226	212	250	185	126	76	40	42	82	155	**266**	1910
81 Pamekasan	**251**	239	229	202	126	104	48	15	11	30	170	240	1665
82 Sumenep	254	**282**	234	192	133	115	56	7	5	39	115	267	1699
83 Sidoardjo	355	**373**	339	249	137	83	39	4	0	42	114	249	1984
84 Pasuruan	212	**273**	196	140	88	62	28	6	4	13	67	164	1253
85 Probolinggo	**224**	209	158	104	71	47	21	11	7	10	82	156	1100
86 Kraksaän	277	223	**300**	70	55	35	26	1	4	31	114	193	1329
87 Besuki	307	**314**	190	87	64	52	30	5	2	9	56	179	1295
88 Situbondo	**252**	211	153	66	55	38	18	6	5	28	53	200	1085
89 Banjuwangi	192	192	138	104	126	117	77	63	68	66	70	**202**	1415
90 Buleleng (Singaradja)	216	**224**	198	127	85	46	13	0	2	10	73	176	1170
91 Puger	217	182	202	117	85	66	37	13	60	62	202	**258**	1501
92 Lumadjang	329	268	269	177	133	146	81	34	51	160	298	**369**	2315
93 Blitar	**339**	240	258	196	159	140	48	29	26	106	190	276	2007
94 Kediri	**334**	282	277	167	143	86	34	16	15	60	150	226	1790
95 Madiun	**308**	245	254	212	146	94	45	27	23	67	215	234	1870
96 Patjitan	**409**	294	266	160	146	150	65	37	48	205	362	358	2500
97 Surakarta	**361**	296	317	206	123	106	60	40	50	104	226	240	2129
98 Klaten	**521**	449	433	246	215	132	75	35	40	108	249	322	2825
99 Djokjakarta	**380**	263	331	188	137	116	52	33	31	99	261	295	2186
100 Magelang	445	387	**470**	249	205	149	78	55	62	162	365	393	3020

	AVERAGE NUMBER OF RAINY DAYS.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
73 Semarang	**24**	22	19	16	13	9	6	5	6	11	17	23	171
74 Kudus	**22**	20	18	11	9	5	3	2	4	7	13	20	134
75 Pati	**22**	19	17	12	9	7	4	2	4	6	13	20	135
76 Rembang	**17**	15	11	9	7	7	3	2	3	5	10	15	104
77 Tuban	**15**	13	12	9	5	5	3	1	2	3	7	13	88
78 Grissee	**17**	**17**	13	10	7	5	2	1	1	4	10	16	103
79 Surabaya	**18**	16	14	13	7	6	3	1	1	4	10	16	109
80 Bangkalan	**18**	14	14	15	11	9	5	3	4	6	10	17	126
81 Pamekasan	**19**	16	15	14	10	8	3	2	1	3	9	18	118
82 Sumenep	**17**	15	14	11	9	8	3	1	1	2	9	16	106
83 Sidoardjo	**19**	**19**	17	13	8	6	2	0	0	3	8	16	111
84 Pasuruan	16	**17**	15	9	7	5	2	1	0	1	5	14	92
85 Probolinggo	**15**	**15**	11	8	6	5	1	1	1	1	5	12	81
86 Kraksaän	**13**	**13**	11	5	5	3	1	0	0	2	7	11	71
87 Besuki	13	**14**	8	6	4	3	2	0	0	1	5	11	67
88 Situbondo	**16**	15	10	7	4	4	1	0	1	1	5	14	78
89 Banjuwangi	**14**	**14**	11	8	8	8	6	6	5	6	8	13	107
90 Buleleng (Singaradja)	**16**	15	15	12	6	4	1	0	1	2	7	**16**	95
91 Puger	**15**	12	13	8	7	6	2	2	4	6	12	**15**	102
92 Lumadjang	**18**	15	16	12	9	8	5	3	4	9	15	17	131
93 Blitar	**20**	17	18	14	11	8	4	3	3	8	14	18	138
94 Kediri	**16**	**16**	**16**	9	8	6	2	2	1	4	9	12	101
95 Madiun	**19**	17	17	13	9	6	3	2	2	5	13	16	122
96 Patjitan	**21**	17	16	12	10	8	5	4	5	9	16	20	143
97 Surakarta	**20**	18	18	12	8	6	4	3	3	8	14	15	129
98 Klaten	**23**	21	20	13	12	8	5	3	4	9	14	19	151
99 Djokjakarta	**20**	17	18	12	10	7	4	3	2	7	15	18	133
100 Magelang	**23**	20	22	17	12	9	7	4	5	10	19	22	170

RESULTS OF RAIN-OBSERVATIONS.

JAVA.

		MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
101	Kedong Kebo.	380	278	352	246	137	140	59	45	50	153	351	**384**	2575
102	Gombong	413	337	393	252	231	184	94	55	75	400	**514**	487	3435
103	Banjumas	337	254	346	264	206	150	121	86	84	309	**453**	426	3036
104	Tjilatjap.	321	236	345	274	290	361	306	200	200	443	**521**	386	3883
105	Parigi	178	116	270	237	229	391	489	314	296	**717**	471	273	3981
106	Tasik Malaja	349	401	**549**	333	317	220	161	144	159	327	366	440	3766
107	Pameungpeuk.	223	162	208	189	209	251	254	85	231	**375**	344	258	2789
108	Tjiandjur	268	232	297	245	173	119	116	117	173	247	**315**	257	2559
109	Sukabumi	290	248	399	426	250	219	113	153	124	233	368	**416**	3239

		AVERAGE NUMBER OF RAINY DAYS.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
101	Kedong Kebo.	**20**	17	19	14	10	8	5	4	5	10	17	**20**	149
102	Gombong	20	17	20	16	12	10	6	5	8	15	20	**21**	170
103	Banjumas	22	18	21	18	13	13	9	6	8	15	21	**23**	187
104	Tjilatjap.	20	16	18	18	15	15	13	11	11	18	**21**	**21**	197
105	Parigi	13	12	15	13	14	14	11	11	11	**19**	18	15	166
106	Tasik Malaja	21	19	**22**	17	17	14	11	11	13	17	19	**22**	203
107	Pameungpeuk.	**16**	11	13	12	12	10	8	4	8	13	14	15	136
108	Tjiandjur	**22**	20	**22**	17	13	10	7	8	10	14	18	18	179
109	Sukabumi	20	18	21	20	15	13	10	9	9	15	18	**22**	190

CELEBES.

		MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
110	Kwandang	234	247	181	167	198	191	127	144	81	170	263	**280**	2283
111	Kele Londej	278	152	268	**362**	287	244	194	194	107	185	283	223	2777
112	Limboto.	137	97	132	179	129	101	88	90	47	79	141	**188**	1408
113	Menado	**478**	337	271	205	167	179	125	121	82	125	205	418	2713
114	Kema	145	139	149	**160**	124	156	89	88	60	75	**160**	150	1495
115	Gorontalo	103	86	95	138	106	145	88	118	49	70	117	119	1234
116	Tontoli	263	200	178	130	197	**310**	243	251	185	226	177	246	2606
117	Donggala	**317**	279	102	141	106	152	131	141	16	100	98	122	1705
118	Segeri	719	463	398	244	216	137	93	28	53	125	387	**730**	3593
119	Pangkadjene	**876**	548	420	235	174	165	80	22	35	110	328	760	3753
120	Tjamba	**516**	348	261	207	177	168	124	53	31	82	220	378	2565
121	Makasser	**744**	544	422	130	101	120	51	13	18	47	189	663	3042
122	Alloë	**457**	402	242	95	90	97	50	21	12	54	165	452	2137

		AVERAGE NUMBER OF RAINY DAYS.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
110	Kwandang	13	12	10	10	13	11	8	9	6	10	13	**14**	129
111	Kele Londej	**23**	16	21	**23**	22	22	18	19	10	15	19	19	227
112	Limboto.	10	8	9	12	11	9	7	9	4	8	12	**13**	112
113	Menado	**22**	18	17	15	15	16	10	12	8	11	16	21	181
114	Kema	12	11	11	**14**	10	13	9	9	5	7	13	11	125
115	Gorontalo	9	7	8	10	10	11	8	9	4	6	9	**11**	102
116	Tontoli	14	12	11	10	12	17	13	15	11	**16**	12	14	157
117	Donggala	**16**	13	8	8	11	13	9	15	5	10	6	15	129
118	Segeri	**23**	18	16	15	13	10	7	3	3	7	15	21	151
119	Pangkadjene	**23**	21	17	14	11	9	6	3	3	7	16	22	152
120	Tjamba	**21**	18	17	16	16	14	10	5	3	7	14	20	161
121	Makasser	**25**	21	19	12	9	9	6	3	2	5	12	23	146
122	Alloë	17	16	13	8	8	8	4	2	1	3	10	**18**	108

RESULTS OF RAIN-OBSERVATIONS.

CELEBES.

	MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
123 Bonthain	145	97	110	125	170	**187**	159	53	31	41	75	93	1286
124 Saleier.	239	120	159	198	164	167	80	10	16	31	148	**240**	1572
125 Kadjang.	147	163	168	281	**541**	395	312	76	46	51	98	175	2453
126 Bikeru.	321	276	306	301	**444**	407	372	122	58	60	186	249	3102
127 Balang Nipa	129	118	130	299	**461**	441	382	134	52	105	81	119	2451

	AVERAGE NUMBER OF RAINY DAYS.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
123 Bonthain	**14**	11	12	12	**14**	**14**	10	6	2	4	8	13	120
124 Saleier.	12	10	10	**13**	11	11	6	2	1	3	8	**13**	100
125 Kadjang.	14	14	13	16	**19**	17	14	5	3	4	6	13	138
126 Bikeru.	17	18	18	16	**20**	18	16	9	4	5	11	18	170
127 Balang Nipa	12	11	12	17	**20**	**20**	17	11	5	6	7	13	151

MOLUCCA- AND SUNDA ISLES.

	MEAN AMOUNT OF RAINFALL IN MILLIMETRES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
128 Kajeli	227	210	227	157	143	**242**	190	146	52	60	61	198	1913
129 Ternate	199	201	160	**262**	226	226	137	120	103	167	211	236	2248
130 Batjan.	177	123	164	211	128	179	151	**217**	101	104	124	187	1866
131 Hitulama	151	157	137	225	272	**401**	328	241	117	105	98	140	2372
132 Amboina	153	110	132	271	497	675	**681**	510	227	185	124	142	3707
133 Saparua	103	105	108	267	451	**708**	699	527	240	217	90	135	3650
134 Amahei	127	101	121	191	274	424	537	**538**	241	174	101	109	2938
135 Wahaai	280	**476**	293	234	140	106	113	94	93	107	110	212	2258
136 Banda	269	179	224	359	405	**502**	251	130	153	129	134	258	2993
137 Mansiname	255	**273**	254	265	95	146	126	154	92	106	128	251	2145
138 Dobo	**315**	284	242	257	193	162	236	46	124	107	191	292	2449
139 Tual	327	245	**360**	226	208	227	227	60	47	91	206	350	2574
140 Sejra	223	164	**253**	214	172	92	15	11	6	66	106	231	1553
141 Serwaru.	162	83	164	**286**	211	157	41	9	11	31	62	153	1370
142 Kupang	**423**	404	193	60	47	10	4	3	1	12	85	265	1507
143 Bima	**196**	185	190	153	61	40	17	0	11	28	127	193	1201
144 Negara	181	185	169	166	119	122	55	66	92	176	**207**	217	1755

	AVERAGE NUMBER OF RAINY DAYS.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
128 Kajeli	15	14	**16**	14	12	14	10	9	5	6	7	15	137
129 Ternate	14	13	13	**16**	**16**	15	10	10	9	11	15	15	157
130 Batjan.	12	11	12	14	12	15	12	**18**	9	10	11	14	150
131 Hitulama	12	11	12	15	16	**19**	15	12	7	7	8	11	145
132 Amboina	15	13	15	18	22	**25**	24	23	15	15	11	14	210
133 Saparua	8	8	9	14	18	**22**	21	21	12	13	7	10	163
134 Amahei	8	8	9	11	13	16	17	**19**	11	9	6	6	133
135 Wahaai	18	**19**	16	13	11	11	9	9	8	10	9	14	147
136 Banda	18	14	17	19	**21**	**21**	18	13	10	10	12	17	190
137 Mansiname	12	**14**	**14**	13	9	9	8	9	7	7	10	13	125
138 Dobo	**16**	13	13	15	13	12	10	3	7	7	10	15	134
139 Tual	**21**	18	19	16	14	15	14	9	4	8	10	19	167
140 Sejra	**13**	7	10	9	8	7	2	1	1	3	6	10	77
141 Serwaru.	10	7	10	**13**	11	9	3	1	1	2	6	10	83
142 Kupang	**18**	16	11	5	4	1	1	0	0	1	8	16	81
143 Bima	13	**14**	12	9	5	4	2	0	1	4	11	**14**	89
144 Negara	15	14	15	10	9	8	5	7	6	10	13	**17**	129

CHAPTER III.

TIDES AND TIDAL STREAMS IN THE INDIAN ARCHIPELAGO.

TIDES AND TIDAL STREAMS IN THE INDIAN ARCHIPELAGO.

§ 1.

FORMULA REPRESENTING OSCILLATORY MOTION.

If we suppose the moon to be the only celestial body able to evoke tidal motions of the waterlevel; moreover, that it revolves round the earth in the plane of the equator with a constant velocity and at a distance which always remains the same, i. e. in a circle; in this case — the simplest which may be assumed — an oscillatory tidal motion of the waterlevel would be observed everywhere, with high water recurring after a period of 12.4 hours, or — which comes to the same thing — with high water recurring twice in 24.8 hours, the period of a moon's day.

If now a curve were drawn, the ordinates representing the measured heights of the water and the abscissae corresponding to the intervals of the observations, the curve would exhibit the form of a regular sinusoïde, and it would therefore be possible and convenient to represent the oscillation of the water by the formula:

$$y = A \cos (n\, t - C) \;.\;.\;.\;.\;.\;.\;.\; (1)$$

In this expression y is the difference, at any time t, between the actual height of the water and the mean waterlevel; A the *amplitude* of the oscillation, or the largest deviation — positive or negative — from the average level, and n the *speed* of the tide, or, expressed in angular value, the part of the whole period run through during the unit of time, for which we take the hour of solar time.

In the supposition made above the whole period, or 360 degrees, corresponds to 12.4 hours and, therefore, the speed n is:

$$n = \frac{360^\circ}{12.4} = 28^\circ.984.$$

It makes no difference in the value of n if we take the astronomical definition of the whole period instead of the physical one: the latter — 12.4 hours — is the true period, but we may as well consider 24.8 hours — the duration of a moon's day — as the period, if only it is kept in mind that during that interval the height of the water runs *twice* through all possible values given by the formula (1), so that, in this case, n is calculated by the expression:

$$n = \frac{720^\circ}{24.8} = 28^\circ.984.$$

The largest value of the deviation y is, according to formula (1), equal to A, the amplitude, and this value is attained whenever

$$n\, t - C = o \text{ or } t = \frac{C}{n} \;.\;.\;.\;.\;.\;.\;.\;.\; (2).$$

From this it is evident, that C, the *argument*, denotes the time — as expressed in angular value — elapsing between the moment when we begin to count the time, or t = o, and the moment when high water occurs.

If the argument is divided by the speed of the tide, this interval of time is found as expressed in hours of civil time and if, finally, we take for the origin of time the moment when the celestial body passes the meridian of the place, then C and $\frac{C}{n}$ represent what is commonly called the establishment of the place.

The time of low water is defined by the formula:

$$n\, t - C = 180^\circ \text{ or } t = \frac{C + 180^\circ}{n} \;.\;.\;.\;.\;.\;.\;.\;.\; (3)$$

and the deviation from the mean level is now negative and equal to — A.

In some textbooks the quantity C or $\frac{C}{n}$ is also called the „lagging behind of the tide"; this term is based on the supposition, that the crest of the tidal wave, in the ideal case of an earth entirely covered with water, would be found always exactly under the moon, i. e. that it is only due to disturbing influences when the quantity C differs from zero.

It is of some importance to state, that this conception is not quite right, and that this quantity by no means would be equal to zero if the surface of the earth were wholly covered with water, and that it would vary for different latitudes.

The supposition, based on the equilibrium theory of tides, as if the top of the wave should always be directed to the moon, would hold good only if moon and earth were motionless: but, as soon as the relative position of the two bodies is variable, the problem of tides becomes a dynamical instead of a statical one, and we have to consider the quaestion of tides as a problem of wave-motion, rather than of deformation.

§ 2.

THE ABSOLUTE AND RELATIVE MOTIONS OF EARTH, MOON AND SUN.

In order to come to a clear conception concerning the influences on tidal phenomena caused by the different motions to which sun and moon are subject, it is desirable to recall to the mind of the reader the different kinds of these motions.

a. The earth revolves round its axis in 23.93447 hours: this is the true, sidereal period of revolution, determined by the interval of time between two subsequent passages through the meridian of a fixed star; the rotational velocity of this motion, as expressed in degrees per hour, therefore, is:

$$g = \frac{360^\circ}{23.93447} = 15^\circ.0410686.$$

b. The period, in which the moon makes a complete revolution round the earth, is 27.3216 days (tropical period), corresponding to a velocity per hour of:

$$s = \frac{360^\circ}{24 \times 27.3216} = 0^\circ.5490165.$$

c. The position of the axis of the ellips, in which the moon moves round the earth, is not constant with respect to a fixed line: it makes a complete revolution in 8.85 years; consequently the interval of time, which elapses between two subsequent passages of the moon through the perigee — the anomalistic period — slightly differs from the tropical period; the angular velocity of this motion is:

$$p = \frac{360^\circ}{8.85 \times 24 \times 365.24} = 0^\circ.0046419.$$

d. The earth moves round the sun in 365.2422 days: or, the sun may be considered to revolve in an orbit round the earth with a rotational velocity of:

$$e = \frac{360^\circ}{365.2422 \times 24} = 0^\circ.0410686.$$

The letters g. s, p and e, by which these different principal motions of the celestial bodies are denoted, are chosen as being the initial letters of the Greek words:

Gaïa = earth.
Selènè = moon.
Perigeios = surrounding the earth.
Hèlios = sun.

By means of these principal velocities many problems concerning the relative motions of the three celestial bodies with respect to each other can be easily solved.

Relative velocities are simply found by subtraction or addition of the absolute velocities, according to the motions taking place in the same or in opposite directions.

Some examples may serve as an illustration of the way in which these data may be used in solving some problems.

1. The angular velocity of the sun with respect to a place on the earth's surface is:

$$g - e = 15^\circ$$

and we find for the duration of a whole revolution, or of one solar day:

$$\frac{360^\circ}{g - e} = 24 \text{ hours.}$$

2. The angular velocity of the moon with respect to a point of the earth's surface is:

$$g - s = 14^\circ.4920521$$

and the duration of a moon's revolution, or of one lunar day:

$$\frac{360^\circ}{g - s} = 24.8412 \text{ hours.}$$

3. The velocity of the moon in its orbit with respect to the axis of the ellipse is:

$$s - p = 0^\circ.5443746$$

and the period of a whole revolution, taken from perigee to perigee — the so called anomalistic period — is:

$$\frac{360^\circ}{24\,(s - p)} = 27.5546 \text{ days.}$$

4. The velocity of the moon with respect to the sun, as seen from out the centre of the earth is:

$$e - s = 0^\circ.5490165.$$

Consequently the interval of time elapsing between two subsequent recurrences of the same *phase* of the moon i. e. the synodic period, is:

$$\frac{360^\circ}{24\,(e - s)} = 29.5306 \text{ days.}$$

§ 3.

THE PRINCIPLE OF HARMONIC ANALYSIS AND PARTIAL TIDES AS EVOKED BY VARIABLE DISTANCE.

If now we consider the case that the moon's orbit is still situated in the plane of the equator, but that the satellite moves round the earth, not in a circle, but in an ellipse, it is evident that the simple formula (1) will no longer give a true representation of the new state of affairs.

The amplitude will now be a variable quantity, its value being greater than the average one when the satellite is in its perigee and smaller when it is in its apogee, and the angular velocity will now not be a constant quantity equal to n, but variable and dependent on the distance.

The formula (1) will still represent the *average* tides, but in reality the observed height of the water will exhibit periodical deviations from those calculated by means of the formula.

Now it is obvious, that it would be very convenient if it were possible to keep the formula (1) as an average form in the new analytical expression, which is to represent the new curve, and to introduce the deviation, caused by the variable distance, by means of one or more periodical terms to be added to formula (1).

The problem to be solved may also be put in this way: is it possible to substitute for the tide-evoking body, moving with variable velocity and at variable distance, firstly an imaginary moon, moving in a circle and with a constant velocity equal to the average velocity of the actual moon, and, secondly, one or more fictitious tide-evoking stars, equally revolving round the earth with uniform velocities and in such a way, that the collective action of these stars be identical to that emanating from the original luminary alone.

It *must* be possible to solve this problem, because a compound oscillatory motion of any discription may always be represented by a continuation of several terms of the form (1) and a periodic motion, moving with variable speed, may be dissolved into a series of periodic motions representing regular oscillations of a different kind, but each of which goes through all their changes with uniform velocity.

In § 2 it has been shown, that the interval of time, elapsing between two subsequent passages of the moon through the perigee of its orbit, is 27.5546 days: the condition to be fulfilled by the new fictive star or stars therefore is, that the joint forces, emanating from the luminaries, must attain exactly the same value after the recurrence of 27.5546 days i. e. that the joint forces act in a period of this duration.

The angular velocity of this motion is:

$$\frac{360^\circ}{27.5546} = 14^\circ.49205 \text{ per diem or } 0^\circ.544 \text{ per hour.}$$

The velocity of the tidal motion caused by the moon (scil. the fictitious average moon) is 28°.984; the problem may therefore be solved if we suppose *two* new stars to revolve round the earth, either of them evoking high water twice during the time of their revolution, and moving in their orbit with uniform velocities equal to:

$$N \ldots\ldots\ldots 28^\circ.984 - 0^\circ.544 = 28^\circ.440.$$
$$L \ldots\ldots\ldots 28^\circ.984 + 0^\circ.544 = 29^\circ.528.$$

Each of these two fictitious stars fulfils the condition, that, after the expiration of 27.5546 days, its relative position to that of the moon must be the same as before, because the change in angular value after that period is in each case:

$$0^\circ.544 \times 24 \times 27.5546 = 360^\circ = 0^\circ.$$

If at any time these two stars join their action to that of the moon (perigee), their action will be opposite to that of the satellite 13.7773 days later (apogee) because

$$0^\circ.544 \times 24 \times 13.7773 = 180^\circ.$$

In following the method explained in § 2, the solution of the problem may be found in a more general way by remarking, that the velocity of the moon with respect to a point of the earth's surface, is g — s, and, therefore, the velocity of the tide 2 (g — s), whilst the velocity of the moon with respect to the axis of its orbit is s — p; consequently the velocities of the fictitious stars must be:

$$N \ldots\ldots\ldots 2(g - s) - (s - p) = 2g - 3s + p = 28^\circ.440$$
$$L \ldots\ldots\ldots 2(g - s) + (s - p) = 2g - s - p = 29^\circ.528$$

and the periods of the fictive tides, denoted by the letters N and L, known by the generic name of „elliptical" tides are:

$$\frac{720^\circ}{28^\circ.440} = 25.3167 \text{ hours for N}$$

and

$$\frac{720^\circ}{29^\circ.528} = 24.3832 \text{ hours for L}$$

the same periods representing the intervals between the successive passages through the (upper) meridian of the corresponding fictive stars.

The conception of tides as an effect of the influence of fictitious stars offers the great advantage that the epoch, at which we commence counting the time, may be fixed as the time of the upper passage of the stars through the meridian.

This outcome of the theory is fully confirmed by the results of observations: in fact, if hourly observations of tides are arranged according to periods of resp. 25.317 and 24.383 hours, we find that both periods actually exist in the final sums, if proper care has been taken to carry on the arrangement until possible influences of other periodical movements are eliminated.

In this empirical way the partial tide L has been proved to be everywhere of minor importance than the principal lunar elliptical tide N; but other periods, which — from a theoretical point of view — satisfy the conditions of the problem as well as the periods N and L, viz.

$$2(g - s) \pm 2(s - p)$$
$$\pm 3(s - p)$$
$$\pm 4(s - p) \text{ etc.}$$

are non-existant, or at least so small, that they may with safety be neglected.

§ 4.

OTHER PARTIAL TIDES DUE TO THE SUN'S ACTION AND THE INFLUENCE OF THE MOON'S DECLINATION.

In the same way as the periods of the partial tides N and L have been deduced, the theoretical existence of other tides may be proved, and in every case it is possible to verify the outcome of the theory — if theory it may be called — in an empirical way by a proper arrangement of tidal observations.

It would be out of place to give here a complete theory of the method of harmonic analysis for which a pretty great versatility in the management of rather complicated formulae is required; neither does it seem necessary to deduce, in the way indicated above, *all* kinds of partial tides, which may be proved to exist.

The main object of this introduction is to convey clear notions about the modern way of conceiving and treating the problem of tides, which brings it under the statistical, rather than under the astronomical problems; and furthermore to show in a popular way, in what manner the different partial tides may be considered to originate.

For our purpose it will be necessary and sufficient to calculate the periods of a few more partial tides, which play an important part in the Indian seas.

As is well known, the moon is not the only celestial body which evokes tidal oscillations, but the action of the sun is also observable in the results of tidal observations.

Here, again, for the real sun, which moves with variable velocity and at unequal distances, we substitute a fictitious body, revolving round the earth with a constant velocity equal to the average value of the actual velocity, whilst the deviations of this ideal case are treated as being caused by auxiliary stars.

It is obvious that the formula, which represents the average tide caused by the sun, must be:

$$S_2 \cos(n\,t - C)$$

in which formula n = 30°, because the tide is semi-diurnal and the average velocity of the luminary 15° per hour.

Sun and moon, however, do not move in the plane of the equator, but the sun in that of the ecliptic, which is inclined $23^\circ 1/_2$ to the plane of the equator, and the moon in a plane, which, on the average, coincides with the ecliptic, but in reality oscillates about this average position with maximum deviations on either side of 5°, the period in which this oscillation is completed being about 18.7 years.

When the moon's declination is not zero, the axis of symmetry of the spheroïd is not situated in the equator and, therefore, not perpendicular to the earth's axis, and a consequence of this unsymmetrical position of the spheroïd with regard to the earth's axis must be — as has been shown by *Newton* — that the two high water levels, which occur in the course of a (moon's) day, are unequal.

It is evident, that this state of affairs might be represented in a general way by supposing a diurnal motion, causing high water to occur only once daily, to be superposed on the existing semi-diurnal motion; or to assume the existence of one or more fictitious stars, evoking tidal motions of a diurnal description.

The conditions, which must be fulfilled in this problem, are: firstly, that the forces, emanating from the stars, go through a complete revolution in 13.66 days (or half the tropical period, § 2, 4), because the obliqueness of the spheroïd is the same for opposite signs of the moon's declination so that the effect must be the same for greatest northerly and greatest southerly declination; and, secondly, that the forces must be highest and the diurnal tides strongest (theoretically), when the declination attains a maximum value, and not perceptible when the moon is in the equator, or the declination zero.

If we suppose the declination of the moon to be maximum and northerly at a given moment, the relative position of the earth and the moon will be exactly the same after an interval of 27.3206 days; the velocity of this motion is s, and, the velocity of the moon with respect to a point of the earth being g — s, we find for the velocities of the two stars, which fulfil the conditions:

$$K_1 \ldots\ldots\ldots g - s + s = g \qquad = 15^\circ.04107.$$
$$O \ldots\ldots\ldots g - s - s = g - 2s = 13^\circ.94304.$$

The action of these stars, taken conjointly, fulfils the above mentioned conditions, though the action of either star by itself does not.

For, if we suppose the forces emanating from the stars to coincide at a given moment, say when the declination is maximum and northerly, they wil counterbalance each other after

$$\frac{27.3206}{4} = 6.83 \text{ days}$$

or when the declination is zero, because, at this time, the difference of phases is:

$$6.83 \times 24 \times 2\,s = 180^\circ$$

and they will strengthen each other's action again after the recurrence of 13.66 days, i. e. when the declination is maximum and southerly, because

$$13.66 \times 24 \times 2\,s = 360^\circ = 0^\circ.$$

In order to respresent the tidal influence caused by the variations of the moon's declination, it is, therefore, necessary to add to the series of periodical terms denoted respectively by M_2, S_2, N and L, two more of the form:

$$K_1 \cos(n\,t - C) + O \cos(n^1\,t - C^1)$$

in which formulae n = 15°.04107 and n^1 = 13°.94304, whilst the periods of revolution of the corresponding fictive stars are:

$$K_1 \ldots\ldots\ldots \frac{360^\circ}{n} = 23.93447 \text{ hours}$$

$$O \ldots\ldots\ldots \frac{360^\circ}{n^1} = 25.81935 \text{ hours.}$$

When tidal observations are arranged according to these periods, it is found that the theory is fully confirmed by the facts, so that the partial diurnal tides, denoted by the initials K_1 and O, may be considered as really existant.

By a quite analogous reasoning we find, that the sun's declination gives rise to two diurnal solar tides, the speeds of which are:

$$g - e + e = g \qquad = 15^\circ.0410686.$$
$$g - e - e = g - 2\,e = 14^\circ.9589314.$$

The fictitious star, corresponding to the first speed, moves in its orbit with the same velocity as the star denoted by K_1; its action therefore is subject to the same periodical variations and their joint action is to be considered as emanating from *one* star K_1; consequently the diurnal tide K_1 is called a lunar-solar tide, and the compensation of the tides K_1 and O, which theoretically ought to take place when the moon's declination is zero, is never complete.

The second velocity g — 2 e corresponds to a fictive star denoted by the letter P: it has its origin in solar action alone, and completes its circuit in

$$\frac{360^\circ}{g - 2\,e} = 24.06589 \text{ hours.}$$

Another influence, which may be mentioned here, is that of the declination of the luminaries on the semi-diurnal tides: in fact it is obvious, that these partial tides will be less intense when the axes of the spheroïds are inclined to the plane of the equator, than when they are moving in this plane; if we suppose the declination to be 90°, or the acting body in the direction of the poles, there would be no tidal motion at all.

We easily find for the velocities of the partial tides, which may be regarded as representing these influences, for the moon:

$$K_2 \ldots\ldots\ldots 2\,(g - s) + 2\,s = 2\,g = 30^\circ.0821372$$

and for the sun:

$$K_2 \ldots\ldots\ldots 2\,(g - e) + 2\,e = 2\,g = 30^\circ.0821372.$$

Here again the lunar and solar influences coincide as to duration of period, and cannot be separated, either by mathematical or by empirical methods of analysis; the speed is twice that of the tide K_1, but the time of revolution of the corresponding fictive star, or

$$\frac{720^\circ}{2\,g} = 23.93447 \text{ hours,}$$

is the same; consequently the star K may be considered to evoke *two* tides, one diurnal, causing high water in 23.93 hours, and one semi-diurnal, causing high water twice in the same period.

Both, the theory and the outcome of practical investigations, show that, in calculating these periods K_2, the positive sign only must be used i. e. one fictive star, the motion of which fulfils the conditions, is sufficient to account for the actual phenomena.

By an analogous reasoning and an application of the same methods many more periods might be found, which have been proved to exist, and which, in fact, are traceable in tidal observations.

The result of the complete analysis of tidal forces is, that some twenty partial tides must be taken into account, when the most perfect accuracy is desired.

Practically however the number of partial tides, which have to be calculated, varies with the place where the observations have been made: in and about the regions of the *Indian Archipelago* the amplitudes of the greater part of these tides are so small, that they may safely be neglected.

Even the elliptic tide L is too small to be taken into account and, therefore, in an inquiry into the nature of Indian tides we feel justified in limiting the number of partial tides to seven, viz.

S_2, M_2, K_1, O, P, N and K_2.

In some cases, where hourly observations were available, a tide S_1, giving high water once in the course of a solar day, has been added; this periodical motion however is not a tide proper, but is to be regarded as due rather to meteorological influences f. i. those of land- and seabreezes.

Other tides, of long duration, are denoted by S a and S s a; the former, representing the average annual rise and fall of the water, cannot be considered as a true tide: this motion is neither exactly periodical, nor are the amplitude and the epoch, at which high waterlevel recurs, constant quantities; it is caused, not by tidal forces, but by monsoon-influences; consequently both S a and S_1 may be considered as meteorological tides.

The tide S s a however is a true tide and has its origin in the variation of the sun's declination; this influence being the same for opposite signs of the declination, this partial tide causes high water twice a year, and its speed accordingly is:

$$\frac{720^\circ}{365^\circ.2422} = 1^\circ.9713 \text{ per diem or } 0^\circ.08214 \text{ per hour.}$$

§ 5.

FICTIVE STARS AND EMPIRICAL DETERMINATION OF TIDAL CONSTANTS.

On recapitulating we find, that the irregularly periodic tidal motions of the water may be broken up into a series of regularly periodic constituents.

Each of these partial tides may be represented by an expression of the form:

$$A \cos (n\,t - C).$$

The quantity n, the speed, or the quantity $T = \frac{360^\circ}{n}$, the period, can be calculated by means of well known astronomical data concerning the different motions to which the earth, the moon and the sun are subject.

By means of theory only, however, we cannot predict the value of the amplitude A and the argument C: either quantity has to be empirically determined by arrangement of tidal observations according to the different periods T.

In this way the amplitude can be determined directly, but, in order to come to a practical definition of C, it is convenient to suppose each partial tide to be caused by tide-evoking forces, emanating from a corresponding fictitious star, revolving round the earth in a period T.

The partial tides, as well as the stars, may be conveniently denoted by the same letters, which in this inquiry will be used also, when convenient, for the amplitudes of the tides.

As the origin of time for all partial tides the moment is chosen when the fictitious star passes the meridian; and, when reduced to this origin of time, the argument is a constant quantity and a characteristic for every partial tide, whilst, by international consent, it is denoted by the Greek letter *kappa*; consequently these kappa-numbers — as we propose to call them — are well defined quantities, denoting the time elapsing between the transit of the star and the epoch of high water of the corresponding tide; the stars being imaginary ones, these epochs of transit may be arbitrarily fixed for one special day, or made to coincide, as far as possible, with the transit epochs of actual luminaries, or made to correspond with special relative positions of the three interacting bodies; but, if once these conditions are agreed to, the time of transit of the star is fixed for every other day and for all possible constellations.

For the stars S_2 and M_2 these astronomical conditions are chosen so as to make the transits of the fictive stars to coincide with those of the mean sun (civil time) and mean moon.

For the other fictive stars these conditions are fixed by internationally accepted rules and consequently it is equally possible to calculate any fictive star's time of transit for any past or future day, as to calculate the time of transit for any really existing celestial body.

§ 6.

CHARACTERISTICS OF SOME PARTIAL TIDES.

As has been remarked above, it will be sufficient, when discussing the tides in and about the Indian Archipelagic seas, to limit the number of partial tides to about seven; they are:

1°. S_2, a semi-diurnal solar tide; high water *twice* during the period of 24 hours; the speed is 30° per hour, and the time of high water, recurring each day at the same hour, is found by dividing 30° into the kappa-number.

2°. M_2, a semi-diurnal tide, caused by the moon when considered as stationary in an average position; high water *twice* within a period of 24.84 hours; the speed is 28°.984 per hour, and the time of high water, recurring each succeeding day about 50 minutes *later* than the day preceding, is found by dividing 28°.984 into the kappa-number and adding this constant quantity to the time of the upper or lower transit of the fictive star. The amplitude of this tide is not absolutely constant, but varies slightly in a period of 19 years with the inclination of the plane of the moon's orbit to that of the ecliptic (nutation).

3°. N, a semi-diurnal tide, caused by the variability of the moon's distance and therefore called „elliptical tide"; high water *twice* within a period of 25.3167 hours; the speed is 28°.4397 per hour, and the time of high water, recurring each day one hour and 19 minutes *later* than the day preceding, is found by dividing 28°.4397 into the kappa-number and adding this constant quantity to the time of the upper and lower transits of the fictitious star. The amplitude varies slightly in a period of 19 years with the inclination of the plane of the moon's orbit to that of the ecliptic.

4°. K_2, a semi-diurnal lunar-solar tide, dependent on the moon's and sun's declination; high water *twice* within a period of 23.9345 hours; the speed is 30°.082 per hour and the time of high water, recurring each day 8 minutes *earlier* than the day preceding, is found by dividing 30°.082 into the kappa-number and adding this constant quantity to the time of the upper and lower transits of the fictive star.

The amplitude of this tide varies considerably in a period of 19 years with the value of the moon's maximum declination.

5°. K_1, a mono-diurnal lunar-solar tide, dependent on the moon's and sun's declination; high water *once* within a period of 23.9345 hours; the speed is 15°.04107 per hour, and the time of high water, recurring each day 4 minutes *earlier* than the day preceding, is found by dividing 15°.04107 into the kappa-number and adding this constant quantity to the time of the upper transit of the fictive star.

The period viz. 23.9345 hours, being the same as that of the revolution of the earth round its axis, this tide varies with siderial time in the same manner as a fixed star, which also rises and sets every day 4 minutes earlier than the day preceding. The amplitude of this tide, as dependent on the moon's declination, varies considerably in a period of 19 years, being smallest when the maximum declination is lowest, and greatest when it is highest.

6°. O, a mono-diurnal lunar tide, dependent on the moon's declination; high water *once* within a period of 25.819 hours; the speed is 13°.943 per hour, and the time of high water, recurring each day one hour and 40 minutes *later* than the day preceding, is found by dividing 15°.943 into the kappa-number and adding this constant quantity to the time of the upper transit of the fictive star.

The amplitude of this tide, as dependent on the moon's declination, varies considerably in a period of 19 years, being least, when the maximum declination is lowest, and greatest when it is highest.

7°. P, a diurnal solar tide, dependent on the sun's declination; high water once within a period of 24.0659 hours; the speed is 14°.959 and high water, recurring each day 4 minutes *later* than the day preceding, is found by dividing 14°.959 into the kappa-number and adding this constant quantity to the time of the upper transit of the fictive star.

The characteristics of the tidal system, observed at a given place, are determined by the manner in which these principal tides mix; here again theory cannot give any clue: system of all kinds are met with; at stations situated at relatively short distances the tides may be found to be of an entirely different description (e. g. *Pemangkat* and *Pontianak, de Bril* and *Makasser, Singapore* and *Tandjong Kalean)* and, owing to various obstructions to free progression of the tidal waves. as groups of isles, narrow passages, shallow water etc., the nature of which is as yet but imperfectly understood, some partial tides may disappear and other may preponderate, often in a most unexpected way.

Consequently every partial tide has to be considered as a separate phenomenon, independent of others as to progression and variation of amplitude and kappa-number; but, so long as the configuration of the surrounding seas and straits remains the same, the constants of these partial tides may be considered as true characteristics, distinctive of each place as f. i. latitude, longitude, climate etc.

§ 7.

DIFFERENT TYPES OF TIDES.

Although the partial tides may be mixed up in all possible combinations, it is convenient, in order to come to a clear conception of the mechanism of tides, to adopt three principal types of tides; but it must be kept in mind that nature does not offer perfect types in this matter any more than in others, and that the adoption of schematical forms is to be regarded merely as a method of fixing the attention on salient points with systematical omission of less important facts.

These three types are:

1°. The *semi-diurnal* type, to be found at places where the semi-diurnal tides are preponderant and the mono-diurnal tides practically insignificant as compared to the former.

2°. The *mono-diurnal* type, observable at places where the diurnal tides predominate and the semi-diurnal almost, or even entirely, vanish.

3°. The *mixed* type, occurring at places where either system is equally well represented.

The principal tides of semi-diurnal description being M_2 and S_2, and those of diurnal period K_1 and O, it is convenient to take the sums of the amplitudes of M_2 and S_2 on the one hand, and those of K_1 and O on the other and to assume these quantities as a measure of the importance of the two different systems.

Their ratio viz. $\frac{K_1 + O}{M_2 + S_2}$ may, accordingly, be taken as a criterion under which type the tides at a given place are to be classified and we might class under the first type all places where this ratio is from zero to 0.25, under the second where it is 1.5 to infinite, and under the third type where it is found to be between 0.25 and 1.5.

The following places might be mentioned as well defined examples of the three types:

Of the semi-diurnal type: *Dover, Brest* and *Ostend,* where the above mentioned ratio is resp. 0.04, 0.05 and 0.06; *Mergui* (0.09), *Dublat* (0.10) and *Kidderpore* (0.11) in *British India; Panama* and *Eastport* in *America* where the distinctive ratio is resp. 0.08 and 0.09.

Of the diurnal type: *Pulu Langkuas* in *Gaspar-strait,* where the ratio is 30.81, *Bawean Isle* in the *Java-sea* (8.07) and generally all places on the shores of this sea; *Cat Island* in the *Gulf of Mexico* (5.17), *Freemantle* (3.44) on the west coast of *Australia* and *Copenhagen* (1.56).

Of the third, mixed type: *Bushire* (1.22), *Aden* (0.86) and *Cochin* (0.93) in *British India; Buenos Ayres* (0.71); *Port Townsend* (1.39) in *America; Honolulu* (1.07); and, finally, a great number of places in the Indian Archipelago, such as *Surabaya* (1.05), *Amboina* (0.84), *Gorontalo* (1.03) etc.

§ 8.

CHARACTERISTICS OF TIDES OF THE FIRST OR SEMI-DIURNAL TYPE.

At places of the first type the partial tides M_2 and S_2 are the most important; if we suppose, as a first approximation, the M_2 tide to be the only one, which has to be taken into account, high water, in this case, would be found to follow the time of the moon's transit at a constant interval of time. This interval is called the port-establishment of the place, but in reality the luni-tidal interval is never a constant quantity, because at those places where M_2 is dominant, the solar tide S_2 is also pretty strong and the stronger it is, the more the time elapsing between the moon's transit and the epoch of high water will be found to differ from the interval calculated by means of the port-establishment; consequently the establishment must receive a correction for this „fortnightly or semi-mensual inequality" before being used as the luni-tidal interval.

On days of new and full moon both luminaries pass the meridian at the same time, viz. at noon; the kappa-numbers being k_s and k_m, the difference of phases between the two motions at that moment, is $k_s - k_m$; the relative velocity of the two tides is:

$$30° - 28°.984 = 1°.016 \text{ per hour}$$

or 24°.384 per diem, the phase of either tide therefore will be the same:

$$\frac{k_s - k_m}{24°.384} = (k_s - k_m)\ 0.04 = a \text{ days}$$

from noon of the date of full and change of the moon; at this period both tides very nearly coincide forming springtide; the amplitude is $A_s + A_m$, i. e. the sum of the amplitudes; the range i. e. the difference between high- and low-water-level, $2\ (A_s + A_m)$, and the time-of-clock of high water is determined by the kappa-number of the solar tide S_2 or — if expressed in units of time — $k_s/_{30°}$.

The establishment, as defined by the time-of-clock of high water at full or change of the moon (vulgar establishment) therefore is not a quantity of which the physical interpretation can be easily given; but the time of high water at springtide is a well defined physical constant (corrected establishment).

If, finally, we arrange tidal observations according to lunar hours, we find the true difference of phases between the motion of the fictive star and that of the corresponding tide; this quantity, identical with the kappa-number of M_2, might be called the scientific establishment.

The constant difference between the kappa-numbers of the tides S_2 and M_2, denoted by a, is generally called the „age of the tide".

The correction for the fortnightly inequality — or the sun's influence — to be applied to the establishment in order to obtain the true luni-tidal interval for a given date, is, consequently, dependent on the age of the tide on the one hand and on the relative importance of the solar tide S_2 with respect to the lunar tide M_2 on the other.

Now the quantity S_2/M_2 is f. i. 0.32 at *Liverpool* and 0.52 at *Portland Breakwater*, 0.13 at *Washington* and 0.56 near *Kerguelen Island*, 0.61 at *Malta*, 0.35 at *Chittagoong* and 0.53 in the *Mergui Archipelago*, whilst for the age of the tide, as measured by $k_s - k_m$, we find at *Malta* 7°, *Helder* 67°, *Panama* 57°, *Newport* 19° and *Washington* 46°; consequently it is impossible to give general rules for the application of this correction and, if more than a rough approximation is wanted, each case has to be treated by itself.

The influence of the tides N and K_2 contributes essentially to the intricate state of affairs: although, as a first approximation, it may be assumed that the amplitude of N is equal to the fifth part of the amplitude of M_2 and that the difference between the kappa-numbers $k_m - k_n$ is about 20°, there are many places where this assumption can hardly be accepted as in conformity with the facts; so f. i. the ratio of amplitudes N/M_2 is 0.27 near *Aden* and *Kathiwadar* and not more than 0.10 near *Ceylon*, 0.32 at *Port Louis (Mauritius)* and 0.18 at *Kidderpore*, 0.17 at *Philadelphia* and 0.42 at *Buenos Ayres*, 0.15 at *den Helder* and 0.25 at *Toulon*, whilst for the quantity $k_m - k_n$ we find: 31° at *Cochin*, — 11° at *Trincomalee (Ceylon)*, 2° near *Vizagapatam* in *British India*, 29° at *Port Townsend* and 3° near *Honolulu*, 12° at *Halifax* and 34° at *Portland* in *N. America*, 9° at *Portland Breakwater* and 34° near *Heligoland.*

With the same mental reserve it might be stated, that the partial tide K_2, to the influence of which the well known great equinoctial tides are to be ascribed, generally shows about the same kappa-number as S_2, whilst the ratio of the amplitudes K_2/S_2 is about 0.29, but there are many exceptions to this rule.

From this description of tides of a well marked semi-diurnal description, in the mechanism of which the mono-diurnal constituents — although never entirely absent — play an unimportant part, it appears that, at places where tides of this type are observed, the port-establishment is a quantity which, when no other information is available, may be very useful: but it has to be kept in mind that it never gives more than a rather rough approximation of the time of high water and that the different formulae, given with a view of obtaining more correct information, are not to be regarded as of general application.

§ 9.

CHARACTERISTICS OF TIDES OF THE SECOND OR DIURNAL TYPE.

The salient point of tides of the second type is, that the time of high water does not follow that of the moon's transit at a constant interval; consequently there is no port-establishment and, apparently, no relation between the moon's position with respect to the meridian or between the moon's phases and the phenomena of tides can be stated to exist.

The principal tide K_1 varying its phase with siderial time, it may be assumed — as a first approximation, analogous to the assumption of a port-establishment in tides of the first type — that high water recurs at a constant interval after the transit, not of the moon, but of any fixed star we may choose. For the sake of simplicity however it is convenient to suppose a fictitious star to pass the meridian at noon at a fixed date, for which is chosen the 21st of June (1).

Consequently the kappa-number of K_1 gives the time-of-clock of high water for this date, and for every following day about 4 minutes have to be subtracted, or 2 hours for every month, so that — as a first approximation — it may be said that, at places of the second type, high water is observed subsequently at each hour of the day

(1) In reality this date oscillates about June 21st in a period of 19 years, but practically it may be assumed to coincide with the date of the sun's greatest northerly declination.

during a period of a year, and, if on the 21st of June it is high water e. g. at 2 p. m., it will be high water on the 21st of December at 2 a. m.

This, however, is only as rough and unsatisfactory a way of predicting as the assumption of a constant port-establishment at places of the first type, because the tide O periodically strengthens and counteracts the tide K_1. This tide plays the same part with respect to K_1 as S_2 to M_2, and for that reason spring- and neaptides occur at places of this type as well as at stations where semi-diurnal tides predominate.

The fictive stars corresponding to either tide K_1 and O pass the meridian at the same moment on the day of the moon's greatest declination; the kappa-numbers being k_k and k_o, the difference between the phases on this date is $k_k - k_o$ and, the relative velocity of the tides being:

$$15^\circ.041 - 13^\circ.943 = 1^\circ.098 \text{ per hour}$$

or 26°.352792 per diem, springtide occurs:

$$\frac{k_k - k_o}{26^\circ.353} = a_1 \text{ days}$$

after that of the moon's maximum declination; a_1 is a quantity which, in this system, is fully analogous to the „age of the tides" in the semi-diurnal system.

Springtide in this diurnal system recurs after

$$\frac{360^\circ}{26^\circ.353} = 13.66 \text{ days}$$

or 26.74 times during the period of a year.

At places where semi-diurnal tides prevail springtime recurs after 14.765 days or 24.74 times a year, so that e. g. the number of spring- and neaptides in the *Java-sea* exceeds by 2 those observed during that period in the *North-sea*.

On account of the influence of the tide O, the retrograde motion of the time of high water is not always 4 minutes per diem; the deviations from this first approximation are, of course, dependent on the ratio of the amplitudes of K_1 and O but, in a general way, the diurnal tides might be described in the following terms.

From springtide to a few days before neaptide high water recurs each day about half an hour *later;* after this the time of high water shows a retrograde motion with increasing velocity, this being about 1.5 hours per diem near the epoch of neaptide. Three days after neaptide this retrograde motion ceases, and the time of high water again slowly retards until springtide, when the retardation is about nil.

This description however holds good only when the ratio of the amplitudes O/K_1 is 0.50 as, on the average, is the case in Indian sea's; but here, again, no more than for the ratio of the amplitudes S_2/M_2, can a general rule be given and the values found for this ratio greatly diverge for different seas and even for different places situated on the shores of one sea.

At *Singapore* the ratio is 1.00, at *Pemangkat (China-sea, west coast of Borneo)* 1.21, at *Amboina* 0.72 and near *Karimon Djawa* 0.17, near *Galle (Ceylon)* 0.28 and at *Bushire (British India)* 0.69, at *South Georgia* 1.94, at *den Helder* 1.60 and at *Copenhagen* 0.18.

At springtide the amplitude is $A_k + A_o$, and the time of high water now corresponds to that of the tide K_1; at neaptide the amplitude is $A_k - A_o$ and the respective ranges are, therefore, $2\ (A_k + A_o)$ and $2\ (A_k - A_o)$ or, the differences between the ranges at spring- and neaptides are equal to 4 times the amplitude of the tide O.

This state of affairs is complicated by the influence of the tide P: this tide causes high water each day 4 minutes *later* than the preceding day; its relative motion with respect to K_1 (which causes high water 4 minutes earlier every day) is 8 minutes per diem or 4 hours per month.

At the time of the summer solstice both tides coincide as to phase and therefore strengthen each other; at the epoch of the winter solstice the difference of phases is $6 \times 4 = 24$ hours, consequently they coincide again; but in March and September the difference of phase is 12 hours and they counteract each other.

At places of the diurnal type therefore tides are less intense near the periods of the equinoxes and strongest in midsummer and midwinter, whereas at places of the first, semi-diurnal type the tides are — owing to the influence of K_2 — on the contrary intensified in March and September and lessened in June and September.

Another point of difference between the two tides is, that the semi-diurnal tides practically do not show any variation in the 19 yearly lunar period (except K_2), whereas the diurnal tides (except P) are considerably affected by the same and are much stronger when the moon's maximum declination is 28° than when it is 18°.

§ 10.

TIDES OF THE THIRD OR MIXED TYPE.

From this discussion of the characteristics of tides of the two types it follows, that no serviceable description can be given of the state of affairs when the types are mixed. The way in which the occurrence of high water varies from day to day depends entirely upon the relation between the amplitudes of the two systems, and this relation varies in manyfold ways according to the place.

About the epoch of springtide of the one system, the influence of the other will be less, and, inversely, at neaptide of the one the other predominates.

In a general way it may be stated, that, owing to the synchronismus of the tides K_1 and P in July and December, the mono-diurnal régime prevails during those months, whilst, on the other hand, the semi-diurnal tides are enfeebled by the opposite phases of the tides S_2 and K_2.

In September and March the obverse obtains, the semi-diurnal tides are strengthened by the tide K_2, the diurnal tides lessened by the counteracting tide P, whilst, moreover, in those months springtide of the semi-diurnal tides mostly coincides with neaptide of the diurnal tides; this is the explanation of the well known fact, that at many places, where about July and December it is high water once in 24 hours, high water occurs twice a day during the equinoctial months: but here again, there are exceptions to this rule, when, as at *Makasser*, the „ages of the tides" for the two systems considerably differ.

The summarizing tables given in the last paragraph of this chapter exhibit for different places, distributed all over the world, the distinctive factors mentioned above by which the tides at those places are characterized.

These tables show better than any further discussion, that the tides observed in European seas are „abnormal in their simplicity", that tides of the first and second pure types are pretty rare, and that those of the mixed type are most numerous.

At all those places apparent irregularities in the time of high water are observed; the assumption of a port-establishment mostly leads to quite erroneous results and there is no simple rule by the application of which even an approximate prediction of the time of high water may be arrived at.

The only way of describing these tides is to indicate the salient points of either system, and a prediction of tides is to be obtained only by combining again the results of the analysis, by which the intricate phenomenon has been been broken up into its different constituents.

§ 11.

OBSERVATIONS OF TIDAL PHENOMENA.

Nothwithstanding the warning in the classical essays on tides of WHEWELL, in which it is clearly stated, that the existence of a port-establishment is by no means a fact which may a priori be admitted, the idea still prevails with practical seamen, that the tidal motions of the waterlevel must follow everywhere, in a more or less reliable degree, the transits of the moon.

This misunderstanding — as it may be called — has given rise to a „circulus vitiosus" from which it seems difficult to escape.

On the one hand the seamen, whose task it is to gather informations in different parts of the world and to forward them to organizing corporations such as the Admiralty, the German Hydrographical Institute and the Bureau des Longitudes, are apt to transmit bona fide but erroneous statements concerning tides and tidal streams, and on the other hand, the Institutes mentioned above, by accepting and publishing data of this kind without critical inquiry, promote instead of prevent inaccurate notions, which, in their turn lead to inaccurate observations and false conclusions.

It cannot be too strongly recommended to young men, part of whose duty in future will be the observation of natural phenomena, to recognize the fact, that observations of this kind are valuable only when they are conducted in an objective manner i. e. when they are made quite independently of preconceived impressions.

Gathering exact observations is one thing and drawing conclusions from them is quite another, and whenever these different stages of any inquiry are intermixed, there is a great probability that the result will prove to be worse than useless because misleading.

It is impossible f. i. to solve by direct observation the old-standing problem of the influence of the moon on the weather, because there is no guarantee whatever, that the two facts, which have been observed at the same time, in casu the phase of the moon and the change of the weather, are linked together by causal connection or by — what comes to the same thing — a natural law.

The proper way of solving such problems is to carefully gather a great quantity of observations, made in a systematical way without any suggestive preconception and afterwards to discuss these data by means of appropiate methods, or, better still, to leave this discussion to the different Institutes established with a view of organizing scientific inquiries of this kind, and, if this be done, the result will show, that the influence of the moon on the weather, if any, is far too small to be of any practical use.

This fundamental error is generally committed in observing tides and tidal streams: in guides and directories we find f. i. not once, but throughout the whole work, statements of the following kind:

„The tides in this port generally cause high water once in 24 hours: it is high water full and change at etc."

Now it is evident, that, if the first statement is true, the second must be false, because high water occurs at fixed hours on days of full and change of the moon only at those places, where the tidal régime is decidedly semi-diurnal and if it is high water on the day of new moon at a given hour, it will certainly not recur at the same hour when the moon is full.

Another statement often found is that the tides are dependent on the monsoons, which of course is impossible, there being no connection between true tidal motions and atmospheric influence; at places where mono-diurnal tides predominate the tides are dependent on the season but not on the monsoons.

As to tidal streams we generally find in the above mentioned books the information, that the flood sets to the one, and the ebb to the opposite point of the compass: this statement is again based on the conception formed beforehand, that such a simple relation between tidal motions in vertical and horizontal direction mostly — if not always — exists, whereas it is well known that, on the contrary, the relation between the two phenomena is very seldom of this simple description and that at some places tides and tidal streams must be regarded as quite independent phenomena.

Observations of tidal phenomena, therefore, should be made in an objective manner by carefully noting the date and the time of observation, the height of the waterlevel and the direction — and if possible the strength — of the current; the record of such observations, especially if they are as numerous as circumstances allow, will be always very valuable, whilst simple statements generally are useless.

The best, because the most complete, way of gathering data concerning vertical tidal motions is by the establishment of a self-registering tide-gauge, which gives automatic and continuous records, but local circumstances often prevent the erection of an instrument of this kind and, moreover, the cost of acquisition and establishment is rather heavy and it wants constant supervision and careful management.

The next best method of observing tidal oscillations is not — as is generally admitted — the observation of the time of high and low water: on the one hand it is not easy to determine the exact moment of extreme height, because the waterlevel about this time remains almost stationary for rather a long period (especially so where tides are diurnal) and, on the other hand, it is scarcely possible to obtain exact observations at nighthours; moreover, the working out of observations of this description, even if they are carefully made, offers great difficulties and, finally, it is this method of observation which has given rise — and still continues to do so — to a great number of erroneous statements to be found in directories and tide-tables.

Because in some European seas the simple observation of the time-of-clock of high water at a day of full or new moon affords a rough but useful approximation to the port-establishment of the place, it is generally admitted that the same reasoning obtains at other places as well and it does not appear that, in this respect, WHEWELL's warning (¹) and the more recent endeavours of DARWIN, BÖRGEN e. a. to divulge more exact notions about the nature of tides have produced the effect, which they should have made.

In the tide-tables issued by the Admiralty, the German Hydrographical office and the Bureau des Longitudes the same time-honoured erroneous informations annually recur; and for many places, where tides are almost exclusively mono-diurnal, data are given under the heading „port-establishment" which have quite another meaning, or even no meaning at all.

For *Tandjong Kalean* f. i. we find 8 hours, for *Gasper-strait* $2^h\ 30^m$, for *Bawean Isle* 8—10 hours, for *Batavia* 10 hours and for *Makasser* $4^h\ 40^m$; whereas at all these places a port-establishment does not exist.

Most probably a correct observation of high water on a date of full or change of the moon, but an incorrect preconception of this datum as a port-establishment has given rise to suchlike erroneous informations in otherwise excellent works of reference.

From these remarks it follows, that the prescript given in the British tide-tables (Appendix n⁰. 1, p. XX) viz. That

„the best way to disentangle the phenomena of the tides when we are observing them at any place is to refer the time of high water and low water to the time of the moon's transit; and to do this *at once*, whilst the series of observations are going on"

must be regarded as an inadequate one for the majority of places and as valuable only when the tides are of the first type i. e. in the *North-sea* and at some places in *British India*.

The best plan of gathering data concerning tidal phenomena at those places where a self-registering tide-gauge cannot be established, is to erect a simple gauge and to note the height of the water and the direction of the current at fixed hours, which can be chosen so, that the observations do not interfere with other work and can be carefully made; of course the value of the series greatly increases with the number of observations; hourly observations are the most useful, but it is not absolutely necessary that they should be made at nighthours or near the epochs of high or low water; the number of observations however should never be less then three a day.

It is certainly not advisable to refer the data, thus obtained, to the time of the moon's transit unless the daily curve can be proved to be almost purely semi-diurnal; but when it exhibits great differences between two successive maxima and minima, or when the curve shows high water once a day only, the data should rather not be worked out an board ship.

The country where tidal observations are organized in the best way is *British India*, where a great number of self-registering tide-gauges are established: some of them are intended to be permanent (scil. for a period of at least 19 years) whilst at other stations the observations are carried on for five years only, after which term the gauge and the meteorological accessories are erected at other stations.

At present tidal constants for 34 British Indian stations are well known.

The results of this methodical and gradually proceeding method of research leave nothing to be desired and constitute a monumentum aere perennius for the Survey of India Department.

The annual expenditure however for cost of establishment, management and reduction is considerable and would rise to a still greater amount if this method were followed in the *Indian Archipelago*, where tides of the most different description are represented and, owing to the enormous variety in coast-lines, the characteristics of tidal oscillations often considerably differ at places situated under apparently the same conditions.

In this region, therefore, the knowledge of the principal partial tides at a great number of stations is to be preferred to a minute inquiry into details and accordingly the plan has been adopted to erect self-registering tide-gauges at a few places (*Tandjong Priok, Tjilatjap, Padang, Amboina* and *Menado*) and to establish as many stations of the second order as possible, where eye-observations are being taken at three or more fixed hours per day.

(¹) Tide-tables for the British and Irish ports etc. page IX: Treatise on tides, art. 12:
„But if the tides are very irregular, this is not the case and then the establishment of the place is of no use, or, rather, there is no proper port-establishment".

At places where the tides are well marked the principal constants may, after this method, be determined with an accuracy which leaves nothing to be desired, and, consequently, the twofold aim to which all tidal investigation tends, viz. the prediction of tides and the construction of cotidal lines, may be arrived at in this way as well as by the establishment of self-registering instruments.

The advantages are, that tidal data of practical and scientific importance are obtained at a minimum of costs, within a short time, and for the most isolated places; the drawbacks are: firstly that a proper control of the observations, whilst carried on, is impossible so that their reliability can be judged only *a posteriori* by the comparison of different series; and secondly, that the partial tides of small amplitude cannot be determined with sufficient accuracy unless several series of observations, extending over many years, are taken into account.

The observations of tidal streams, made by daily recording their direction at three or more fixed hours, are, of course, much more incomplete than the observations of the tides proper.

The nature of *vertical* tidal oscillations can be fully investigated if a sufficient number of observations, taken by means of a tide-gauge, are available; but the characteristics of *horizontal* tidal oscillations cannot become fully known unless *two* quantities are observed viz. direction and velocity.

Measuring the velocity of a current, however, is a difficult business and good series of observations of this kind are extremely rare; in the *Indian Archipelago* only two series of complete current-observations have been made, viz. at two points in strait *Surabaya*, but they are very valuable because hourly records have been registered and the series extend over a period of a full year.

At other places merely the direction of the currents has been observed by means of buoy fettered to a fixed point.

It is obvious that, in this way, only the principal movements of the currents can be deduced, because an influence may be traceable in the intensity of the stream and not in its direction; the results of the investigations concerning the nature of these phenomena, therefore, show the percentages with which the different partial tidal-currents may come to evidence, which, of course, for the weaker ones only happens when it is slack water of the strongest currents.

Another consequence of this incomplete mode of observing is, that the records are discontinuous, the transition from positive to negative values being abrupt; in deducing the constants from these records, however, they have to be treated as if they were of a continuous kind, by drawing a sinusoidal curve through the ordinates.

Hence sometimes for the amplitudes, as expressed in percentage of frequency, a number greater than 100 % is obtained.

The tidal constants, given in this work, have been calculated at the Observatory at *Batavia* after a method, which need not be explained here and concerning which the reader is referred to the papers published by the author in the „Proceedings of the Indian Institute of Engineers".

§ 12.

THE INTERPRETATION OF TIDAL CONSTANTS.

As has been mentioned above, it is generally impossible to give a verbal description of tidal phenomena at a given place, unless the tides are of an abnormal simplicity, such as are observed in the *North-sea* and the *Java-sea*.

Consequently it is advisable to deduce the most important characteristics at once from the tidal constants and not to make a vain effort at treating an intricate phenomenon as if it were subject to a simple law.

As the physical meaning of the different constants has been fully explained above, an example, showing how the principal characteristics of the tides may be easily deduced from the constants, may be given here.

Tandjong Kalean, Northern entrance of *Banka-strait*, Long. 105°.1 E. from Gr., Lat. 2°.0 S.

a. Tidal constants, deduced from observations taken at 9 a. m., 2 p. m. and 6 p. m., extending over 4 years.

	A.	k.
S_2	11.9 cm.	241°
M_2	25.3	186°
K_1	94.6	159°
O	54.6	93°
P	26.7	151°
N	5.4	166°
K_2	3.5	244°.

The distinctive features of the tides at this place are decidedly mono-diurnal, because the ratio:

$$\text{Ampl.}\ \frac{K_1 + O}{M_2 + S_2} = \frac{149.2}{37.2} = 4.01$$

hence spring- and neaptide occur once in 13.66 days.

On the average the rise of the water above mean water-level at springtide of the diurnal tides is:

$$\text{Ampl. } (K_1 + O) = 94.6 + 54.6 = 149.2 \text{ cm.}$$

and the range (springrise) accordingly 298.4 cm.

The mean height at neaptide between high and low water is:

$$\text{Ampl. } (K_1 - O) = 94.6 - 54.6 = 40.0 \text{ cm.}$$

Neaprise, i. e. the height between high-water mark of neaptide and mean low-water mark at springtide is:

$$\text{Ampl. } 2 \times O = 109.2 \text{ cm.}$$

The age of the diurnal tide is:

$$\text{Kappa-number } (K_1 - O) = 159° - 93° = 66°$$

or $66 \times 0.04 = 2.64$ days; i. e. it is springtide 2.64 days after the day when the moon's declination is maximum, and neaptide 2.64 days from the day when the moon passes the equator.

About June 21st the time of high water at springtide is, in angular value, 159°, or, in hours of mean solar time (vide table III*b* K_1) $10^h.6$ p. m.; about December 21st high water at springtide occurs at $22^h.6$ or at $10^h.6$ a. m.

The kappa-numbers of K_1 and P being about the same, the tides will be considerably stronger in July and December than in March and September.

During the former months the rise of springtide above mean water-level is:

$$\text{Ampl. } (K_1 + O + P) = 94.6 + 54.6 + 26.7 = 175.9 \text{ cm.}$$

and in the equinoctial months:

$$\text{Ampl. } (K_1 + O - P) = 94.6 + 54.6 - 26.7 = 122.5 \text{ cm.}$$

whilst at neaptides the rise of the water will be respectively:

$$\text{Ampl. } (K_1 - O + P) = 94.6 - 54.6 + 26.7 = 66.7 \text{ cm.}$$

$$\text{Ampl. } (K_1 - O - P) = 94.6 - 54.6 - 26.7 = 13.3 \text{ cm.}$$

Consequently at neaptide in March and September the semi-diurnal tides M_2 and S_2, which in June and December play an unimportant part, considerably gain in importance; springtide of these partial tides occurs:

$$\text{Kappa-number } (S_2 - M_2) = 241° - 186° = 55°$$

or $55 \times 0.04 = 2.20$ days after full and change of the moon, and causes the water to rise above mean water-level:

$$\text{Ampl. } (M_2 + S_2) = 25.3 + 11.9 = 47.2 \text{ cm.}$$

In March and September the moon is new or full when she passes the equator and, the ages of the two tidal systems, viz. 2.6 and 2.2 days, being about the same, springtide of the semi-diurnal coincides with neaptide of the mono-diurnal tides.

Moreover about this period the semi-diurnal tides will be strengthened by the small tide K_2, so that the range will be, of the semi-diurnal tides:

$$2 \times \text{Ampl. } (M_2 + S_2 + K_2) = 2\,(25.3 + 11.9 + 3.5) = 81.4 \text{ cm.}$$

whilst of the mono-diurnal tides it is only $2 \times 13.3 = 26.6$ cm.

Consequently the tides in the equinoctial months exhibit a more or less semi-diurnal character, especially so two or three days after full and change.

The average time of high water of these semi-diurnal tides occurs 186° or (vide table III*b* M_2) 6.4 hours after the time-of-clock of the moon's transit; the time of high water on the date of springtide (of these tides) is:

$$241°/30° = 8 \text{ p. m. and } 8 \text{ a. m.}$$

Other characteristics of the tides at this place are: that the ratio of the amplitudes $S_2/M_2 = 0.47$, of the amplitudes $O/K_1 = 0.58$, and that the tides are considerably stronger in years when the moon's declination attains a maximum value (1894, 1913) than when it is minimum (1903, 1904 and 1922).

During the former period the average range at springtide is (vide table V):

$$2\,[94.6 \times 1.11 + 54.6 \times 1.18] = 339 \text{ cm.}$$

whereas in the latter years it only amounts to:

$$2\,[94.6 \times 0.88 + 54.6 \times 0.81] = 255 \text{ cm.}$$

or, at the period when they are most intense, the tides will be about 33 % stronger than during the years when the moon's declination attains its minimum value.

b. Tidal streams.

	A.	k.
S_2	21 %	150°
M_2	45 „	74°
K_1	84 „	68°
O	46 „	3°.

A positive sign denotes that the current sets to the eastward (i. e. entering the strait), a negative sign that it sets to the westward (flowing out of the strait).

From these constants it appears that near *Tandjong Kalean* the solar semi-diurnal tidal stream sets to the eastward along the *Banka* coast at 150°/30 = 5 a. m. and 5 p. m. and, accordingly, with maximum velocity to the westward at 11 a. m. and 11 p. m.

The lunar tidal stream sets, with a maximum force, to the east 74°/28°.948 = 2.6 hours (table III*b* M_2) and to the west 8.8 hours after the transit of the moon.

The strongest partial tidal current, however, is the K_1 stream, which about June 21st runs with maximum velocity to the eastward at 68°/15°.041 = 4.5 p. m. (vide table III*b* K_1) and to the westward at 4.5 a. m., whereas in December the reverse obtains.

If we compare the constants of the tidal streams with those of the tides proper, we find the differences between the corresponding kappa-numbers:

S_2	241° — 150°	=	91°
M_2	186° — 74°	=	112°
K_1	159° — 68°	=	91°
O	93° — 3°	=	90°.

The meaning of these figures is that, in all cases except one, the differences of phases between tides and tidal streams is almost exactly 90° i. e. that, each partial tide being considered separately, the moment of maximum velocity of the stream happens at the time of the greatest rise and fall of the water and that the turning point of the streams corresponds exactly with the point of time when the height of the water (due to the partial tide) is greatest or lowest.

Although the kappa-numbers of the partial tides, considered separately, show, that near this place the flood always sets to the east and the ebb to the west, it is still possible that, at times, the water will be seen to flow westward with a rising tide or eastward when the water is falling.

This apparently paradoxical statement, viz. that a phenomenon taken as a whole follows another law than each of its constituents when taken separately, finds its reason in the fact, that, although the mono-diurnal regime of tidal streams preponderates, as well as the mono-diurnal system of tides, they do this to an unequal extent.

For the coefficient of „diurnality" (if this term may be admitted) we find:

for the tides:

$$\text{Ampl. } \frac{K_1 + O}{M_2 + S_2} = \frac{149.2}{37.2} = 4.01$$

and for the streams:

$$\text{Ampl. } \frac{K_1 + O}{M_2 + S_2} = \frac{130}{66} = 1.97.$$

Consequently the regime of tidal streams is much more (twice as much) semi-diurnal than that of the tides, and if we compare the two curves of the tides and of the streams, without breaking them up in their periodical constituents, we bring together two phenomena of different kinds which should not be examined together, and, in the subjective case, we at times will find the above mentioned divergencies from the general law, which holds good for the integrating factors and not for the whole.

The results of the observations exhibit the fact, that near *Tandjong Kalean* a pretty strong perennial current of a frequency of, on the average, 20 % runs to the westward throughout the whole year, except in February and March when a slight tendency to easterly currents can be observed; these perennial and seasonal currents combine with the tidal streams and, accordingly, throughout almost the whole year the westerly currents exceed the easterly ones in strength as well as in duration.

§ 13.

CHARACTERISTICS OF TIDES IN THE INDIAN ARCHIPELAGO.

Before we endeavour to give, in general outlines, a description of the principal features of tides in the *Indian Archipelago*, and venture to offer an explanation of the way in which they may be imagined to originate, it is desirable to recall to the mind of the reader some principal points relating to waves and wave-motion.

In mid-ocean, on board ship, tidal waves cannot be observed, their wave-length being much too great to exhibit to the eye at the same time a top and a hollow.

Only waves of a relatively short period and small wave-length are experienced, such as are caused by an object thrown into the water, by the motion of the vessel, or by the wind.

All those waves are characterized by their wave-length (the distance from crest to crest or from trough to trough) being small with respect to the depth of the water. In this case the particles of the water move in circles and the velocity of the wave depends on the wave-length and is independent of the depth.

If the velocity of progression is denoted by V, the length of the wave by L, and the period by T, these three quantities are mutually related by the following expressions, as given by Schott:

$$V = 1.25 \sqrt{L} = 1.56 \text{ T.}$$

$$L = 0.64 \text{ V}^2 = 1.56 \text{ T}^2.$$

$$T = 0.80 \sqrt{L} = 0.64 \text{ V.}$$

If, for example, the length is 36 metres, the velocity is 7.5 metres per second; if the length is 64 metres, the velocity increases to 12 m. p. s. whilst the periods are resp. 4.8 and 6.4 seconds.

The stronger the wind, the greater the length of the waves, the longer the period and the greater the velocity of propagation.

From the fact that the particles move about in circular orbits, it follows that the greatest velocity of horizontal translation happens at the moment of the extreme positions or, rather, that a particle has its greatest horizontal velocity in the direction in which the wave proceeds when the crest of the wave is under it and, inversely, that it swings backwards with maximum velocity when in the hollow of the wave.

The energy of these waves is relatively small because the motion is limited to the superficial layers; still, owing to the great inertia of the mass and the small internal friction, the movement holds on a considerable time after the wind has ceased to blow. This wave-motion is called the swell, and the waves, no longer influenced by variable wind-gusts, become regularly periodic.

TIDES AND TIDAL STREAMS IN THE INDIAN ARCHIPELAGO.

As the wave, on approaching the shore, proceeds in shallow water, the character of the motion alters altogether: the particles do not move any longer in circular orbits but in ellipses, which are the flatter the nearer they are to the bottom, and very near the shore the superficial part of the waves travels faster than the particles near the bottom.

The front of the wave now becomes steeper and steeper, thus giving rise to the phenomena observed on the beach and known under the names of breakers, surf, billows etc., which gradually wear away by expending their energy in overcoming frictional resistances, in a rolling to and backwards of different objects, in altering the coastlines, in excavating rocks etc.

The tidal waves, as evoked by the forces emanating from the moon and sun, are of a quite different description.

Originally the wave is forced to follow the motion of the moon with a velocity independent of the depth of the sea; but there is hardly a place on the surface of the earth where such a *forced wave* could follow an undisturbed track for any considerable time and, as soon as obstacles to its forced way are encountered, the wave motion assumes the form and follows the laws of a *free* wave.

Consequently, in studying the phenomena of tides we have to consider the tide-waves mostly as free waves, which are free to move in all directions; in fact tide-waves are found to progress not only from E to W, but as frequently from W to E, from N to S or from S to N.

The length of a tide-wave is always very great with respect to the depth of the sea, from which it follows that the velocity of the wave depends — not on the wave-length — but on the depth of the sea.

The rate of progression f. i. of the M_2 wave is the same as that of the K_1 wave, the length of which is twice that of M_2: the velocity of propagation and the depth of the sea are related to each other by the simple relation:

$$V = \sqrt{g p}$$

in which V is the velocity of the wave, g the acceleration of a body falling freely under the action of gravity or 9.806 metres per second, and p the depth as expressed in metres.

If we assume for the *Java-sea* a depth of 50 and for the *Banda-sea* a depth of 3000 metres, we find for the velocity with which all tide-waves propagate: in the former sea 22 and in the latter 542 metres per second.

The wave-length can be deduced from the velocity and the period by means of the formula:

$$L = V T.$$

We find f. i. for the length of the

M_2 wave	*Java-sea*	273	metres.
	Banda-sea	6732	"
K_1 wave	*Java-sea*	528	"
	Banda-sea	13008	"

In mid-ocean the tidal elevation is very small and the particles move about not in circular, but in elliptical orbits, which are always very flat; apparently therefore their energy is much less than that of the wind-waves, but in reality it is much greater, because the horizontal motion, which at the surface exceeds the vertical motion more than a thousand times, is the same throughout the whole mass of the water from the surface to the bottom.

From this description of tidal oscillation in deep ocean it follows that there the velocity of the tide-currents is greatest at the moment when the extreme positions are attained, or i. o. w. that the time of high and low water coincides with the epoch of strongest tide-stream.

These currents, however, are never strong in mid-ocean: for the M_2 tide and a tide-range of 1.3 metres Börgen calculates the velocity of the stream to 65 m. per hour, or to 400 m. during the rise of the water i. e. in 6.2 hours.

As the waves approach the coast, the energy, radiated (if this term may be used in analogy to light and radiant-heat phenomena) by deep ocean, has to accomodate itself to a space which gradually diminishes: hence the energy apparently augments and the tidal swelling, as well as the tidal currents, considerably increase by the shallowness and convergence of the shores; the same obtains in triangularly shaped bays and inlets to an even greater extent owing to the convergence in a horizontal plane as well as in a vertical one.

At the same time, the tidal elevation ceasing to be small with respect to the depth of the water, the orbit in which the particles flow ceases to be symmetrical and, the position of the ellipse becoming inclined, the tidal current is no more strongest at the time of greatest elevation or depression, but when the water-level is at its average height.

Another effect of the progression in shallow water is that it gives rise to partial tides of short duration, viz. the so called shallow-water tides, which at some stations cause a check to the descent of the water *(Ymuiden, Portland Breakwater, Moulmein)*; at others a secondary rise occurs shortly after high water (the „*agger*" near *den Helder)*, or a secondary minimum shortly after low water *(Hoek van Holland)*.

When, however, the depth becomes insignificant with respect to the elevation, the theory is no longer to be regarded as a safe guide in discussing the observed phenomena and it is very difficult to introduce the friction as a factor in the formulae.

On the other hand good series of tide-observations, embracing tides proper and streams at a great number of well chosen stations along the line of wave-progression (for which tidal constants have been calculated), are still very rare, so that it is impossible, either by theory or by the discussion of empirical data, to give a satisfactory explanation of all tidal phenomena as observed at shores, in inlets, bays and rivers.

As in the case of ordinary waves, and in fact of all kinds of motion, it is friction which ultimately converts the energy of tidal motion into mechanical work and heat.

Now frictional resistance increases directly as the relative velocity of the fluid and the surface against which it flows; consequently we arrive at the important conclusion, that tides of short period wear off in a shorter time than tides of long duration, and that the formation of shallow-water tides is to be regarded as a powerful agent in this process.

Furthermore we may conclude from the preceding considerations, that all obstacles to the free progression of tidal waves will tend to equalize the amplitudes of partial tides of nearly the same period.

The periods of S_2 and M_2 f. i. are almost equal, but as the amplitude of M_2 generally is about twice that of S_2, the velocity of the corresponding swinging motions (vertical and horizontal) is also twice as great, and consequently the M_2 tide wears off by friction at a greater ratio than the tide S_2 until ultimately both tides have the same amplitude, or i. o. w. until the ratio of the amplitude of S_2 to that of M_2 has become equal to unity.

If now we suppose a sea, too small or too shallow to have tides of its own, communicating with the ocean by a channel, the tidal elevation and horizontal motion will generally show a considerable increase up to a certain point of the channel, where the rise and fall is greatest.

If we proceed farther, the tidal pulsation gradually decreases and at the same time the general character of the tides changes because the semi-diurnal tides are worn off gradually and the diurnal tides accordingly commence to preponderate.

There is however no reason why the horizontal motion of the water should always decrease at the same rate as the vertical fluctuation, and it is quite possible, that at the one end of the channel the relation between tidal streams and tidal elevation will be found to be quite different from that at the other end.

At *Sembilangan* in *Surabaya-strait* f. i. the tides proper are principally mono-diurnal, but the streams are chiefly semi-diurnal, whilst near the funnel at the eastern entrance of the strait both, tides and streams, are mainly of a semi-diurnal kind.

Another striking example is afforded by *Sunda-strait*: here the tides follow the regime of the ocean and are chiefly semi-diurnal; but they are rather weak and the streams are mainly diurnal and evidently caused by the water being pumped in and out during the period of the tide K_1, owing to the mono-diurnal fluctuations prevailing in the *Java-sea*.

Within the precincts of the *Indian Archipelago*, therefore, and as well in and near the channels and passages by which the oceanic tide-waves enter, we may expect to find everywhere the relations of tides to streams of a very intricate description and different for various places according to local circumstances.

The most instructive example, exhibiting the way in which tides alter their character in proceeding through narrowing sea-rivers is afforded by *Madura-strait*.

South of *Java*, at *Tjilatjap*, the tides bear a pretty normal i. e. oceanic character, the ratio of the diurnal to the semi-diurnal tides being 0.42; but just after having passed *Bali-strait* they have entirely altered their qualities and at *Meinderts-droogte* near the northern entrance of the strait, we find for the above named ratio r = 1.66.

As the wave proceeds westward in *Madura-strait*, the semi-diurnal tides (as measured by the sum of the amplitudes M_2 and S_2) increase from 35 cm. near *Meinderts-droogte* to 69 cm. at *Zwaantjes-droogte*, whilst the diurnal fluctuation increases only from 59 cm. at the former to 67 cm. at the latter station.

The tides, therefore, at first assume a more semi-diurnal character due to the influence of the narrowing estuary and, accordingly, the ratio r decreases from 1.66 at the entrance to 0.97 in the middle of the strait.

It still continues to do so, but to a smaller extent, near *Pasuruan*, *Karang Kleta* and *Gading*, where we find the ratio r to be about 0.80; but as the wave proceeds farther on, the fluctuations of small period (M_2, S_2, N, K_2) evidently wear off whilst the diurnal waves practically remain the same, so that near *Surabaya* the ratio increases to 1.05 and, finally, on pushing their way up *Surabaya-strait*, the semi-diurnal waves are gradually annihilated and the ratio r augments to 2.13 near *Sembilangan* and even to 8.67 near *Oedjong Pangka* at the northern entrance of *Surabaya-strait*.

The diurnal tides K_1 and O however hardly show any trace of wear, the fluctuation near *Sembilangan* being the same (72 cm.) as at *Pasuruan* and *Surabaya*.

At the same time the ratio of the amplitudes S_2/M_2 increases: we find 0.42 near *Meinderts-droogte*, 0.52 at *Zwaantjes-droogte*, 0.66 at *Surabaya* and 0.87 at *Sembilangan*.

The same process of degeneration or alteration takes place to a greater or less degree wherever tidal waves enter the Archipelagic seas, and the degeneration will be more perfect, or the „diurnality" more exclusive the narrower and more frequent the passages through which the wave has to force its way and the shallower the water.

Normal (oceanic) values of the ratio $\frac{K_1 + O}{M_2 + S_2}$ are only to be found where the *Indian Ocean* has free acces f. i. at the west coast of *Sumatra*, the south coast of *Java* and at *Kupang*.

At the northern point of *Sumatra* near *Segli (Atjeh)* the ratio r is 0.32, but, on proceeding into *Malakka-strait*, the character becomes more and more diurnal and at *Singapore* we find for the ratio 0.52, whilst at *Tandjong Kalean* it has increased to about 4.

Probably owing to the influence of the Micronesian Island-groups *(Ladrone Isles, Caroline Isles, Marshall Archipelago* et al.) the tide-wave, originating in the *Pacific Ocean*, on reaching the east coast of *Halmaheira* has already acquired abnormal qualities so that at *Gamsungi* (east coast *Halmaheira*) we find for the ratio's $K_1 + O/M_2 + S_2$ and S_2/M_2 respectively 0.76 and 1.29.

Here, therefore, the coefficient of diurnality is pretty large and the S_2 tide even greater than the M_2 tide, which seems difficult to explain.

In the shallow *Java-sea* the different waves, which enter it from various sides, have lost their semi-diurnal constituents altogether and tides are almost exclusively mono-diurnal; but, the main wave proceeding from E to W (as is shown in the Charts of *cotidal lines*) it is difficult to understand how the waves coming out of *Makasser-strait*, from the *Sunda-sea* and filtering through the passages of the *Sunda Isles* (all of which are *not* exclusively mono-diurnal) might give rise to tides of such a peculiar character as observed in the *Java-sea*.

Consequently, if an explanation of these tides has to be given, another cause than the mere degeneration owing to frictional influences must be admitted to act: this can hardly be any other than interference, which might be supposed to come into play in the following manner: the M_2 wave, which egresses from *Makasser-strait*, shows opposite phases to the M_2 wave which finds it way through the *Sunda Isles* and probably also to that travelling westward from the *Sunda-sea*; but the mono-diurnal K_1 waves, which meet in this region of the *Java-sea*, are of nearly equal phases; hence, south of *Makasser* within a certain precinct, the M_2 tides are, owing to the superposition of the oscillatory motions, annihilated, whilst the mono-diurnal tides are, on the contrary, strengthened.

If now we consider the waves proceeding westward in the *Java-sea* as emanating from this region, an acceptable explanation is offered of the tides in this sea and their rather abrupt occurrence on the northern coast of *Madura Isle*.

In this supposition, therefore, the region between the *Java-* and the *Sunda-sea* is to be regarded as acting in the way of a screen, or rather as a grating, by which the undulations of short duration are kept back, whilst those of long wave-length are freely transmitted and even intensified.

It would be out of place to give in this work more than a general sketch of the prominent traits of the tides in the *Indian Archipelago* and of the way in which they may be supposed to originate.

The object of this work is chiefly to forward a fund of reliable facts rather than to offer explanations of the observed phenomena, which, on the one hand are still difficult to give and, on the other hand, may be left to the reader.

There is one point however, which must be noticed here because it concerns, in a general manner, the way in which tide-waves are propagated in these Archipelagic seas.

It has been mentioned above that the velocity of wave-progression depends on the depth of the sea and by means of the formula $V = \sqrt{gp}$ the velocity in the *Java-sea* has been calculated to be 22 and in the *Banda-sea* 542 metres per second.

In the *Java-sea*, therefore, the rate of progression is very slow and consequently we may expect to find tides of quite different phases within relatively short distances of each other, or i. o. w. the *cotidal lines* in this region and in the equally shallow *China-sea* very crowded.

In the eastern parts of the Archipelago the velocity of the waves is about 25 times greater than in the *Java-sea* and, accordingly, tides in this region must bear a much more uniform character and the cotidal lines follow each other at great distances.

§ 14.

COTIDAL LINES.

All investigations into problems concerning physical geography naturally culminate in the projection of maps exhibiting the state of affairs at the same moment of time and at every point of the globe, or at least for a considerable area.

The track along which a barometric depression travels, the way in which the elements of terrestrial magnetism vary in quantity and direction at different points of the earth's surface, the general direction of the marine-currents — all those problems can be grasped only when a general review of the available data is given in synchronous charts.

The first condition, which must be fulfilled by the data, is, that they should be of exactly the same kind or i. o. w. that they should be strictly comparable among themselves; when this condition is not satisfied the question is not put in an intelligible manner, and the answer can hardly be expected to be as distinct as we want it to be and it must remain ambiguous.

Consequently the definition of cotidal lines, as generally given: „cotidal lines are lines connecting all the points at which high water is simultaneous" cannot be regarded as being quite devoid of ambiguity because, as has been explained above, the occurrence of high water is determined by different laws at different places and in various regions.

The lines f. i. connecting all places where actually high water occurs at the same moment in the *Java-sea* would have a quite different meaning from those exhibiting the same facts along *Sumatra's* west coast.

If therefore we accept the definition as given above, we may be able to give maps of cotidal lines for some limited precincts, but it would be quite impossible to project charts of this kind for the whole world.

If we want to study the difficult problem of tide-progression it is, therefore, absolutely necessary not to mix the different waves, which must be regarded as propagating each in their own way and independently of each other, and to project as many charts as there are different kinds of wave-motion.

Consequently the selection of port-establishments as convenient data for the construction of tidal maps is not recommendable: in regions as f. i. the *North-sea*, where tides bear a pretty uniform character and the mono-diurnal tides can (for all practical purposes) be neglected, charts exhibiting lines of equal port-establishments have in fact lead to useful results; but as soon as the tide proceeds into the *Danish* seas, where the diurnal tides predominate, the meaning of those lines cease to be intelligible.

On the *Atlantic* coasts of *North-America* the lines of equal port-establishments certainly exhibit in a useful manner the way in which the waves progress, but in the *Mexican Gulf* they cease to do so, whereas at the west coast of *America*, and in fact over the whole area of the *Pacific*, the port-establishment is of no use, owing to the preponderance of the diurnal tides.

Cotidal lines, therefore, must be defined as: lines connecting all those points where, at a given moment, and for a given partial tide-wave, the phase of the wave-motion is the same.

Maps exhibiting lines of this description may be given for any area, and, in fact, for the whole world whilst, when the data are sufficiently complete, there will be no discontinuity in the drawings.

Now, as each different wave-motion, as brought into prominence by the analysis of the records, must be regarded to follow its own laws of propagation, it would strictly be necessary to project as many maps as there are distinct partial tides; this however is unnecessary, nor would it be feasable for want of data, and it will, provisionally at least, be sufficient if three charts are given of cotidal lines viz. for the semi-diurnal tides, which are best represented by the tide M_2, for the diurnal tides, the principal representative of which is the tide K_1, and for the tides of long duration, for which the lunar monthly tide might be chosen.

It must be kept in mind however that when maps of this discription are given, the meaning of the term cotidal lines is quite different from that which originally haw attached to it by WHEWELL and afterwards by BERGHAUS, who proposed the name ISORACHIDS (see STIELER's Hand-atlas and MÜLLER's Kosmische Physik 3rd. ed.), and KRÜMMEL who, in his „Ozeanographie" suggests to call them *Homoplerols*.

Cotidal lines, as given in this work, bear no relation to the time of actual high water; the points connected by these lines may actually show quite different tides, but they give a true picture of the progression of the waves and, in order to preclude misunderstanding concerning this point, the lines in our maps are not marked by hours, but by degrees.

Owing to want of data concerning tides of long duration, only two maps are given in this work viz. those of the tides M_2 and K_1: they must be regarded as a first essay and will, no doubt, have to be completed and altered in many respects when once the tidal work, which is still in progress, is finished.

In the western parts of the Archipelago the data are sufficiently numerous to leave no doubt about the motion of the principal waves; it is obvious f. i. that in the *Java-sea* the waves proceed westwards — the old hypothesis, that they originate in the *Java-sea*, becoming untenable.

In the eastern parts however the available data are still very spare and at many places where waves which have travelled over different pathways come into play, as f. i. near the southern entrance of *Makasser-strait* and in the *China-sea*, the lines will probably continue to bear a somewhat hypothetical character, even when as many observations have been taken as circumstances allow.

As cotidal lines are to exhibit the state of the wave-motion at the same point of time, the kappa-numbers which bear relation to *local* time, must be corrected for the difference in longitude between the place of observation and a central station.

For this station *Batavia* has been chosen, so that, for all places situated eastward from *Batavia*, for a difference of 15° one hour has to be subtracted from the time as given by the kappa-number divided by the speed of the corresponding tide.

The longitude of *Batavia* being 106°.9 E. of Gr.; if that of any other tidal station be denoted by L, the kappa-numbers of M_2 and K_1 are reduced to *Batavia* time by addition of respectively:

$$M_2 \text{ tide} \ldots\ldots \frac{28°.984}{15°}(106°.9 - L) = 1.932\,(106°.9 - L).$$

$$K_1 \text{ tide} \ldots\ldots \frac{15°.041}{15°}(106°.9 - L) = 1.003\,(106°.9 - L).$$

§ 15.

TIDAL PREDICTION.

As has been shown in the foregoing paragraphs the mere giving of port-establishments, as is done in different tide-tables, is, for the majority of places, an inadequate method of exhibiting the characteristics of a tidal system and of no possible use for the prediction of tides.

Thoroughly reliable tide-tables can be made only by making use of the data obtained by the method of analysis and by calculating the epoch of high water for every day by means of intricate computations or a tide-integrating machine.

In this way the tide-tables for every year are calculated for the *British-Indian* ports, which are issued by the „Survey of India Department"; it is obvious, however, that tables of this kind can be given only for places where the traffic is sufficiently developed to justify suchlike annually recurring labour and expenditure; and, even if this would be of no account, tide-tables on this scale, given for places all over the surface of the earth, would constitute quite a little library, which it would be difficult to keep up to date.

It is, therefore, of some importance to proffer a general method of tide-prediction by which it is possible to find, by simple means, the tide-curve for any date at a given place for which tidal constants are known.

It is quite unnecessary that this method should aim at the greatest accuracy, because, on the one hand if a vessel has to enter a road or harbour, it is not the question to know exactly the time of high water or the precise height of the water-level but, in a general way, about what time tides are favourable for different purposes, and, on the other hand, it is impossible to predict the exact height of the water owing to the variable influences of the meteorological pseudo-tides S_1 (diurnal variation) and Sa (annual variation).

These tides — if tides they may be called — are almost exclusively dependent on wind, weather, and currents and, though by means of statistics an average value of their amplitudes and kappa-numbers may be deduced, the individual values will exhibit considerable divergencies from the one year to the other; consequently it is impossible to predict for any day the *absolute* height of the water with respect to a fixed mark.

The *relative* height of the water however i. e. the rise and fall during a certain day, as dependent on the influence of the true tides, may be predicted with accuracy.

On this account it seems to be of little use to take into consideration the tides of minor importance and sufficient if a method be given of drawing a curve showing the principal characteristics of tidal motions for any date or any series of days.

Besides, such a method might essentially contribute to the conveyance of clear notions concerning the way in which the principal constituents will combine, because it gives an ocular demonstration of the causes of variation of tidal phenomena from the one day to the other.

Such a method, to prove of practical use, must fulfil the following conditions:

1°. the operations must be of the simplest description;

2°. astronomical data, which have to be searched after in almanacs, are to be excluded;

3°. the data, on which it is based, must be given in such a way as to be applicable for a long series of years, in the way everlasting almanacs are.

If such everlasting tables, from which tidal curves can be calculated, were given for seldom visited regions, and annual tables for places where traffic is considerable, the problem of tides would be solved in a most practical manner for nautical purposes, whereas it is, for the above-mentioned reasons, obvious that the use of port-establishments leads to useful results only at places where tides of the first type occur.

In § 5 it has been stated that the point of time, at which the fictitious stars pass the meridian of the place, can be calculated for any past or future day as well as for actual stars.

Table I exhibits this time of transit through the meridian of *Greenwich* on January 1st of the years 1890—1924 for 6 fictive stars, the star S_2 always passing the meridian at 0 hours or at noon, at which moment we commence counting the time after astronomical practice.

The values, as given in the table, are expressed in parts of a circle; they show how many degrees the star has still to run through in its orbit at noon of January 1st before it passes the meridian.

Given the time of transit for January 1st, it is easy to calculate that for any other date by adding to the values given in Table I the phase-variation in 24 hours multiplied by the number of days past since January 1st.

These phase-variations, — a quantity which we call s, are evidently found by taking 24 times the difference between the speed of the star-motion and that of the mean sun, viz. 24 (30° — n) for the tides M_2, N and K_2, and 24 (15° — n) for the tides K_1, O and P.

At the headings of tables III*a* these quantities s are given, where as in the table itself we find, for every date of a common year, the result of the above mentioned multiplication of s with the number of days past since the beginning of the year.

In the case of a leap year we have, for any date after February 28, to take the next day, for which reason the value for December 32nd also appears in the tables.

By means of tables I and III*a*, therefore, we can find, for any date of the years 1890—1924, at what time (as expressed in angular value) the fictive star under consideration passes the meridian.

At noon of August 28 f. i. of the year 1900 the M_2 star will have to go through 4° + 67° = 71° before passing the meridian of *Greenwich;* if we want to know the time of transit, as expressed in units of time (hours), we have to devide 71° by the *speed* of the star.

This reduction of angular value to time is facilitated by tables III*b*, in which the quotients are given of any number of degrees and the speeds of the various stars.

At the above-mentioned date the star passes the meridian at 2.4 hours after noon, or at $2^h\ 24^m$ p. m.; from the same table III*a* it appears that the whole period is 12.4 hours; consequently the lower passage of the star will occur at 2.4 + 12.4 = 14.8 hours of the 28th or at $2^h\ 48^m$ a. m. of the 29th of August.

When, on adding the angular values of tables I and III*a*, we find a value greater than 360°, this quantity must be subtracted for the same reason as we commence anew counting the time of a clock when its hand has passed the 12th hour.

If now we desire to calculate the time-of-clock of the star's transit for any other place on the globe, a correction for longitude must be applied; the mean sun is the only star which passes the meridian of all places at the same moment of local time.

This correction is given in table II for every difference in longitude of 10°; for the stars M_2, N and O this correction occasionally amounts to a considerable amount, for the stars K_1, P and K_2 however it may be safely neglected.

If e. g. we want to know the time-of-clock when the stars M_2, K_1 and O pass the meridian of *Batavia* on August 31 of the year 1898, we find (Longitude 106°.9 E.):

Table I 1898	M_2 = 205°	K_1 = 161°	O = 48°
Table II (correction)	—7°	0°	—7°
	198°	161°	41°
Table III*a* August 31	140°	121°	19°
	338°	282°	60°
Table III*b* (time)	11.7^h	18.7^h	4.3^h

The M_2 star on the given date passes the meridian at $11^h\ 42^m$ p. m., the K_1 star at $18^h\ 41^m$ or at $6^h\ 42^m$ a. m. of September 1, and the O star at $4^h\ 18^m$ p. m.

By the use of the tables I, II and III many other problems concerning the motions of the fictive stars can be easily solved, f. i.

1°. On which dates of February 1910 will the mean sun and moon pass the meridian at about the same time at *Cochin;* or i. o. w. on which date will the moon pass the meridian of that place about noon.

Cochin is situated in 76°.3 Long. E. of Greenw.

Table I, 1910	M_2 = 129°
Table II (correction)	—5°
	124°

The M_2 star passes the meridian at 0^h, or at noon, on those dates of February for which the table III*a* shows the nearest values to:

360° — 124° = 236° or on February 9 and 24.

Consequently on those dates the moon will be full or new; which of the two cannot be decided by the data of the tables.

2°. On which date of September 1899 the stars K_1 and O pass the meridian of *Batavia* at the same time.

Table I, 1899	K_1 = 160°	O = 308°
Table II (correction)	0°	—7°
	160°	301°

If we call x the angular values given in table III*a* K_1 and y those given in table III*a* O, the motion of both stars will be about synchronous on those dates of September for which:

160° + x = 301° + y or x — y = 41°.

On calculating the 30 differences of the corresponding values x and y, as given in tables III*a*, we find that they come nearest to 41° on September 2 (50°) and 16 (31°); accordingly on those dates the point of time at which the stars pass the meridian of the place will be about the same, and (§ 9, p. 178) the moon's declination will be greatest; whether northerly or southerly is left undecided.

3°. In a note to § 9 it has been stated that, on the average, the star K_1 passes the meridian at noon on the 21st of June, but that the exact date oscillates about this date.

From table I we see that the extreme values of the time of passage on January 1 are 160° in 1899 and 179° in 1908.

In these years, therefore, the star passes the meridian at noon on those dates for which in table III*a* K_1 we find:

160° + x = 360° x = 200° June 12

179° + x = 360° x = 181° July 2

From this it follows that, owing to the influence of the nutation of the earth's axis, the star K_1 passes the meridian at noon on June 21 only in the years when the moon's declination is greatest (28°.5 in 1894 and 1913), or smallest (18°.5 in 1904 and 1922), but that in other years this date oscillates between June 12 and July 2 as extreme values.

4°. By the same method we find that, on the average, the motion of the star K_2 is synchronous with that of the mean sun on March and September 21: this happens in 1894 and 1913 when the moon's declination attains its extreme values; from tables I and III*a* K_2 we find that in these years the star K_2 passes the meridian at noon on the dates determined by the equation:

158° + x = 360° x = 202° March 22, September 21

but in 1899 and 1908 the dates of synchronism with the sun-tide are:

140° + x = 360° x = 220° March 13, September 11

178° + x = 360° x = 182° April 2, October 1.

In the same manner the date of synchronism of the motion of the elliptical tide N with that of the M_2 tide, of the three stars M_2, S_2 and N or M_2, S_2 and K_2, or of the four stars M_2, S_2, N and K_2 can be easily predicted by means of the tables.

With the time of transit of the stars known for any date we may choose, it is evident that also the time of high water, corresponding to each partial tide, can be easily calculated at any place for which tidal constants are given.

We simply have to add the kappa-number of the tide to the angular value taken from the tables for the corresponding star, and, by means of the tables III*b*, we immediately find the time-of-clock at which high water of that partial tide occurs.

In § 12 the kappa-numbers are given for *Tandjong Kalean;* we have found above the time of transit of the stars M_2, K_1 and O at *Batavia* on August 31, 1898 (the difference in longitude between the two places need not be taken into account):

	$S_2 = 000°$	$M_2 = 338°$	$K_1 = 282°$	$O = 60°$
Kappa-number	241°	186°	159°	93°
	241°	164°	81°	153°
Table III*b* (time)	$8^h.0$	$5^h.7$	$5^h.4$	$11^h.0.$

On the date in question, therefore, the tide S_2 will cause high water at $8^h\ 0^m$ p. m. and a. m., the tide M_2 at $5^h\ 42^m$ p. m., the tide K_1 at $5^h\ 24^m$ p. m. and the tide O at $11^h\ 0^m$ p. m.

All problems relating to the *tides* and the way in which they mix can thus be as easily solved by means of the tables I—III as those concerning the motions of the *stars*, e. g.:

On which dates in September 1920 will it be springtide of the semi-diurnal and neaptide of the diurnal tides at *Tandjong Kalean?*

In working out this example it must be kept in mind that 1920 is a leap year so that, if we seek the values corresponding to a given date after February 28, we have to take the *next* date and, inversely, if — as in this case — we have to find a date corresponding to an angular value, we must take one day *earlier* than that shown by the table.

Table I, 1920	$S_2 = 000°$	$M_2 = 247°$	$K_1 = 163°$	$O = 87°$
Table II (correction)		—7°		—7°
		240°		80°
Kappa-number	241°	186°	159°	93°
	241°	66°	322°	173°

Consequently the tides S_2 and M_2 will coincide on those dates for which (table III*a* M_2):

$66° + x = 241° \qquad x = 175°$ Aug. 31, Sept. 15, Sept. 30.

The tides K_1 and O will be in opposition on those dates for which:

$$322° + x - (173° + y) = 180° \qquad x - y = 31°$$

which happens on September 2, 14 and 28°.

In the beginning, the middle and the end of September 1920, accordingly, the semi-diurnal tides will come into evidence by the double reason that they are intensified, whilst at the same time the mono-diurnal tides are enfeebled.

If we calculate the time of high water of the tide K_2 for August 31, September 15 and September 30, we find respectively:

Table I, 1920	148°	148°	148°
Kappa-number	244°	244°	244°
	32°	32°	32°
Table III*a* K_2	241°	211°	182°
	273°	243°	214°
Table III*b* (time)	$9^h.1$	$8^h.1$	$7^h.1$

From this it appears that, on September 15 (243°), the K_2-tide will run almost exactly parallel to the S_2-tide (241°), both tides causing high water about 8 o'clock p. m. and a. m., but on the other dates the synchronism will be less complete.

At *Tandjong Kalean*, therefore, where tides are chiefly mono-diurnal, the occurrence of unusually strong equinoctial semi-diurnal tides can be traced in the records, although the fluctuation they produce is small as compared to that evoked by the diurnal tides.

Some more examples of different kinds are given in an essay on tide-prediction published in the „Proceedings of the Royal Society of Natural sciences of *Netherland's India*" Vol. LVI, 1896, in which paper also the reasons are discussed, why the data of tables I and III*a* are given in whole degrees only and why the quotients in table III*b* have not been carried further than to the first decimal.

In the way indicated above we may, by means of operations of the simplest kind, get exact information concerning each partial tide at any date and for any place of the world; but if we want to know how the tidal curve runs on, we have to put together again, by some method or other of synthesis, what has been broken up into its constituents by analysis.

This is done in the most perfect, because continuous way, by means of Lord Kelvin's tide-predicting machine or integrator, but there is only one such machine and, moreover, it would be impracticable to have annual tide-tables printed for all places of the world.

Consequently it is desirable that another simple, though less perfect, method of synthesis should be devised, which enables one to draw the tidal curve for a given date.

In the tables IV hourly values are given for seven partial tides and different amplitudes of the deviations from the mean water-level, as caused at subsequent hours by these tides; by the first operation the time of high water for every partial tide can be calculated; the second operation is to take from the tables IV the series corresponding to the tides and the amplitudes and to combine them in such a way, that high water for each tide corresponds as nearly as possible with the calculated points of time.

Although this method of combining the partial tides, by which an error of half an hour may be made, evidently leads to better results the more the mono-diurnal tides predominate, it has been proved to be of sufficient accuracy to point out some peculiarities also of the shallow-water tides of very short duration, as observed at *Portland Breakwater*, *Moulmein* and on the shores of *Holland* (see paper cited above).

If the accuracy, which can be arrived at, is considered insufficient, it will be easy to supersede the tables IV by others giving half-hourly or even quarter-hourly values, but it must be noticed that the amount of labour increases in the same ratio as the number of data in the tables, whilst the accuracy augments to a far less degree.

It has been remarked in § 6 and 9, that the amplitudes of the diurnal tides K_1 and O, and of the semi-diurnal tide K_2, are considerably affected by the fluctuations in the obliquity of the plane of the moon's orbit to that of the equator; consequently the amplitudes, given for these tides in the tidal constants, are to be regarded as *average* values which must undergo a correction when the amplitude for a given day is required; in table V these corrections are given for every year of the period 1890—1924.

On tabulating the hourly values, as taken from table IV, we commence by inserting the first or maximum deviation in the file corresponding to the time of high water, say the 6[th] hour; the second value comes opposite to the 7[th], the 3[rd] to the 8[th] hour etc.; but if we come to the bottom of the table at the 23[rd] hour, we cannot in every case go on with the arrangement by beginning again at the top of the table.

As to the tides S_2, K_2, K_1 and P, the periods of which are nearly 24 hours, this method would not be liable to objection, but in the case of the tides M_2, N and O which oscillate in periods of resp. 24.84, 25.32 and 25.82 hours, it would be inaccurate.

Consequently, on inscribing the three latter tides, it is a better plan to fill in the files *preceding* the hour of maximum by the same values as those tabulated in the following files, but in the opposite direction, from the bottom to the top of the table, in such a way that there will be symmetry in the figures with respect to the hour of high water.

An example, showing how this method of tidal prediction works, will, better than any further discussion, exhibit its advantages and the points in which it falls short.

Example I. *Tandjong Kalean*, Longitude 105°.1, E. from Gr. — Latitude 2°.0 South.

To calculate the tidal oscillations for June 25 of the year 1899.

The corrected amplitudes of the tides K_1, O and K_2 are (see table V):

K_1 . . . . 94.6 × 1.01 = 95.5 cm.
O . . . . 54.6 × 1.02 = 55.7 „
K_2 . . . . 3.5 × 1.01 = 3.6 „

The tides N and K_2 are very small and might be omitted without materially affecting the tide-curve, as is easily proved by drawing the curves.

Table I, 1899	$S_2 =$ —	$M_2 = 105°$	$K_1 = 160°$	$O = 308°$	$P = 191°$	$N = 325°$	$K_2 = 140°$
Table II, correction		—7°		—7°		—11°	
		98°		301°		314°	
Kappa-number	241°	186°	159°	93°	151°	166°	244°
	241°	284°	319°	34°	342°	120°	24°
Table III*a*, June 25.	—	307°	188°	119°	172°	73°	15°
		231°	147°	153°	154°	193°	39°
Table III*b* (time)	$8^h.0$	$8^h.0$	$9^h.8$	$11^h.0$	$10^h.3$	$6^h.7$	$1^h.3$

TIDAL DEVIATIONS AT TANDJONG KALEAN ON JUNE 25, 1899, IN CENTIMETRES.

Hours of local time.	Semi-diurnal tides.				Diurnal tides.			Total semi-diurnal tides.	Total diurnal tides.	Total.
	S_2.	M_2.	N.	K_2.	K_1.	O.	P.			
Noon.	— 7	—15	— 5	3	—84	—49	—24	—24	—157	—181*
1	—11	—23	— 5	**4**	—69	—42	—20	—35	—131	—166
2	—13	—25	— 4	3	—49	—32	—14	—39*	— 95	—134
3	—11	—20	— 2	2	—26	—20	— 7	—31	— 53	— 84
4	— 7	—11	0	0	0	— 7	0	—18	— 7	— 25
5	0	1	3	— 2	25	6	7	2	38	40
6	7	13	4	— 3	48	19	14	21	81	102
7	11	22	**5**	— 4	68	31	20	34	119	153
8	**13**	**25**	4	— 3	84	41	24	**39**	149	188
9	11	22	3	— 2	94	49	27	34	170	**204**
10	7	13	0	0	**97**	53	**28**	20	**178**	198
11	0	1	— 2	2	94	**55**	27	1	176	177
12	— 7	—11	— 4	3	84	53	24	—19	161	142
13	—11	—20	— 5	4	68	49	20	—32	137	105
14	—13	—25	— 5	3	48	41	14	—40*	103	63
15	—11	—23	— 3	2	25	31	7	—35	63	28
16	— 7	—15	— 1	0	0	19	0	—23	19	— 4
17	0	— 4	1	— 2	—26	6	— 7	— 5	— 27	— 32
18	7	8	3	— 3	—49	— 7	—14	15	— 70	— 55
19	11	19	5	— 4	—69	—20	—20	31	—109	— 78
20	13	24	5	— 3	—84	—32	—24	**39**	—140	—101
21	11	24	4	— 2	—94	—42	—27	37	—163	—126
22	7	17	2	0	—97	—49	—28	26	—174*	—148
23	0	7	0	2	—93	—54	—27	9	—174	—165

Example II. *Tandjong Kalean.*
To calculate the tidal oscillations for September 22, of the year 1899.
For the sum of the astronomical arguments in Table I and the kappa-numbers we have found above:

	S_2	M_2	K_1	O	P	N	K_2
	241°	284°	319°	34°	342°	120°	24°
Table III*a*, September 22	—	317°	100°	217°	260°	156°	200°
		241°	59°	251°	242°	276°	224°
Table III*b* (time)	$8^h.0$	$8^h.3$	$3^h.9$	$18^h.0$	$16^h.2$	$9^h.7$	$7^h.4$

TIDAL DEVIATIONS AT TANDJONG KALEAN ON SEPTEMBER 22, 1899, IN CENTIMETRES.

Hours of local time.	Semi-diurnal tides.				Diurnal tides.			Total semi-diurnal tides.	Total diurnal tides.	Total.
	S_2.	M_2.	N.	K_2.	K_1.	O.	P.			
Noon.	— 7	—15	— 1	— 3	48	—18	—14	—26	16	—10
1	—11	—23	— 1	— 4	68	—30	—20	—39	18	—21
2	—13	—25	— 3	— 3	84	—40	—24	—44*	**20**	—24*
3	—11	—20	— 5	— 2	94	—48	—27	—38	19	—19
4	— 7	—11	— 5	0	**97**	—53	—28	—23	16	— 7
5	0	1	— 4	2	94	—55	—27	— 1	12	11
6	7	13	— 2	3	84	—54	—24	21	6	27
7	11	22	0	**4**	68	—49	—20	37	— 1	**36**
8	**13**	**25**	3	3	48	—42	—14	**44**	— 8	36
9	11	22	4	2	25	—32	— 7	39	—14	25
10	7	13	**5**	0	0	—20	0	25	—20	5
11	0	1	4	— 2	—26	— 7	7	3	—26	—23
12	— 7	—11	3	— 3	—49	6	14	—18	—29	—47
13	—11	—20	0	— 4	—69	19	20	—35	—30*	—65
14	—13	—25	— 2	— 3	—84	31	24	—43*	—29	—72*
15	—11	—23	— 4	— 2	—94	41	27	—40	—26	—66
16	— 7	—15	— 5	0	—97	49	**28**	—27	—20	—47
17	0	— 4	— 5	2	—93	53	27	— 7	—13	—20
18	7	8	— 3	3	—84	**55**	24	15	— 5	10
19	11	19	— 1	4	—68	53	20	33	5	38
20	13	24	1	3	—48	49	14	**41**	15	56
21	11	24	3	2	—24	41	7	40	24	**64**
22	7	17	5	0	1	31	0	29	32	61
23	0	7	5	— 2	26	19	— 7	10	38	48

From these two examples it appears, that on the 25th June of 1899 it will be springtide of the diurnal and also of the semi-diurnal tides; the tidal curve clearly shows only one maximum and minimum, but its form is not symmetric owing to the influence of the semi-diurnal tides, which considerably affect the velocity of the rise and fall and cause the water to rise during 9 and to fall during 15 hours: the range is rather great and amounts to 358 cm.; the height between mean water-level and low water at noon is less than that between the average level and high water at 9 p. m.

On September 22 the tides are of a quite different type; it is springtide of the semi-diurnal, but neaptide of the diurnal tides and the tidal curve bears a decidedly semi-diurnal character; it is not symmetrical, the height to which the water rises at 7 p. m. being much less than that to which it comes at 9 a. m. of September 23; and there is even a greater difference (40 cm.) between the two low-water levels occurring at 2 p. m. of September 22 and at 2 a. m. of September 23; the range is much less than on June 25 and amounts only to 130 cm.

This example clearly exhibits how various and equally competent observers, taking observations at the same place, but at different times, may come to apparently inconsistent and even contradictory conclusions concerning the nature of tides and how semi-diurnal tidal fluctuations are at times observed at places where nevertheless a port-establishment does not exist.

TABLE I. ANGULAR VALUES CORRESPONDING TO THE TIME OF TRANSIT THROUGH THE MERIDIAN OF GREENWICH, FOR DIFFERENT STARS ON JANUARY 1st.

	M_2.	K_1.	O.	P.	N.	K_2.		M_2.	K_1.	O.	P.	N.	K_2.
1890	247°	177°	66°	191°	3°	175°	**1908**	306°	179°	123°	190°	258°	178°
1891	146	177	326	191	350	174	1909	230	178	49	191	284	176
1892	45	175	227	191	338	170	1910	129	176	310	190	271	173
1893	328	172	154	191	3	164	1911	28	175	211	190	259	170
1894	226	169	56	191	350	158	**1912**	286	173	113	190	246	165
1895	125	167	318	191	337	155	1913	209	169	40	191	271	158
1896	23	165	220	191	325	150	1914	108	167	302	190	258	153
1897	306	162	147	191	349	144	1915	6	165	204	190	246	149
1898	205	161	48	191	337	141	**1916**	265	163	105	190	233	146
1899	105	160	308	191	325	140	1917	189	161	31	191	258	142
1900	4	161	207	191	313	141	1918	88	161	291	190	246	142
1901	263	162	105	190	301	145	1919	347	162	190	190	234	144
1902	163	165	2	190	290	150	**1920**	247	163	87	190	223	148
1903	63	168	256	190	279	157	1921	171	165	8	191	249	151
1904	323	172	151	190	267	164	1922	71	170	263	190	237	159
1905	247	174	71	190	293	168	1923	331	172	157	190	226	164
1906	147	177	327	190	281	173	**1924**	231	176	52	190	215	171
1907	47	179	224	190	270	177							

NB. In calculating the data of this table the quantities denoted in the theory by the initials N, I, ν, ξ, ν' and $2\nu''$ have been taken as corresponding to mid-year. Leap years are indicated by big type.

TABLE II. CORRECTIONS TO BE APPLIED TO THE VALUES GIVEN IN TABLE I FOR PLACES SITUATED IN LONGITUDES EAST FROM GREENWICH.

	M_2.	O.	N.		M_2.	O.	N.
0°—10°	0°	0°	—1°	90°—100°	— 6°	— 7°	—10°
10°—20°	—1	—1	—2	100°—110°	— 7	— 7	—11
20°—30°	—2	—2	—3	110°—120°	— 8	— 8	—12
30°—40°	—2	—2	—4	120°—130°	— 8	— 9	—13
40°—50°	—3	—3	—5	130°—140°	— 9	—10	—14
50°—60°	—4	—4	—6	140°—150°	—10	—10	—15
60°—70°	—4	—5	—7	150°—160°	—10	—11	—16
70°—80°	—5	—5	—8	160°—170°	—11	—12	—17
80°—90°	—6	—6	—9	170°—180°	—12	—12	—18

TABLE III[a]. ANGULAR VALUES TO BE ADDED TO THOSE GIVEN IN TABLE I IN CALCULATING THE TIME OF TRANSIT FOR ANY DATE. M_2.

Delay of phase = s = 24°.3814992 per 24 hours.

Dates.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Dates.
1	0°	36°	359°	34°	46°	82°	93°	129°	165°	176°	212°	223°	1
2	24	60	23	59	70	106	117	153	189	201	236	248	2
3	49	85	47	83	95	130	142	178	213	225	261	272	3
4	73	109	72	107	119	155	166	202	238	249	285	297	4
5	98	133	96	132	143	179	191	224	262	274	310	321	5
6	122	158	120	156	168	204	215	249	287	298	334	345	6
7	146	182	145	181	192	228	239	273	311	322	358	10	7
8	171	206	169	205	216	252	264	298	335	347	23	34	8
9	195	231	194	229	241	277	288	324	0	11	47	58	9
10	219	255	218	254	265	301	312	348	24	36	71	83	10
11	244	280	242	278	290	325	337	13	49	60	96	107	11
12	268	304	267	303	314	350	1	37	73	84	120	132	12
13	293	328	291	327	338	14	26	61	97	109	145	156	13
14	317	353	315	351	3	39	50	86	122	133	169	180	14
15	341	17	340	16	27	63	74	110	146	157	193	205	15
16	6	42	4	40	52	87	99	135	170	182	218	229	16
17	30	66	29	64	76	112	123	159	195	206	242	254	17
18	54	90	53	89	100	136	148	183	219	231	266	278	18
19	79	115	77	113	125	160	172	208	244	255	291	302	19
20	103	139	102	138	149	185	196	232	268	279	315	327	20
21	128	163	126	162	173	209	221	257	292	304	340	351	21
22	152	188	151	186	198	234	245	281	317	328	4	15	22
23	176	212	175	211	222	258	269	305	341	353	28	40	23
24	201	237	199	235	247	282	294	330	5	17	53	64	24
25	225	261	224	259	271	307	318	354	30	41	77	89	25
26	250	285	248	284	295	331	343	18	54	66	102	113	26
27	274	310	272	308	320	356	7	43	79	90	126	137	27
28	298	334	297	333	344	20	31	67	103	114	150	162	28
29	323		321	357	8	44	56	92	127	139	175	186	29
30	347		346	21	33	69	80	116	152	163	199	210	30
31	11		10		57		104	140		188		235	31
												259	

NB. In leap years for any date after the 28[th] February take the value as that given for the *succeeding date* in the table.

TABLE III[b]. EXHIBITING THE HOURS OF SOLAR TIME CORRESPONDING TO DIFFERENT ANGULAR VALUES. M_2.

Speed = n = 28°.9841042 per hour.

Degrees.	0	1	2	3	4	5	6	7	8	9	Degrees.
0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0
1	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.7	1
2	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	2
3	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	3
4	1.4	1.4	1.4	1.5	1.5	1.6	1.6	1.6	1.7	1.7	4
5	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	5
6	2.1	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.3	2.4	6
7	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.7	2.7	2.7	7
8	2.8	2.8	2.8	2.9	2.9	2.9	3.0	3.0	3.0	3.1	8
9	3.1	3.1	3.2	3.2	3.2	3.3	3.3	3.3	3.4	3.4	9
10	3.4	3.5	3.5	3.6	3.6	3.6	3.7	3.7	3.7	3.8	10
11	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.0	4.1	4.1	11
12	4.1	4.2	4.2	4.2	4.3	4.3	4.3	4.4	4.4	4.4	12
13	4.5	4.5	4.6	4.6	4.6	4.7	4.7	4.7	4.8	4.8	13
14	4.8	4.9	4.9	4.9	5.0	5.0	5.0	5.1	5.1	5.1	14
15	5.2	5.2	5.2	5.3	5.3	5.3	5.4	5.4	5.4	5.5	15
16	5.5	5.6	5.6	5.6	5.7	5.7	5.7	5.8	5.8	5.8	16
17	5.9	5.9	5.9	6.0	6.0	6.0	6.1	6.1	6.1	6.2	17
18	6.2	6.2	6.3	6.3	6.3	6.4	6.4	6.4	6.5	6.5	18
19	6.6	6.6	6.6	6.7	6.7	6.7	6.8	6.8	6.8	6.9	19
20	6.9	6.9	7.0	7.0	7.0	7.1	7.1	7.1	7.2	7.2	20
21	7.2	7.3	7.3	7.3	7.4	7.4	7.4	7.5	7.5	7.6	21
22	7.6	7.6	7.7	7.7	7.7	7.8	7.8	7.8	7.9	7.9	22
23	7.9	8.0	8.0	8.0	8.1	8.1	8.1	8.2	8.2	8.2	23
24	8.3	8.3	8.3	8.4	8.4	8.4	8.5	8.5	8.6	8.6	24
25	8.6	8.7	8.7	8.7	8.8	8.8	8.8	8.9	8.9	8.9	25
26	9.0	9.0	9.0	9.1	9.1	9.1	9.2	9.2	9.2	9.3	26
27	9.3	9.3	9.4	9.4	9.4	9.5	9.5	9.6	9.6	9.6	27
28	9.7	9.7	9.7	9.8	9.8	9.8	9.9	9.9	9.9	10.0	28
29	10.0	10.0	10.1	10.1	10.1	10.2	10.2	10.2	10.3	10.3	29
30	10.3	10.4	10.4	10.4	10.5	10.5	10.6	10.6	10.6	10.7	30
31	10.7	10.7	10.8	10.8	10.8	10.9	10.9	10.9	11.0	11.0	31
32	11.0	11.1	11.1	11.1	11.2	11.2	11.2	11.3	11.3	11.3	32
33	11.4	11.4	11.4	11.5	11.5	11.6	11.6	11.6	11.7	11.7	33
34	11.7	11.8	11.8	11.8	11.9	11.9	11.9	12.0	12.0	12.0	34
35	12.1	12.1	12.1	12.2	12.2	12.2	12.3	12.3	12.3	12.4	35

TABLE III[a]. ANGULAR VALUES TO BE ADDED TO THOSE GIVEN IN TABLE I IN CALCULATING THE TIME OF TRANSIT FOR ANY DATE. K₁.

Delay of phase = s = — 0°.9856464 per 24 hours.

Dates.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Dates.
1	360°	329°	302°	271°	242°	211°	182°	151°	120°	91°	60°	31°	1
2	359	328	301	270	241	210	181	150	120	90	59	30	2
3	358	327	300	269	240	209	180	149	119	89	58	29	3
4	357	326	299	268	239	208	179	148	118	88	57	28	4
5	356	326	298	267	238	207	178	147	117	87	56	27	5
6	355	325	297	266	237	206	177	146	116	86	55	26	6
7	354	324	296	265	236	205	176	145	115	85	54	25	7
8	353	323	295	264	235	204	175	144	114	84	53	24	8
9	352	322	294	263	234	203	174	143	113	83	52	23	9
10	351	321	293	262	233	202	173	142	112	82	51	22	10
11	350	320	292	261	232	201	172	141	111	81	51	21	11
12	349	319	291	260	231	200	171	140	110	80	50	20	12
13	348	318	290	259	230	199	170	139	109	79	49	19	13
14	347	317	289	258	229	198	169	138	108	78	48	18	14
15	346	316	288	257	228	197	168	137	107	77	47	17	15
16	345	315	287	257	227	196	167	136	106	76	46	16	16
17	344	314	286	256	226	195	166	135	105	75	45	15	17
18	343	313	285	255	225	194	165	134	104	74	44	14	18
19	342	312	284	254	224	193	164	133	103	73	43	13	19
20	341	311	283	253	223	192	163	132	102	72	42	12	20
21	340	310	282	252	222	191	162	131	101	71	41	11	21
22	339	309	281	251	221	190	161	130	100	70	40	10	22
23	338	308	280	250	220	189	160	129	99	69	39	9	23
24	337	307	279	249	219	188	159	128	98	68	38	8	24
25	336	306	278	248	218	188	158	127	97	67	37	7	25
26	335	305	277	247	217	187	157	126	96	66	36	6	26
27	334	304	276	246	216	186	156	125	95	65	35	5	27
28	333	303	275	245	215	185	155	124	94	64	34	4	28
29	332		274	244	214	184	154	123	93	63	33	3	29
30	331		273	243	213	183	153	122	92	62	32	2	30
31	330		272		212		152	121		61		1	31
												0	

NB. In leap years for any date after the 28[th] February take the value as that given for the *succeeding date* in the table.

TABLE III[b]. EXHIBITING THE HOURS OF SOLAR TIME CORRESPONDING TO DIFFERENT ANGULAR VALUES. K₁.

Speed = n = 15°.0410686 per hour.

Degrees.	0	1	2	3	4	5	6	7	8	9	Degrees.
0	0.0	0.1	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0
1	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.3	1
2	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2
3	2.0	2.1	2.1	2.2	2.3	2.3	2.4	2.5	2.5	2.6	3
4	2.7	2.7	2.8	2.9	2.9	3.0	3.1	3.1	3.2	3.3	4
5	3.3	3.4	3.5	3.5	3.6	3.7	3.7	3.8	3.9	3.9	5
6	4.0	4.1	4.1	4.2	4.3	4.3	4.4	4.5	4.5	4.6	6
7	4.7	4.7	4.8	4.9	4.9	5.0	5.1	5.1	5.2	5.3	7
8	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.9	5.9	8
9	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5	6.6	9
10	6.7	6.7	6.8	6.9	6.9	7.0	7.1	7.1	7.2	7.3	10
11	7.3	7.4	7.5	7.5	7.6	7.7	7.7	7.8	7.9	7.9	11
12	8.0	8.1	8.1	8.2	8.3	8.3	8.4	8.5	8.5	8.6	12
13	8.7	8.7	8.8	8.9	8.9	9.0	9.1	9.1	9.2	9.3	13
14	9.3	9.4	9.5	9.5	9.6	9.7	9.7	9.8	9.9	9.9	14
15	10.0	10.1	10.1	10.2	10.3	10.3	10.4	10.5	10.5	10.6	15
16	10.7	10.7	10.8	10.9	10.9	11.0	11.1	11.1	11.2	11.3	16
17	11.3	11.4	11.5	11.5	11.6	11.7	11.7	11.8	11.9	11.9	17
18	12.0	12.1	12.1	12.2	12.3	12.3	12.4	12.5	12.5	12.6	18
19	12.7	12.7	12.8	12.9	12.9	13.0	13.0	13.1	13.1	13.2	19
20	13.3	13.3	13.4	13.5	13.5	13.6	13.7	13.7	13.8	13.9	20
21	13.9	14.0	14.1	14.1	14.2	14.3	14.3	14.4	14.5	14.5	21
22	14.6	14.7	14.7	14.8	14.9	14.9	15.0	15.1	15.1	15.2	22
23	15.3	15.3	15.4	15.5	15.5	15.6	15.7	15.7	15.8	15.9	23
24	15.9	16.0	16.1	16.1	16.2	16.3	16.3	16.4	16.5	16.5	24
25	16.6	16.7	16.7	16.8	16.9	16.9	17.0	17.1	17.1	17.2	25
26	17.3	17.3	17.4	17.5	17.5	17.6	17.7	17.7	17.8	17.9	26
27	17.9	18.0	18.1	18.1	18.2	18.3	18.3	18.4	18.5	18.5	27
28	18.6	18.7	18.7	18.8	18.9	18.9	19.0	19.1	19.1	19.2	28
29	19.3	19.3	19.4	19.5	19.5	19.6	19.7	19.7	19.8	19.9	29
30	19.9	20.0	20.1	20.1	20.2	20.3	20.3	20.4	20.5	20.5	30
31	20.6	20.7	20.7	20.8	20.9	20.9	21.0	21.1	21.1	21.2	31
32	21.3	21.3	21.4	21.5	21.5	21.6	21.7	21.7	21.8	21.9	32
33	21.9	22.0	22.1	22.1	22.2	22.3	22.3	22.4	22.5	22.5	33
34	22.6	22.7	22.7	22.8	22.9	22.9	23.0	23.1	23.1	23.2	34
35	23.3	23.3	23.4	23.5	23.5	23.6	23.7	23.7	23.8	23.9	35

TABLE III[a]. O.

ANGULAR VALUES TO BE ADDED TO THOSE GIVEN IN TABLE I IN CALCULATING THE TIME OF TRANSIT FOR ANY DATE.

Delay of phase = s = 25°.3671456 per 24 hours.

Dates.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Dates.
1	0°	66°	57°	123°	164°	230°	271°	338°	44°	85°	152°	193°	1
2	25	92	82	148	189	256	297	3	70	111	177	218	2
3	51	117	107	174	215	281	322	29	95	136	202	243	3
4	76	142	133	199	240	307	348	55	120	161	228	269	4
5	101	168	158	225	266	332	13	79	146	187	253	294	5
6	127	193	183	250	291	357	38	105	171	212	278	319	6
7	152	219	209	275	316	23	64	130	196	237	304	345	7
8	178	244	234	301	342	48	89	155	222	263	329	10	8
9	203	269	260	326	7	73	114	181	247	288	355	36	9
10	228	295	285	351	32	99	140	206	273	314	20	61	10
11	254	320	310	17	58	124	165	232	298	339	45	86	11
12	279	345	336	42	83	149	190	257	323	4	71	112	12
13	304	11	1	67	108	175	216	282	349	30	96	137	13
14	330	36	26	93	134	200	241	308	14	55	121	162	14
15	355	62	52	118	159	226	267	333	39	80	147	188	15
16	21	87	77	144	185	251	292	358	65	106	172	213	16
17	46	112	103	169	210	276	317	24	90	131	197	239	17
18	71	138	128	194	235	302	343	49	115	156	223	264	18
19	97	163	153	220	261	327	8	74	141	182	248	289	19
20	122	188	179	245	286	352	33	100	166	207	274	315	20
21	147	214	204	270	311	18	59	125	192	233	299	340	21
22	173	239	229	296	337	43	84	151	217	258	324	5	22
23	198	264	255	321	2	69	110	176	242	283	350	31	23
24	223	290	280	346	28	94	135	201	268	309	15	56	24
25	249	315	305	12	53	119	160	227	293	334	40	81	25
26	274	341	331	37	78	145	186	252	318	359	66	107	26
27	300	6	356	63	104	170	211	277	344	25	91	132	27
28	325	31	22	88	129	195	236	303	9	50	117	158	28
29	350		47	113	154	221	262	328	34	76	142	183	29
30	16		72	139	180	246	287	353	60	101	167	208	30
31	41		98		205		312	19		126		234	31
												259	

NB. In leap years for any date after the 28th February take the value as that given for the *succeeding date* in the table.

TABLE III[b]. O.

EXHIBITING THE HOURS OF SOLAR TIME CORRESPONDING TO DIFFERENT ANGULAR VALUES.

Speed = n = 13°.9430356 per hour.

Degrees.	0	1	2	3	4	5	6	7	8	9	Degrees.
0	0.0	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0
1	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.3	1.4	1
2	1.4	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2
3	2.1	2.2	2.3	2.4	2.4	2.5	2.6	2.6	2.7	2.8	3
4	2.9	2.9	3.0	3.1	3.1	3.2	3.3	3.4	3.4	3.5	4
5	3.6	3.6	3.7	3.8	3.9	3.9	4.0	4.1	4.1	4.2	5
6	4.3	4.4	4.4	4.5	4.6	4.6	4.7	4.8	4.9	4.9	6
7	5.0	5.1	5.1	5.2	5.3	5.4	5.4	5.5	5.6	5.6	7
8	5.7	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.3	6.4	8
9	6.4	6.5	6.6	6.6	6.7	6.8	6.9	6.9	7.0	7.1	9
10	7.1	7.2	7.3	7.4	7.4	7.5	7.6	7.6	7.7	7.8	10
11	7.9	7.9	8.0	8.1	8.1	8.2	8.3	8.4	8.4	8.5	11
12	8.6	8.6	8.7	8.8	8.9	9.0	9.1	9.1	9.2	9.3	12
13	9.4	9.4	9.5	9.6	9.6	9.7	9.8	9.9	9.9	10.0	13
14	10.1	10.1	10.2	10.3	10.4	10.4	10.5	10.6	10.6	10.7	14
15	10.8	10.9	10.9	11.0	11.1	11.1	11.2	11.3	11.4	11.4	15
16	11.5	11.6	11.6	11.7	11.8	11.9	11.9	12.0	12.1	12.1	16
17	12.2	12.3	12.4	12.4	12.5	12.6	12.6	12.7	12.8	12.9	17
18	12.9	13.0	13.1	13.1	13.2	13.3	13.4	13.4	13.5	13.6	18
19	13.6	13.7	13.8	13.9	13.9	14.0	14.1	14.1	14.2	14.3	19
20	14.4	14.4	14.5	14.6	14.6	14.7	14.8	14.9	14.9	15.0	20
21	15.1	15.1	15.2	15.3	15.4	15.4	15.5	15.6	15.6	15.7	21
22	15.8	15.9	15.9	16.0	16.1	16.1	16.2	16.3	16.4	16.4	22
23	16.5	16.6	16.6	16.7	16.8	16.9	16.9	17.0	17.1	17.1	23
24	17.2	17.3	17.4	17.4	17.5	17.6	17.6	17.7	17.8	17.9	24
25	17.9	18.0	18.1	18.1	18.2	18.3	18.4	18.4	18.5	18.6	25
26	18.6	18.7	18.8	18.9	18.9	19.0	19.1	19.1	19.2	19.3	26
27	19.4	19.4	19.5	19.6	19.6	19.7	19.8	19.9	19.9	20.0	27
28	20.1	20.1	20.2	20.3	20.4	20.4	20.5	20.6	20.6	20.7	28
29	20.8	20.9	20.9	21.0	21.1	21.1	21.2	21.3	21.4	21.4	29
30	21.5	21.6	21.6	21.7	21.8	21.9	21.9	22.0	22.1	22.1	30
31	22.2	22.3	22.4	22.4	22.5	22.6	22.6	22.7	22.8	22.9	31
32	22.9	23.0	23.1	23.1	23.2	23.3	23.4	23.4	23.5	23.6	32
33	23.6	23.7	23.8	23.9	23.9	24.0	24.1	24.1	24.2	24.3	33
34	24.4	24.4	24.5	24.6	24.6	24.7	24.8	24.9	24.9	25.0	34
35	25.1	25.1	25.2	25.3	25.4	25.4	25.5	25.6	25.6	25.7	35

NB. Quotients greater than 24 hours indicate that, on the date in question, high water of this tide does not occur: in this case calculate the time of transit, or high water, for the *preceding* day.

TABLE III^a. ANGULAR VALUES TO BE ADDED TO THOSE GIVEN IN TABLE I IN CALCULATING THE TIME OF TRANSIT FOR ANY DATE. P.

Delay of phase = s = 0°.9856464 per 24 hours.

Dates.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Dates.
1	0°	31°	58°	89°	118°	149°	178°	209°	240°	269°	300°	329°	1
2	1	32	59	90	119	150	179	210	240	270	301	330	2
3	2	33	60	91	120	151	180	211	241	271	302	331	3
4	3	34	61	92	121	152	181	212	242	272	303	332	4
5	4	34	62	93	122	153	182	213	243	273	304	333	5
6	5	35	63	94	123	154	183	214	244	274	305	334	6
7	6	36	64	95	124	155	184	215	245	275	306	335	7
8	7	37	65	96	125	156	185	216	246	276	307	336	8
9	8	38	66	97	126	157	186	217	247	277	308	337	9
10	9	39	67	98	127	158	187	218	248	278	309	338	10
11	10	40	68	99	128	159	188	219	249	279	309	339	11
12	11	41	69	100	129	160	189	220	250	280	310	340	12
13	12	42	70	101	130	161	190	221	251	281	311	341	13
14	13	43	71	102	131	162	191	222	252	282	312	342	14
15	14	44	72	103	132	163	192	223	253	283	313	343	15
16	15	45	73	103	133	164	193	224	254	284	314	344	16
17	16	46	74	104	134	165	194	225	255	285	315	345	17
18	17	47	75	105	135	166	195	226	256	286	316	346	18
19	18	48	76	106	136	167	196	227	257	287	317	347	19
20	19	49	77	107	137	168	197	228	258	288	318	348	20
21	20	50	78	108	138	169	198	229	259	289	319	349	21
22	21	51	79	109	139	170	199	230	260	290	320	350	22
23	22	52	80	110	140	171	200	231	261	291	321	351	23
24	23	53	81	111	141	172	201	232	262	292	322	352	24
25	24	54	82	112	142	172	202	233	263	293	323	353	25
26	25	55	83	113	143	173	203	234	264	294	324	354	26
27	26	56	84	114	144	174	204	235	265	295	325	355	27
28	27	57	85	115	145	175	205	236	266	296	326	356	28
29	28		86	116	146	176	206	237	267	297	327	357	29
30	29		87	117	147	177	207	238	268	298	328	358	30
31	30		88		148		208	239		299		359	31
												360	

NB. In leap years for any date after the 28th February take the value as that given for the *succeeding date* in the table.

TABLE III^b. EXHIBITING THE HOURS OF SOLAR TIME CORRESPONDING TO DIFFERENT ANGULAR VALUES. P.

Speed = n = 14°.9589314 per hour.

Degrees.	0	1	2	3	4	5	6	7	8	9	Degrees.
0	0.0	0.1	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0
1	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.3	1
2	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2
3	2.0	2.1	2.1	2.2	2.3	2.3	2.4	2.5	2.5	2.6	3
4	2.7	2.7	2.8	2.9	2.9	3.0	3.1	3.1	3.2	3.3	4
5	3.3	3.4	3.5	3.5	3.6	3.7	3.7	3.8	3.9	3.9	5
6	4.0	4.1	4.1	4.2	4.3	4.3	4.4	4.5	4.5	4.6	6
7	4.7	4.7	4.8	4.9	4.9	5.0	5.1	5.1	5.2	5.3	7
8	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.9	5.9	8
9	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5	6.6	9
10	6.7	6.7	6.8	6.9	6.9	7.0	7.1	7.1	7.2	7.3	10
11	7.3	7.4	7.5	7.5	7.6	7.7	7.7	7.8	7.9	7.9	11
12	8.0	8.1	8.1	8.2	8.3	8.3	8.4	8.5	8.5	8.6	12
13	8.7	8.7	8.8	8.9	8.9	9.0	9.1	9.1	9.2	9.3	13
14	9.3	9.4	9.5	9.5	9.6	9.7	9.7	9.8	9.9	9.9	14
15	10.0	10.1	10.1	10.2	10.3	10.3	10.4	10.5	10.5	10.6	15
16	10.7	10.7	10.8	10.9	10.9	11.0	11.1	11.1	11.2	11.3	16
17	11.3	11.4	11.5	11.5	11.6	11.7	11.7	11.8	11.9	11.9	17
18	12.0	12.1	12.1	12.2	12.3	12.3	12.4	12.5	12.5	12.6	18
19	12.7	12.7	12.8	12.9	13.0	13.1	13.1	13.2	13.3	13.3	19
20	13.4	13.5	13.5	13.6	13.7	13.7	13.8	13.9	13.9	14.0	20
21	14.1	14.1	14.2	14.3	14.3	14.4	14.5	14.5	14.6	14.7	21
22	14.7	14.8	14.9	14.9	15.0	15.1	15.1	15.2	15.3	15.3	22
23	15.4	15.5	15.5	15.6	15.7	15.7	15.8	15.9	15.9	16.0	23
24	16.1	16.1	16.2	16.3	16.3	16.4	16.5	16.5	16.6	16.7	24
25	16.7	16.8	16.9	16.9	17.0	17.1	17.1	17.2	17.3	17.3	25
26	17.4	17.5	17.5	17.6	17.7	17.7	17.8	17.9	17.9	18.0	26
27	18.1	18.1	18.2	18.3	18.3	18.4	18.5	18.5	18.6	18.7	27
28	18.7	18.8	18.9	18.9	19.0	19.1	19.1	19.2	19.3	19.3	28
29	19.4	19.5	19.5	19.6	19.7	19.7	19.8	19.9	19.9	20.0	29
30	20.1	20.1	20.2	20.3	20.3	20.4	20.5	20.5	20.6	20.7	30
31	20.7	20.8	20.9	20.9	21.0	21.1	21.1	21.2	21.3	21.3	31
32	21.4	21.5	21.5	21.6	21.7	21.7	21.8	21.9	21.9	22.0	32
33	22.1	22.1	22.2	22.3	22.3	22.4	22.5	22.5	22.6	22.7	33
34	22.7	22.8	22.9	22.9	23.0	23.1	23.1	23.2	23.3	23.3	34
35	23.4	23.5	23.5	23.6	23.7	23.7	23.8	23.9	23.9	0.0	35

TABLE IIIa. ANGULAR VALUES TO BE ADDED TO THOSE GIVEN IN TABLE I IN CALCULATING THE TIME OF TRANSIT FOR ANY DATE. N.

Delay of phase = s = 37°.4464896 per 24 hours.

Dates.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Dates.
1	0°	81°	49°	130°	174°	254°	298°	19°	99°	143°	224°	267°	1
2	37	118	87	168	211	292	335	56	137	180	261	305	2
3	75	156	124	205	248	329	13	94	174	218	299	342	3
4	112	193	162	243	286	7	50	131	212	255	336	19	4
5	150	231	199	280	323	44	88	168	249	293	14	57	5
6	187	268	237	317	1	82	125	206	287	330	51	94	6
7	225	306	274	355	38	119	162	243	324	8	88	132	7
8	262	343	311	32	76	157	200	281	2	45	126	169	8
9	300	20	349	70	113	194	237	318	39	82	163	207	9
10	337	58	26	107	151	231	275	356	77	120	201	244	10
11	14	95	64	145	188	269	312	33	114	157	238	282	11
12	52	133	101	182	225	306	350	71	151	195	276	319	12
13	89	170	139	220	263	344	27	108	189	232	313	356	13
14	127	208	176	257	300	21	65	145	226	270	351	34	14
15	164	245	214	294	338	59	102	183	264	307	28	71	15
16	202	283	251	332	15	96	140	220	301	345	65	109	16
17	239	320	288	9	53	134	177	258	339	22	103	146	17
18	277	357	326	47	90	171	214	295	16	59	140	184	18
19	314	35	3	84	128	208	252	333	54	97	178	221	19
20	351	72	41	122	165	246	289	10	91	134	215	259	20
21	29	110	78	159	203	283	327	48	128	172	253	296	21
22	66	147	116	197	240	321	4	85	156	209	290	334	22
23	104	185	153	234	277	358	42	122	193	247	328	11	23
24	141	222	191	271	315	36	79	160	231	284	5	48	24
25	179	260	228	309	352	73	117	197	268	322	42	86	25
26	216	297	266	346	30	111	154	235	316	359	80	123	26
27	254	334	303	24	67	148	191	272	353	37	117	161	27
28	291	12	340	61	105	185	229	310	31	74	155	198	28
29	329		18	99	142	223	266	347	68	111	192	236	29
30	6		55	136	180	260	304	25	135	149	230	273	30
31	43		93		217		341	62		186		311	31
												348	

NB. In leap years for any date after the 28th February take the value as that given for the *succeeding date* in the table.

TABLE IIIb. EXHIBITING THE HOURS OF SOLAR TIME CORRESPONDING TO DIFFERENT ANGULAR VALUES. N.

Speed = n = 28°.4397296 per hour.

Degrees.	0	1	2	3	4	5	6	7	8	9	Degrees.
0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0
1	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	1
2	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	2
3	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	3
4	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.7	1.7	4
5	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	5
6	2.1	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.4	2.4	6
7	2.4	2.5	2.5	2.5	2.6	2.6	2.6	2.7	2.7	2.7	7
8	2.8	2.8	2.8	2.9	2.9	3.0	3.0	3.0	3.1	3.1	8
9	3.1	3.2	3.2	3.2	3.3	3.3	3.4	3.4	3.4	3.5	9
10	3.5	3.5	3.6	3.6	3.6	3.7	3.7	3.7	3.8	3.8	10
11	3.8	3.9	3.9	3.9	4.0	4.0	4.0	4.1	4.1	4.1	11
12	4.2	4.2	4.2	4.3	4.3	4.4	4.4	4.4	4.5	4.5	12
13	4.5	4.6	4.6	4.6	4.7	4.7	4.7	4.8	4.8	4.8	13
14	4.9	4.9	5.0	5.0	5.0	5.1	5.1	5.1	5.2	5.2	14
15	5.2	5.3	5.3	5.4	5.4	5.4	5.5	5.5	5.5	5.6	15
16	5.6	5.6	5.7	5.7	5.7	5.8	5.8	5.8	5.9	5.9	16
17	5.9	6.0	6.0	6.0	6.1	6.1	6.1	6.2	6.2	6.2	17
18	6.3	6.3	6.4	6.4	6.4	6.5	6.5	6.5	6.6	6.6	18
19	6.6	6.7	6.7	6.7	6.8	6.8	6.8	6.9	6.9	7.0	19
20	7.0	7.0	7.1	7.1	7.1	7.2	7.2	7.2	7.3	7.3	20
21	7.4	7.4	7.4	7.5	7.5	7.5	7.6	7.6	7.6	7.7	21
22	7.7	7.7	7.8	7.8	7.8	7.9	7.9	7.9	8.0	8.0	22
23	8.0	8.1	8.1	8.1	8.2	8.2	8.2	8.3	8.3	8.4	23
24	8.4	8.4	8.5	8.5	8.5	8.6	8.6	8.6	8.7	8.7	24
25	8.7	8.8	8.8	8.8	8.9	8.9	9.0	9.0	9.0	9.1	25
26	9.1	9.1	9.2	9.2	9.2	9.3	9.3	9.4	9.4	9.4	26
27	9.5	9.5	9.5	9.6	9.6	9.6	9.7	9.7	9.7	9.8	27
28	9.8	9.8	9.9	9.9	10.0	10.0	10.0	10.1	10.1	10.1	28
29	10.2	10.2	10.2	10.3	10.3	10.4	10.4	10.4	10.5	10.5	29
30	10.5	10.6	10.6	10.6	10.7	10.7	10.7	10.8	10.8	10.8	30
31	10.9	10.9	10.9	11.0	11.0	11.0	11.1	11.1	11.1	11.2	31
32	11.2	11.2	11.3	11.3	11.4	11.4	11.4	11.5	11.5	11.5	32
33	11.6	11.6	11.6	11.7	11.7	11.7	11.8	11.8	11.8	11.9	33
34	11.9	12.0	12.0	12.0	12.1	12.1	12.1	12.2	12.2	12.2	34
35	12.3	12.3	12.4	12.4	12.4	12.5	12.5	12.5	12.6	12.6	35

TABLE III[a]. ANGULAR VALUES TO BE ADDED TO THOSE GIVEN IN TABLE I IN CALCULATING THE TIME OF TRANSIT FOR ANY DATE. K₂.

Delay of phase = s = − 1°.9712928 per 24 hours.

Dates.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Dates.
1	360°	299°	244°	183°	123°	62°	3°	302°	241°	182°	121°	62°	1
2	358	297	242	181	121	60	1	300	239	180	119	60	2
3	356	295	240	179	120	58	359	298	237	178	117	58	3
4	354	293	238	177	118	56	357	296	235	176	115	56	4
5	352	291	236	175	116	54	355	294	233	174	113	54	5
6	350	289	234	173	114	52	353	292	231	172	111	52	6
7	348	287	232	171	112	51	351	290	229	170	109	50	7
8	346	285	230	169	110	49	349	288	227	168	107	48	8
9	344	283	228	167	108	47	347	286	225	166	105	46	9
10	342	281	226	165	106	45	345	284	223	164	103	44	10
11	340	279	224	163	104	43	343	282	221	162	101	42	11
12	338	277	222	161	102	41	342	280	219	160	99	40	12
13	336	275	220	159	100	39	340	278	217	158	97	38	13
14	334	273	218	157	98	37	338	276	215	156	95	36	14
15	332	271	216	155	96	35	336	274	213	154	93	34	15
16	330	269	214	153	94	33	334	273	211	152	91	32	16
17	328	267	212	151	92	31	332	271	209	150	89	30	17
18	326	265	210	149	90	29	330	269	207	148	87	28	18
19	325	263	208	147	88	27	328	267	205	146	85	26	19
20	323	261	206	145	86	25	326	265	204	144	83	24	20
21	321	259	204	143	84	23	324	263	202	142	81	22	21
22	319	257	202	141	82	21	322	261	200	140	79	20	22
23	317	256	200	139	80	19	320	259	198	138	77	18	23
24	315	254	198	137	78	17	318	257	196	136	75	16	24
25	313	252	196	135	76	15	316	255	194	135	73	14	25
26	311	250	194	133	74	13	314	253	192	133	71	12	26
27	309	248	192	131	72	11	312	251	190	131	69	10	27
28	307	246	190	129	70	9	310	249	188	129	68	8	28
29	305		188	127	68	7	308	247	186	127	66	6	29
30	303		187	125	66	5	306	245	184	125	64	4	30
31	301		185		64		304	243		123		2	31
												0	

NB. In leap years for any date after the 28[th] February take the value as that given for the *succeeding date* in the table.

TABLE III[b]. EXHIBITING THE HOURS OF SOLAR TIME CORRESPONDING TO DIFFERENT ANGULAR VALUES. K₂.

Speed = n = 30°.0821372 per hour.

Degrees.	0	1	2	3	4	5	6	7	8	9	Degrees.
0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0
1	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	1
2	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	2
3	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	3
4	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.6	4
5	1.7	1.7	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	5
6	2.0	2.0	2.1	2.1	2.1	2.2	2.2	2.2	2.3	2.3	6
7	2.3	2.4	2.4	2.4	2.5	2.5	2.5	2.6	2.6	2.6	7
8	2.7	2.7	2.7	2.8	2.8	2.8	2.9	2.9	2.9	3.0	8
9	3.0	3.0	3.1	3.1	3.1	3.2	3.2	3.2	3.3	3.3	9
10	3.3	3.4	3.4	3.4	3.5	3.5	3.5	3.6	3.6	3.6	10
11	3.7	3.7	3.7	3.8	3.8	3.8	3.9	3.9	3.9	4.0	11
12	4.0	4.0	4.1	4.1	4.1	4.2	4.2	4.2	4.3	4.3	12
13	4.3	4.4	4.4	4.4	4.5	4.5	4.5	4.6	4.6	4.6	13
14	4.7	4.7	4.7	4.8	4.8	4.8	4.9	4.9	4.9	5.0	14
15	5.0	5.0	5.1	5.1	5.1	5.2	5.2	5.2	5.3	5.3	15
16	5.3	5.4	5.4	5.4	5.5	5.5	5.5	5.6	5.6	5.6	16
17	5.7	5.7	5.7	5.8	5.8	5.8	5.9	5.9	5.9	6.0	17
18	6.0	6.0	6.1	6.1	6.1	6.2	6.2	6.2	6.3	6.3	18
19	6.3	6.4	6.4	6.4	6.5	6.5	6.5	6.6	6.6	6.6	19
20	6.7	6.7	6.7	6.8	6.8	6.8	6.9	6.9	6.9	7.0	20
21	7.0	7.0	7.0	7.1	7.1	7.1	7.2	7.2	7.2	7.3	21
22	7.3	7.3	7.4	7.4	7.4	7.5	7.5	7.5	7.6	7.6	22
23	7.6	7.7	7.7	7.7	7.8	7.8	7.8	7.9	7.9	7.9	23
24	8.0	8.0	8.0	8.1	8.1	8.1	8.2	8.2	8.2	8.3	24
25	8.3	8.3	8.4	8.4	8.4	8.5	8.5	8.5	8.6	8.6	25
26	8.6	8.7	8.7	8.7	8.8	8.8	8.8	8.9	8.9	8.9	26
27	9.0	9.0	9.0	9.1	9.1	9.1	9.2	9.2	9.2	9.3	27
28	9.3	9.3	9.4	9.4	9.4	9.5	9.5	9.5	9.6	9.6	28
29	9.6	9.7	9.7	9.7	9.8	9.8	9.8	9.9	9.9	9.9	29
30	10.0	10.0	10.0	10.1	10.1	10.1	10.2	10.2	10.2	10.3	30
31	10.3	10.3	10.4	10.4	10.4	10.5	10.5	10.5	10.6	10.6	31
32	10.6	10.7	10.7	10.7	10.8	10.8	10.8	10.9	10.9	10.9	32
33	10.9	11.0	11.0	11.0	11.1	11.1	11.1	11.2	11.2	11.2	33
34	11.3	11.3	11.3	11.4	11.4	11.4	11.5	11.5	11.5	11.6	34
35	11.6	11.6	11.7	11.7	11.7	11.8	11.8	11.8	11.9	11.9	35

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE SOLAR TIDE S_2, TO BE USED ALSO IN TABULATING THE TIDE K_2. S_2, K_2.

Hours of mean time.	AMPLITUDE.																			
	1	2	3	4	5	6	7	8	9	10	13	16	19	22	25	28	31	34	37	40
0	1	2	3	4	5	6	7	8	9	10	13	16	19	22	25	28	31	34	37	40
1	1	2	3	3	4	5	6	7	8	9	11	14	16	19	22	24	27	29	32	35
2	1	1	2	2	3	3	4	4	5	5	7	8	10	11	13	14	16	17	19	20
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	—1	—1	—2	—2	—3	—3	—4	—4	—5	—5	—7	—8	—10	—11	—13	—14	—16	—17	—19	—20
5	—1	—2	—3	—3	—4	—5	—6	—7	—8	—9	—11	—14	—16	—19	—22	—24	—27	—29	—32	—35
6	—1	—2	—3	—4	—5	—6	—7	—8	—9	—10	—13	—16	—19	—22	—25	—28	—31	—34	—37	—40
7	—1	—2	—3	—3	—4	—5	—6	—7	—8	—9	—11	—14	—16	—19	—22	—24	—27	—29	—32	—35
8	—1	—1	—2	—2	—3	—3	—4	—4	—5	—5	—7	—8	—10	—11	—13	—14	—16	—17	—19	—20
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1	1	2	2	3	3	4	4	5	5	7	8	10	11	13	14	16	17	19	20
11	1	2	3	3	4	5	6	7	8	9	11	14	16	19	22	24	27	29	32	35
12	1	2	3	4	5	6	7	8	9	10	13	16	19	22	25	28	31	34	37	40
13	1	2	3	3	4	5	6	7	8	9	11	14	16	19	22	24	27	29	32	35
14	1	1	2	2	3	3	4	4	5	5	7	8	10	11	13	14	16	17	19	20
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	—1	—1	—2	—2	—3	—3	—4	—4	—5	—5	—7	—8	—10	—11	—13	—14	—16	—17	—19	—20
17	—1	—2	—3	—3	—4	—5	—6	—7	—8	—9	—11	—14	—16	—19	—22	—24	—37	—29	—32	—35
18	—1	—2	—3	—4	—5	—6	—7	—8	—9	—10	—13	—16	—19	—22	—25	—28	—31	—34	—37	—40
19	—1	—2	—3	—3	—4	—5	—6	—7	—8	—9	—11	—14	—16	—19	—22	—24	—27	—29	—32	—35
20	—1	—1	—2	—2	—3	—3	—4	—4	—5	—5	—7	—8	—10	—11	—13	—14	—16	—17	—19	—20
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1	1	2	2	3	3	4	4	5	5	7	8	10	11	13	14	16	17	19	20
23	1	2	3	3	4	5	6	7	8	9	11	14	16	19	22	24	27	29	32	35

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR TIDE M_2. M_2.

Hours of mean time.	AMPLITUDE.																			
	1	2	3	4	5	6	7	8	9	10	13	16	19	22	25	28	31	34	37	40
0	1	2	3	4	5	6	7	8	9	10	13	16	19	22	25	28	31	34	37	40
1	1	2	3	4	4	5	6	7	8	9	11	14	17	19	22	25	27	30	32	35
2	1	1	2	2	3	3	4	4	5	5	7	8	10	12	13	15	16	18	20	20
3	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2
4	0	—1	—1	—2	—2	—3	—3	—3	—4	—4	—6	—7	—8	—10	—11	—12	—14	—15	—16	—17
5	—1	—2	—2	—3	—4	—5	—6	—7	—7	—8	—11	—13	—16	—18	—20	—23	—25	—28	—30	—33
6	—1	—2	—3	—4	—5	—6	—7	—8	—9	—10	—13	—15	—19	—22	—25	—28	—31	—34	—37	—40
7	—1	—2	—3	—4	—5	—6	—6	—7	—8	—9	—12	—15	—17	—20	—23	—26	—29	—31	—34	—37
8	—1	—1	—2	—2	—3	—4	—4	—5	—6	—6	—8	—10	—12	—14	—15	—17	—19	—21	—23	—25
9	0	0	0	—1	—1	—1	—1	—1	—1	—2	—2	—3	—3	—3	—4	—4	—5	—5	—6	—6
10	0	1	1	1	2	2	2	3	3	3	4	5	6	7	8	9	11	12	13	14
11	1	2	2	3	4	5	5	6	7	8	10	12	14	17	19	21	23	26	28	30
12	1	2	3	4	5	6	7	8	9	10	13	16	19	21	24	27	30	33	36	39
13	1	2	3	4	5	6	7	8	9	10	12	15	18	21	24	27	30	33	35	38
14	1	1	2	3	3	4	5	6	6	7	9	11	13	15	17	20	22	24	26	28
15	0	1	1	1	1	2	2	2	2	3	3	4	5	6	7	7	8	9	10	11
16	0	0	—1	—1	—1	—1	—2	—2	—2	—2	—3	—4	—5	—5	—6	—7	—7	—8	—9	—10
17	—1	—1	—2	—3	—3	—4	—5	—5	—6	—7	—9	—11	—13	—15	—17	—19	—21	—23	—25	—27
18	—1	—2	—3	—4	—5	—6	—7	—8	—9	—9	—12	—15	—18	—21	—24	—27	—29	—32	—35	—38
19	—1	—2	—3	—4	—5	—6	—7	—8	—9	—10	—13	—16	—19	—22	—25	—28	—30	—33	—36	—39
20	—1	—2	—2	—3	—4	—5	—5	—6	—7	—8	—10	—12	—15	—17	—19	—22	—24	—26	—28	—31
21	0	—1	—1	—1	—2	—2	—3	—3	—3	—4	—5	—6	—7	—8	—9	—10	—11	—12	—13	—14
22	0	0	0	1	1	1	1	1	1	1	2	2	3	3	3	4	4	5	5	5
23	1	1	2	2	3	4	4	5	5	7	8	10	11	13	15	17	19	20	22	24

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE SOLAR TIDE S_2, TO BE USED ALSO IN TABULATING THE TIDE K_2. S_2, K_2.

Hours of mean time.	AMPLITUDE.																			
	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
0	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
1	37	40	42	45	48	50	53	55	58	61	63	66	68	71	74	76	79	81	84	87
2	22	23	25	26	28	29	31	32	34	35	37	38	40	41	43	44	46	47	49	50
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	—22	—23	—25	—26	—28	—29	—31	—32	—34	—35	—37	—38	—40	—41	—43	—44	—46	—47	—49	—50
5	—37	—40	—42	—45	—48	—50	—53	—55	—58	—61	—63	—66	—68	—71	—74	—76	—79	—81	—84	—87
6	—43	—46	—49	—52	—55	—58	—61	—64	—67	—70	—73	—76	—79	—82	—85	—88	—91	—94	—97	—100
7	—37	—40	—42	—45	—48	—50	—53	—55	—58	—61	—63	—66	—68	—71	—74	—76	—79	—81	—84	—87
8	—22	—23	—25	—26	—28	—29	—31	—32	—34	—35	—37	—38	—40	—41	—43	—44	—46	—47	—49	—50
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	22	23	25	26	28	29	31	32	34	35	37	38	40	41	43	44	46	47	49	50
11	37	40	42	45	48	50	53	55	58	61	63	66	68	71	74	76	79	81	84	87
12	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
13	37	40	42	45	48	50	53	55	58	61	63	66	68	71	74	76	79	81	84	87
14	22	23	25	26	28	29	31	32	34	35	37	38	40	41	43	44	46	47	49	50
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	—22	—23	—25	—26	—28	—29	—31	—32	—34	—35	—37	—38	—40	—41	—43	—44	—46	—47	—49	—50
17	—37	—40	—42	—45	—48	—50	—53	—55	—58	—61	—63	—66	—68	—71	—74	—76	—79	—81	—84	—87
18	—43	—46	—49	—52	—55	—58	—61	—64	—67	—70	—73	—76	—79	—82	—85	—88	—91	—94	—97	—100
19	—37	—40	—42	—45	—48	—50	—53	—55	—58	—61	—63	—66	—68	—71	—74	—76	—79	—81	—84	—87
20	—22	—23	—25	—26	—28	—29	—31	—32	—34	—35	—37	—38	—40	—41	—43	—44	—46	—47	—49	—50
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	22	23	25	26	28	29	31	32	34	35	37	38	40	41	43	44	46	47	49	50
23	37	40	42	45	48	50	53	55	58	61	63	66	68	71	74	76	79	81	84	87

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR TIDE M_2. M_2.

Hours of mean time.	AMPLITUDE.																			
	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
0	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
1	38	40	43	46	48	51	53	56	59	61	64	67	69	72	74	77	80	82	85	88
2	23	24	26	28	29	31	32	34	36	37	39	40	42	43	45	47	48	50	51	53
3	2	2	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5
4	—19	—20	—21	—23	—24	—25	—27	—28	—29	—31	—32	—33	—35	—36	—37	—38	—40	—41	—42	—44
5	—35	—38	—40	—43	—45	—47	—50	—52	—55	—57	—60	—62	—65	—67	—70	—72	—74	—77	—79	—82
6	—43	—46	—49	—52	—55	—58	—61	—64	—67	—70	—73	—76	—79	—82	—84	—87	—90	—93	—96	—99
7	—40	—42	—45	—48	—51	—53	—56	—59	—62	—64	—67	—70	—73	—76	—78	—81	—84	—87	—89	—92
8	—27	—28	—30	—32	—34	—36	—38	—39	—41	—43	—45	—47	—49	—51	—52	—54	—56	—58	—60	—62
9	—7	—7	—8	—8	—9	—9	—10	—10	—11	—11	—12	—12	—13	—13	—14	—14	—14	—15	—15	—16
10	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
11	32	35	37	39	41	44	46	48	50	53	55	57	59	62	64	66	69	71	73	75
12	42	45	48	51	54	57	60	63	65	68	71	74	77	80	83	86	89	92	95	98
13	41	44	47	50	53	56	58	61	64	67	70	73	76	78	81	84	87	90	93	96
14	30	32	34	36	38	40	43	45	47	49	51	53	55	57	59	61	63	66	68	70
15	11	12	13	14	14	15	16	17	18	18	19	20	21	22	22	23	24	25	26	26
16	—10	—11	—12	—12	—13	—14	—15	—15	—16	—17	—17	—18	—19	—20	—20	—21	—22	—22	—23	—24
17	—29	—31	—33	—35	—37	—39	—41	—43	—45	—48	—50	—52	—54	—56	—58	—60	—62	—64	—66	—68
18	—41	—44	—47	—49	—52	—55	—58	—61	—64	—67	—69	—72	—75	—78	—81	—84	—86	—89	—92	—95
19	—42	—45	—48	—51	—54	—57	—60	—63	—66	—69	—72	—75	—78	—81	—84	—87	—89	—92	—95	—98
20	—33	—35	—38	—40	—42	—45	—47	—49	—52	—54	—56	—59	—61	—63	—65	—68	—70	—72	—75	—77
21	—16	—17	—18	—19	—20	—21	—22	—23	—24	—25	—27	—28	—29	—30	—31	—32	—33	—34	—35	—36
22	6	6	7	7	7	8	8	9	9	9	10	10	11	11	11	12	12	13	13	13
23	26	27	29	31	33	35	36	38	40	42	44	45	47	49	51	53	54	56	58	60

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR-SOLAR TIDE K_1, TO BE USED ALSO IN TABULATING THE TIDES S_1 AND P. K_1, S_1, P.

Hours of mean time.	AMPLITUDE. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19
2	1	2	3	3	4	5	6	7	8	9	10	10	11	12	13	14	15	16	16	17
3	1	1	2	3	4	4	5	6	6	7	8	8	9	10	11	11	12	13	13	14
4	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10
5	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	-1	-1	-1	-1	-2	-2	-2	-2	-3	-3	-3	-3	-4	-4	-4	-4	-5	-5	-5
8	-1	-1	-2	-2	-3	-3	-4	-4	-5	-5	-6	-6	-7	-7	-8	-8	-9	-9	-10	-10
9	-1	-1	-2	-3	-4	-4	-5	-6	-6	-7	-8	-9	-9	-10	-11	-11	-12	-13	-14	-14
10	-1	-2	-3	-3	-4	-5	-6	-7	-8	-9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-17
11	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-15	-16	-17	-18	-19
12	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20
13	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-13	-14	-15	-16	-17	-18	-19
14	-1	-2	-3	-3	-4	-5	-6	-7	-8	-9	-9	-10	-11	-12	-13	-14	-15	-15	-16	-17
15	-1	-1	-2	-3	-3	-4	-5	-6	-6	-7	-8	-8	-9	-10	-10	-11	-12	-13	-13	-14
16	0	-1	-1	-2	-2	-3	-3	-4	-4	-5	-5	-6	-6	-7	-7	-8	-8	-9	-9	-10
17	0	0	-1	-1	-1	-1	-2	-2	-2	-2	-3	-3	-3	-3	-4	-4	-4	-4	-5	-5
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	1	1	1	1	2	2	2	2	3	3	3	4	4	4	4	5	5	5	5
20	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10
21	1	1	2	3	4	4	5	6	6	7	8	9	9	10	11	11	12	13	14	14
22	1	2	3	3	4	5	6	7	8	9	10	10	11	12	13	14	15	16	17	17
23	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	17	18	19

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR-SOLAR TIDE K_1, TO BE USED ALSO IN TABULATING THE TIDES S_1 AND P. K_1, S_1, P.

Hours of mean time.	AMPLITUDE. 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
0	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
2	18	19	20	21	22	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35
3	15	16	16	17	18	18	19	20	20	21	22	23	23	24	25	25	26	27	28	28
4	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20
5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	-6	-6	-6	-6	-7	-7	-7	-7	-8	-8	-8	-8	-9	-9	-9	-10	-10	-10	-10	-11
8	-11	-11	-12	-12	-13	-13	-14	-14	-15	-15	-16	-16	-17	-17	-18	-18	-19	-19	-20	-20
9	-15	-16	-16	-17	-18	-19	-19	-20	-21	-21	-22	-23	-23	-24	-25	-26	-26	-27	-28	-28
10	-18	-19	-20	-21	-22	-23	-24	-24	-25	-26	-27	-28	-29	-30	-30	-31	-32	-33	-34	-35
11	-20	-21	-22	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-33	-34	-35	-36	-37	-38	-39
12	-21	-22	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-33	-34	-35	-36	-37	-38	-39	-40
13	-20	-21	-22	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-33	-34	-35	-36	-37	-38	-39
14	-18	-19	-20	-21	-22	-22	-23	-24	-25	-26	-27	-28	-28	-29	-30	-31	-32	-33	-34	-34
15	-15	-15	-16	-17	-17	-18	-19	-20	-20	-21	-22	-22	-23	-24	-24	-25	-26	-27	-27	-29
16	-10	-11	-11	-12	-12	-13	-13	-14	-14	-15	-15	-16	-16	-17	-17	-18	-18	-19	-19	-20
17	-5	-5	-6	-6	-6	-6	-7	-7	-7	-7	-8	-8	-8	-8	-9	-9	-9	-9	-10	-10
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
19	6	6	6	7	7	7	7	8	8	8	8	9	9	9	10	10	10	10	11	11
20	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20
21	15	16	17	17	18	19	19	20	21	22	22	23	24	24	25	26	27	27	28	29
22	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	31	32	33	34	35
23	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR-SOLAR TIDE K_1, TO BE USED ALSO IN TABULATING THE TIDES S_1 AND P. K_1, S_1, P.

Hours of mean time.	AMPLITUDE. 43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
0	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
1	42	44	47	50	53	56	59	62	65	68	71	73	76	79	82	85	88	91	94	97
2	37	40	42	45	48	50	53	55	58	61	63	66	68	71	74	76	79	81	84	87
3	30	32	35	37	39	41	43	45	47	49	52	54	56	58	60	62	64	66	68	71
4	21	23	24	26	27	29	30	32	33	35	36	38	39	41	42	44	45	47	48	50
5	11	12	12	13	14	15	16	16	17	18	19	19	20	21	22	22	23	24	25	26
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	-11	-12	-13	-14	-15	-15	-16	-17	-18	-18	-19	-20	-21	-22	-22	-23	-24	-25	-26	-26
8	-22	-23	-25	-26	-28	-29	-31	-32	-34	-35	-37	-38	-40	-41	-43	-44	-46	-47	-49	-51
9	-31	-33	-35	-37	-39	-41	-43	-46	-48	-50	-52	-54	-56	-58	-61	-63	-65	-67	-69	-71
10	-37	-40	-43	-45	-48	-50	-53	-56	-58	-61	-64	-66	-69	-71	-74	-77	-79	-82	-84	-87
11	-42	-44	-47	-50	-53	-56	-59	-62	-65	-68	-71	-74	-76	-79	-82	-85	-88	-91	-94	-97
12	-43	-46	-49	-52	-55	-58	-61	-64	-67	-70	-73	-76	-79	-82	-85	-88	-91	-94	-97	-100
13	-41	-44	-47	-50	-53	-56	-59	-62	-65	-67	-70	-73	-76	-79	-82	-85	-88	-91	-93	-96
14	-37	-40	-42	-45	-47	-50	-53	-55	-58	-60	-63	-65	-68	-71	-72	-76	-78	-81	-84	-86
15	-30	-32	-34	-36	-38	-41	-43	-45	-47	-49	-51	-53	-55	-57	-59	-62	-64	-66	-68	-70
16	-21	-23	-24	-25	-27	-28	-30	-31	-33	-34	-36	-37	-39	-40	-42	-43	-45	-46	-48	-49
17	-11	-11	-12	-13	-14	-14	-15	-16	-17	-17	-18	-19	-20	-20	-21	-22	-22	-23	-24	-25
18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	12	13	13	14	15	16	17	17	18	19	20	21	21	22	23	24	25	26	26	27
20	22	24	25	27	28	30	31	33	34	36	37	39	40	42	44	45	47	48	50	51
21	31	33	35	37	39	42	44	46	48	50	52	55	57	59	61	63	65	67	70	72
22	38	40	43	45	48	51	53	56	59	61	64	66	69	72	74	77	80	82	85	87
23	42	45	48	50	53	56	59	62	65	68	71	74	77	80	82	85	88	91	94	97

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR-SOLAR TIDE K_1, TO BE USED ALSO IN TABULATING THE TIDES S_1 AND P. K_1, S_1, P.

Hours of mean time.	AMPLITUDE. 103	106	109	112	115	118	121	124	127	130	133	136	139	142	145	148	151	154	157	160
0	103	106	109	112	115	118	121	124	127	130	133	136	139	142	145	148	151	154	157	160
1	99	102	105	108	111	114	117	120	123	126	128	131	134	137	140	143	146	149	152	155
2	89	92	94	97	99	102	105	107	110	112	115	118	120	123	125	128	131	133	136	138
3	72	75	77	79	81	83	85	88	90	92	94	96	98	100	102	104	107	109	111	113
4	51	53	54	56	57	59	60	62	63	65	66	68	69	71	72	74	75	77	78	80
5	26	27	28	29	29	30	31	32	32	33	34	35	35	36	37	38	39	39	40	41
6	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
7	-27	-28	-29	-30	-30	-31	-32	-33	-34	-34	-35	-36	-37	-37	-38	-39	-40	-41	-41	-42
8	-52	-54	-55	-57	-58	-60	-61	-63	-64	-66	-67	-69	-70	-72	-73	-75	-76	-78	-79	-81
9	-73	-75	-78	-80	-82	-84	-86	-88	-90	-93	-95	-97	-99	-101	-103	-105	-108	-110	-112	-114
10	-89	-92	-95	-97	-100	-103	-105	-108	-110	-113	-116	-118	-121	-124	-126	-129	-132	-134	-137	-139
11	-100	-103	-106	-108	-111	-114	-117	-120	-123	-126	-129	-132	-135	-137	-140	-143	-146	-149	-152	-155
12	-103	-106	-109	-112	-115	-118	-121	-124	-127	-130	-133	-136	-139	-142	-145	-148	-151	-154	-157	-160
13	-99	-102	-105	-108	-111	-114	-117	-119	-122	-125	-128	-131	-134	-137	-140	-143	-145	-148	-151	-154
14	-89	-91	-94	-96	-99	-102	-104	-107	-109	-112	-115	-117	-120	-122	-125	-127	-130	-133	-135	-138
15	-72	-74	-76	-78	-80	-82	-85	-87	-89	-91	-93	-95	-97	-99	-101	-103	-106	-108	-110	-112
16	-50	-52	-53	-55	-56	-58	-59	-61	-62	-64	-65	-67	-68	-70	-71	-73	-74	-76	-77	-79
17	-25	-26	-27	-28	-28	-29	-30	-31	-31	-32	-33	-34	-34	-35	-36	-37	-37	-38	-39	-40
18	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
19	28	29	30	30	31	32	33	34	35	35	36	37	38	39	39	40	41	42	43	44
20	53	54	56	57	59	60	62	63	65	67	68	70	71	73	74	76	77	79	80	82
21	74	76	78	80	83	85	87	89	91	93	95	98	100	102	104	106	108	111	113	115
22	90	93	95	98	101	103	106	108	111	114	116	119	121	124	127	129	132	135	137	140
23	100	103	106	109	112	114	117	120	123	126	129	132	135	138	141	144	147	150	152	155

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR TIDE O. O.

Hours of mean time.	AMPLITUDE. 1	2	3	4	5	6	7	8	9	10	13	16	19	22	25	28	31	34	37	40
0	1	2	3	4	5	6	7	8	9	10	13	16	19	22	25	28	31	34	37	40
1	1	2	3	4	5	6	7	8	9	10	13	16	18	21	24	27	30	33	36	39
2	1	2	3	4	4	5	6	7	8	9	11	14	17	19	22	25	27	30	33	35
3	1	1	2	3	4	4	5	6	7	7	10	12	14	16	19	21	23	25	28	30
4	1	1	2	2	3	3	4	5	5	6	7	9	11	12	14	16	17	19	21	23
5	0	1	1	1	2	2	2	3	3	3	5	6	7	8	9	10	11	12	13	14
6	0	0	0	0	1	1	1	1	1	1	1	2	2	2	3	3	3	4	4	4
7	0	0	0	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-3	-3	-4	-4	-4	-5	-5
8	0	-1	-1	-1	-2	-2	-3	-3	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-14	-15
9	-1	-1	-2	-2	-3	-3	-4	-5	-5	-6	-8	-9	-11	-13	-15	-16	-18	-20	-21	-23
10	-1	-2	-2	-3	-4	-5	-5	-6	-7	-8	-10	-12	-14	-17	-19	-21	-24	-26	-28	-30
11	-1	-2	-3	-4	-4	-5	-6	-7	-8	-9	-12	-14	-17	-20	-22	-25	-28	-30	-33	-36
12	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-13	-16	-19	-21	-24	-27	-30	-33	-36	-39
13	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-13	-16	-19	-22	-25	-28	-31	-34	-37	-40
14	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-13	-15	-18	-21	-24	-27	-30	-33	-36	-39
15	-1	-2	-3	-3	-4	-5	-6	-7	-8	-9	-11	-14	-17	-19	-22	-24	-27	-30	-32	-35
16	-1	-1	-2	-3	-4	-4	-5	-6	-7	-7	-9	-12	-14	-16	-18	-20	-23	-25	-27	-29
17	-1	-1	-2	-2	-3	-3	-4	-4	-5	-6	-7	-9	-10	-12	-14	-15	-17	-18	-20	-22
18	0	-1	-1	-1	-2	-2	-2	-3	-3	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13
19	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-3	-3	-3	-4
20	0	0	0	1	1	1	1	1	1	2	2	2	3	3	4	4	5	5	6	6
21	0	1	1	2	2	2	3	3	3	4	5	6	7	9	10	11	12	13	14	16
22	1	1	2	2	3	4	4	5	5	6	8	10	11	13	15	17	19	20	22	24
23	1	2	2	3	4	5	5	6	7	8	10	12	15	17	19	22	24	26	29	31

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR TIDE O. O.

Hours of mean time.	AMPLITUDE. 43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
0	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
1	42	45	48	50	53	56	59	62	65	68	71	74	77	80	83	85	88	91	94	97
2	38	41	43	46	49	51	54	57	59	62	65	67	70	72	75	78	80	83	86	88
3	32	34	37	39	41	43	45	48	50	52	54	57	59	61	63	66	68	70	72	75
4	24	26	28	29	31	33	34	36	38	39	41	43	44	46	48	50	51	53	55	56
5	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	31	32	33	34	35
6	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10	11	11
7	-6	-6	-6	-7	-7	-8	-8	-8	-9	-9	-10	-10	-10	-11	-11	-12	-12	-12	-13	-13
8	-16	-17	-18	-19	-20	-21	-22	-23	-25	-26	-27	-28	-29	-30	-31	-32	-33	-34	-36	-37
9	-25	-27	-28	-30	-32	-34	-35	-37	-39	-41	-42	-44	-46	-48	-49	-51	-53	-55	-56	-58
10	-33	-35	-37	-40	-42	-44	-46	-49	-51	-53	-56	-58	-60	-62	-65	-67	-69	-72	-74	-76
11	-38	-41	-44	-46	-49	-52	-55	-57	-60	-63	-65	-68	-71	-73	-76	-79	-81	-84	-87	-89
12	-42	-45	-48	-51	-54	-57	-60	-62	-65	-68	-71	-74	-77	-80	-83	-86	-89	-92	-95	-98
13	-43	-46	-49	-52	-55	-58	-61	-64	-67	-70	-73	-76	-79	-82	-85	-88	-91	-94	-97	-100
14	-41	-44	-47	-50	-53	-56	-59	-62	-65	-68	-70	-73	-76	-79	-82	-85	-88	-91	-94	-97
15	-38	-40	-43	-45	-48	-51	-53	-56	-58	-61	-64	-66	-69	-72	-74	-77	-79	-82	-85	-87
16	-31	-34	-36	-38	-40	-42	-45	-47	-49	-51	-53	-56	-58	-60	-62	-64	-67	-69	-71	-73
17	-23	-25	-27	-28	-30	-32	-33	-35	-36	-38	-40	-41	-43	-45	-46	-48	-50	-51	-53	-54
18	-14	-15	-16	-17	-18	-19	-20	-21	-22	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-33
19	-4	-4	-4	-5	-5	-5	-5	-6	-6	-6	-7	-7	-7	-7	-8	-8	-8	-8	-9	-9
20	7	7	8	8	8	9	9	10	10	11	11	12	12	13	13	14	14	14	15	15
21	17	18	19	20	21	23	24	25	26	27	28	29	31	32	33	34	35	36	38	39
22	26	28	29	31	33	35	36	38	40	42	44	45	47	49	51	53	54	56	58	60
23	38	36	38	40	43	45	47	50	52	54	57	59	61	63	66	68	70	73	75	77

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR TIDE N. N.

Hours of mean time.	AMPLITUDE. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	2	3	4	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18
2	1	1	2	2	3	3	4	4	5	5	6	7	7	8	8	9	9	10	10	11
3	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2
4	0	-1	-1	-2	-2	-2	-3	-3	-4	-4	-4	-5	-5	-6	-6	-6	-7	-7	-8	-8
5	-1	-2	-2	-3	-4	-5	-6	-5	-7	-8	-9	-9	-10	-11	-12	-13	-13	-14	-15	-16
6	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20
7	-1	-2	-3	-4	-5	-6	-7	-8	-9	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19
8	-1	-1	-2	-3	-3	-4	-5	-5	-6	-7	-7	-8	-9	-9	-10	-11	-11	-12	-13	-14
9	0	0	-1	-1	-1	-1	-2	-2	-2	-2	-3	-3	-3	-3	-4	-4	-4	-4	-5	-5
10	0	1	1	1	1	1	2	2	2	3	3	3	3	3	4	4	4	4	5	5
11	1	1	2	3	3	4	5	5	6	7	7	8	9	10	10	11	12	12	13	14
12	1	2	3	4	5	6	7	8	9	9	10	11	12	13	14	15	16	17	18	19
13	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
14	1	2	2	3	4	5	6	6	7	8	9	9	10	11	12	13	13	14	15	16
15	0	1	1	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	8
16	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2
17	-1	-1	-2	-2	-3	-3	-4	-4	-5	-6	-6	-7	-7	-8	-8	-9	-9	-10	-10	-11
18	-1	-2	-3	-4	-4	-5	-6	-7	-8	-9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18
19	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20
20	-1	-2	-3	-4	-4	-5	-6	-7	-8	-9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18
21	-1	-1	-2	-2	-3	-3	-4	-4	-5	-5	-6	-6	-7	-8	-8	-9	-9	-10	-10	-11
22	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2
23	0	1	1	2	2	2	3	3	4	4	4	5	5	6	6	7	7	7	8	8

TABLE IV. HOURLY VALUES FOR DIFFERENT AMPLITUDES OF THE LUNAR TIDE N. N.

Hours of mean time.	AMPLITUDE. 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
0	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	33	34	35
2	11	12	13	13	14	14	15	15	16	16	17	17	18	19	19	20	20	21	21	22
3	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3
4	-8	-9	-9	-10	-10	-10	-11	-11	-12	-12	-12	-13	-13	-14	-14	-15	-15	-15	-16	-16
5	-17	-17	-18	-19	-20	-21	-21	-22	-23	-24	-25	-25	-26	-27	-28	-28	-29	-30	-31	-32
6	-21	-22	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-33	-34	-35	-36	-37	-38	-38	-39
7	-20	-21	-22	-23	-24	-25	-26	-26	-27	-28	-29	-30	-31	-32	-33	-34	-35	-36	-37	-38
8	-14	-15	-16	-16	-17	-18	-18	-19	-20	-20	-21	-22	-22	-23	-24	-24	-25	-26	-26	-27
9	-5	-5	-6	-6	-6	-6	-7	-7	-7	-7	-8	-8	-8	-8	-9	-9	-9	-9	-9	-10
10	5	5	6	6	6	6	7	7	7	8	8	8	8	8	9	9	9	9	10	10
11	14	15	16	16	17	18	18	19	20	21	21	22	22	23	24	25	25	26	27	27
12	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	35	36	37	38
13	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	35	36	37	38	39
14	17	17	18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	31
15	8	9	9	10	10	10	11	11	12	12	12	13	13	13	14	14	15	15	15	16
16	-2	-2	-2	-2	-2	-2	-2	-2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-4
17	-12	-12	-13	-13	-14	-14	-15	-15	-16	-17	-17	-18	-18	-19	-19	-20	-20	-21	-22	-22
18	-19	-19	-20	-21	-22	-23	-24	-25	-26	-26	-27	-28	-29	-30	-31	-32	-33	-34	-34	-35
19	-21	-22	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-33	-34	-35	-36	-37	-38	-39	-40
20	-18	-19	-20	-21	-22	-23	-24	-25	-25	-26	-27	-28	-29	-30	-31	-32	-32	-33	-34	-35
21	-11	-12	-12	-13	-14	-14	-15	-15	-16	-16	-17	-17	-18	-18	-19	-19	-20	-21	-21	-22
22	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-3	-3	-3	-3	-3	-3	-3	-3
23	9	9	9	10	10	11	11	11	12	12	13	13	13	14	14	15	15	16	16	16

§ 16.

TIDAL CONSTANTS.

In § 12 it has been fully explained how tidal constants may be interpreted and in the preceding paragraph a method has been given which enables the student to draw tidal curves for any day or series of days; in this paragraph, therefore, verbal descriptions of the characteristics of the tides can be dispensed with.

The constants relating to the annual and semi-annual variations of the mean height of the water-level are given only when they could be determined without ambiguity, which is the case, either when these fluctuations are strongly marked, or when the series of observations extend over many years, so that the aperiodic motions are eliminated from the general result and reliable average values can be deduced.

In printing the results of the observations the different stations are not always arranged according to their geographical position, because the work is still in progress and some results are coming off whilst the printing is going on.

1. Tandjong-Priok Harbour.

Java-sea, north coast of *Java*, near *Batavia*. Long. 106°.9 E., Lat. 6°.1 S.

The tidal constants have been computed from observations made by means of a self-registering instrument.

	1887—1888.		1890—1891.		1891—1892.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_1	2.5 cm.	21°	3.1 cm.	19°	2.1 cm.	27°	2.6 cm.	22°
S_2	5.7	294	5.4	291	5.8	287	5.6	291
M_2	4.8	347	5.5	354	5.5	355	5.3	352
K_1	26.5	144	26.8	141	26.7	144	26.7	143
O	13.6	121	13.6	105	13.9	130	13.7	119
P	7.3	146	8.0	144	7.0	138	7.4	143
N	2.0	311	2.0	322	2.1	317	2.0	317
K_2	2.1	271	2.4	269	2.2	264	2.2	268

The constants of the tides S a and S s a, as calculated from the three series, exhibit so many discrepancies, that it is impossible to deduce accurate average values.

2. Edam Island.

Java-sea, north coast of *Java*, near *Tandjong-Priok Harbour*. Long. 106°.8 E., Lat. 6°.0 S.

The tidal constants are computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m.

	1893—1894.		1894—1895.		1895—1896.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_2	3.6 cm.	264°	3.4 cm.	278°	4.2 cm.	278°	3.7 cm.	273°
M_2	4.9	294	5.1	300	4.5	288	4.8	294
K_1	16.0	137	14.8	148	14.6	140	15.1	142
O	7.8	126	7.4	134	7.9	126	7.7	129
P	6.2	110	5.9	155	5.8	109	6.0	125
N	1.5	16	1.4	306	1.7	284	1.5	322
K_2	1.9	32	1.1	15	3.0	45	2.0	31
S a	—	—	—	—	—	—	1.7	172
S s a	—	—	—	—	—	—	2.3	143

The annual and semi-annual variations, though small, are well marked in the monthly means for the three years; the former motion causes high water-level about mid-September, and low water-level about the middle of March; the latter high water on June 2 and December 2, and low water on September 1 and March 3.

The effect of the two periodic motions is: a principal maximum in October, a secondary maximum in June; a principal minimum in March, and a secondary minimum in September.

3. Duizend Eilanden.

Java-sea, western parts. Long. 106°.5 E., Lat. 5°.6 S.

The tidal constants have been computed from a series of eye-observations, taken at the hours 6 a. m., noon, 6 p. m. and midnight, during the period of one year, on the occasion of the hydrographic survey of these isles. Current observations have been made at all hours; the constants are the result of an arrangement according to different periods of 4277 observations.

	Tides.		Tidal streams, sea-miles per 24 hours.		
	A.	k.	A.	k.	Direction pos. sign.
S_1	4.0 cm.	219°	—	—	—
S_2	5.5	11	0.72 cm.	67°	E
M_2	0.8	266	1.59	240	E
K_1	28.1	165	1.75	347	N E
O	6.6	138			
P	10.6	157			
N	0.5	314			
K_2	2.0	294			

Constants for annual and semi-annual variations cannot be given here.

4. Boompjes Island.

Java-sea, north coast of *Java*. Long. 108°.4 E., Lat. 5°.9 S.

The tidal constants are computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of 5 years.

	1890—1891.		1891—1892.		1892—1893.		1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	5.1 cm.	195°	4.8 cm.	178°	6.8 cm.	232°	5.3 cm.	228°	6.0 cm.	209°	5.9 cm.	219°
M_2	11.9	319	11.9	323	11.2	316	12.0	326	10.9	321	11.5	323
K_1	15.6	100	15.3	109	20.3	95	13.8	100	16.3	107	16.0	102
O	5.6	124	7.8	111	6.5	120	8.2	114	8.1	114	7.2	116
P.	4.5	97	1.7	156	6.7	52	1.1	72	3.9	123	3.0	85
N	4.8	292	3.4	288	4.4	274	3.6	5	3.3	264	3.3	293
K_2	2.8	192	3.9	197	8.4	180	4.1	176	3.0	232	4.2	191
S a.	—	—	—	—	—	—	—	—	—	—	3.4	103
S s a.	—	—	—	—	—	—	—	—	—	—	1.6	107

The annual and semi-annual variations of the mean water-level, though small, are well marked in the monthly means for the five years; the former causes high water about July 4 and low water about January 2; the latter high water on May 15 and November 14, and low water on February 13 and August 14.

In the current-observations no trace of tidal streams could be found; they only exhibit the fact, that the current sets to the eastward from December to March, with a maximum of frequency in January and February; and to the westward from April to November, with greatest frequency (100 %) in July, August, September and October; taken over the whole year, there is a considerable surplus of transfer of water to the westward or i. o. w. the east-monsoon currents are stronger and of longer duration than the west-monsoon currents.

5. Karimon Djawa Isles.

Java-sea. Long. 110°.4 E., Lat. 5°.9 S.

The tidal constants have been computed from eye-observations taken at the hours 7 a. m., 9 a. m., 11 a. m., 1 p. m., 3 p. m. and 5 p. m. during the period March 1887 to February 1888, on the occasion of the hydrographic survey of this group of isles. During this time 4600 current-observations were made, from which the tidal constants have been calculated; the period of one year is evidently too short to allow constants for annual and semi-annual movements being calculated with any degree of accuracy.

	Tides.		Tidal streams, sea-miles per 24 hours.		
	A.	k.	A.	k.	Direction pos. sign.
S_1	1.4 cm.	141°	0.47 cm.	244°	N
S_2	5.1	344	—	—	—
M_2	2.1	246	0.66	91	N E
K_1	23.3	357	1.37	201	E
O	3.7	262			
P	9.3	327			
N	1.0	42			
K_2	1.6	22			

6. Semarang.

Java-sea, north coast of *Java*. Long. 110°.4 E., Lat. 7°.0 S.

The tidal constants have been computed from hourly eye-observations of an ordinary tide-gauge, taken during the period of a complete year.

	A.	k.
S_1	5.6 cm.	331°
S_2	3.3	160
M_2	4.7	283
K_1	18.2	26
O	4.4	254
P	3.6	10
N	1.6	256
K_2	1.8	247
Sa	11.4	77

The annual oscillation of the mean water-level is well marked and causes high water to occur about June 7, and low water about December 7.

7. Bawean-Island.

Java-sea, eastern parts. Long. 112°.7 E., Lat. 5.9 S.

The tidal constants have been computed from eye-observations taken at the hours 6 a. m., 8 a. m., 10 a. m., noon, 2 p. m., 4 p. m. and 6 p. m. on the road of *Sangkapura* during a period of eight months, on the occasion of the hydrographic survey.

At the same time 4290 current-observations have been made, at all hours of the day, but not at the same place, from which also tidal constants have been calculated.

	Tides.		Tidal streams, sea-miles per 24 hours.		
	A.	k.	A.	k.	Direction pos. sign.
S_1	7.6 cm.	187°	0.42 cm.	189°	N N W
S_2	4.5	16	0.79	267	E
M_2	3.9	72	2.05	139	E
K_1	43.0	326	1.62	170	E
O	24.8	300			
P	12.5	297			
N	3.4	116			
K_2	2.8	315			

The annual and semi-annual variations, as deduced from these data, are very small and cannot be regarded as sufficiently accurate.

8, 9. Udjong Pangka (Long. 112°.6 E., Lat. 6°.9 S.); **Arisbaya** (Long. 112°.8 E., Lat. 6°.9 S.). *Java-sea.*

The tidal constants for these two places, situated resp. near the north-western and north-eastern entrances to *Surabaya-strait*, on the north coasts of *Java* and *Madura*, have been computed from observations made by means of self-registering tide-gauges during the period of one complete year.

	Udjong Pangka.		Arisbaya.	
	A.	k.	A.	k.
S_1	6.3 cm.	341°	4.6 cm.	341°
S_2	5.8	12	6.4	9
M_2	3.0	133	2.3	104
K_1	50.6	326	51.5	326
O	23.7	279	24.4	262
P	16.5	343	11.7	335
N	2.2	109	2.0	93
K_2	1.7	16	2.5	3

10. Sembilangan, *Surabaya-strait*. Long. 112°.7 E., Lat. 7°.1 S.

The tidal constants are computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of 4 years.

	1890—1891.		1891—1892.		1892—1893.		1893—1894.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	14.7 cm.	11°	18.9 cm.	0°	16.2 cm.	0°	13.2 cm.	13°	15.7 cm.	5°
M_2	18.1	348	16.2	356	19.7	352	18.2	7	18.0	356
K_1	46.7	323	46.8	312	52.3	321	48.1	321	47.0	318
O	22.7	277	24.9	270	25.9	276	26.3	283	24.9	277
P	17.7	314	5.7	310	11.1	320	11.5	305	11.5	313
N	3.5	344	3.6	345	2.2	359	4.0	11	3.3	348
K_2	7.1	9	3.0	335	5.4	2	3.6	3	4.6	1
Sa	—	—	—	—	—	—	—	—	11.1	103
Ssa	—	—	—	—	—	—	—	—	5.6	150

The annual variation causes high water to occur about July 4, and low water about January 4; the semi-annual fluctuation causes high water on June and December 4 and low water on September and March 4.

11. Surabaya-strait. Current-observations. Under the superintendence of Mr. J. C. Ribbers C. E. hourly observations of the velocity and direction of surface-currents have been made during the period of a full year and at two stations in the strait.

At the first station, denoted by F and situated near *Sembilangan*, the number of observations amount to 7723; at the second station, denoted by L, established at a distance of 6.7 kilometers southward from *Sembilangan*, 7380 observations have been registered.

A positive sign corresponds to a northward, a negative sign to a southward motion of the water.

	Station F.			Station L.		
	A.		k.	A.		k.
	0.01 miles per hour.	Cm. per second.		0.01 miles per hour.	Cm. per second.	
S_1	14.1	7.3	183°	9.6	4.9	201°
S_2	60.3	31.0	26	40.6	20.9	10
M_2	176.5	90.8	36	111.8	57.5	31
K_1	34.9	18.0	243	30.0	15.4	235
O	8.3	4.3	48	6.3	3.2	145
N	31.7	16.3	359	20.9	10.8	5
K_2	15.4	7.9	44	7.1	3.7	21
Sa	13.5	6.9	165	2.4	1.2	201
Ssa	10.1	5.2	164	9.4	4.8	142
W	8.4	4.3		—7.1	—3.7	

12, 13, 14, 15. Surabaya (Long. 112°.6 E., Lat. 7°.2 S.); **Pasuruan** (Long. 112°.9 E., Lat. 7°.6 S.); **Gading** (Long. 112°.9 E., Lat. 7°.2 S.); **Karang Kleta** (Long. 112°.8 E., Lat. 7°.3 S.).

The tidal constants for these places, situated in *Madura-strait*, have been computed from observations taken by means of self-registering tide-gauges, during the period of one full year.

	Surabaya.		Pasuruan.		Gading.		Karang Kleta.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_1	2.0 cm.	83°	2.4 cm.	95°	1.5 cm.	40°	5.2 cm.	349°
S_2	26.4	355	30.4	343	30.4	346	29.3	346
M_2	44.3	351	59.6	340	59.2	344	59.3	341
K_1	46.9	318	44.5	304	46.0	308	45.0	304
O	27.2	284	26.1	276	25.9	269	27.2	275
P	14.2	321	14.8	302	13.9	306	14.2	326
N	9.1	337	11.3	332	12.3	325	15.7	317
K_2	8.0	357	8.0	342	8.1	356	4.9	349
Sa	3.4	292	2.3	40	1.5	79	2.3	33
Ssa	6.6	165	3.0	142	3.9	154	3.2	126

The constants for *Surabaya* have been calculated by the late Mr. H. YPES and were published for the first time in the Proceedings of the Royal Institute of Engineers, Vol. 1885—1886.

16. Zwaantjes-droogte.

Madura-strait. Long. 113°.1 E., Lat. 7°.5 S. The tidal constants for this place have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of 2 years.

	1892—1893.		1893—1894.		Mean.	
	A.	k.	A.	k.	A.	k.
S_2	26.1 cm.	342°	20.7 cm.	346°	23.4 cm.	344°
M_2	46.8	331	43.9	335	45.3	333
K_1	49.6	303	45.0	311	47.2	307
O	21.0	271	22.3	275	21.6	273
P	6.0	279	10.7	304	8.2	295
N	7.8	315	8.6	328	8.1	322
K_2	8.5	57	3.5	74	5.9	62
S a	—	—	—	—	—	—
S sa	2.5	112	4.5	100	3.5	105°

The annual oscillation S a cannot be determined from this series with any degree of accuracy.

The constants of the M_2 tide-stream are: for the first year, A = 30 %, k = 76°; for the second year, A = 38 %, k = 65° or, on the average, A = 34 %, k = 71°.

For other tides no reliable results have been deduced from the available data.

17. Meinderts-droogte.

Long. 114°.4 E., Lat. 7.6 S., near the most eastern point of *Java.*

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of 4 consecutive years.

	1890—1891.		1891—1892.		1892—1893.		1893—1894.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	9.6 cm.	337°	10.8 cm.	335°	10.5 cm.	326°	12.0 cm.	341°	10.7 cm.	335°
M_2	24.0	326	25.6	327	26.7	326	24.8	326	25.3	326
K_1	36.2	302	38.2	302	34.4	308	33.6	298	35.6	303
O.	21.5	269	21.0	274	21.3	273	19.7	270	20.9	272
P.	6.0	285	8.7	298	12.2	303	4.3	293	7.8	295
N.	5.1	326	4.0	310	5.5	307	5.0	305	4.9	312
K_2	1.8	268	3.9	330	4.0	345	5.4	305	3.8	312
S a	—	—	—	—	—	—	—	—	8.3	10
S sa	—	—	—	—	—	—	—	—	5.5	136

The annual and semi-annual variations are well marked in the mean monthly values of the water-level: the former causes high water about 29 March and low water about 28 September, the latter high water on May and November 29 and low water on February and August 28.

The effect of the two superposed periodic motions is: a principal maximum in May and a principal minimum in September; and a secondary maximum and minimum resp. in January and March.

The constants for the tidal streams, as deduced from observations made during the two first years are:

	A.	k.	Direction for positive sign.
S_2	16.6 %	269°	N 29° E
M_2	24.3	130	N 39° E
K_1	17.2	119	N 39° E
S a	48.3	134	N 43° W
W	40.4		N 24° W

18. Banjuwangi. *Bali-strait.*

Long. 114°.4 E., Lat. 8°.2 S.

The tidal constants have been calculated from observations, taken at the hours 9 a. m., 2 p. m. and 6 p. m. during the year June 1895—May 1896.

	A.	k.
S_2	31.6 cm.	348°
M_2	42.8	293
K_1	27.0	300
O	14.5	263
P	6.8	342
N	10.5	257
K_2	4.7	285

The constants of the annual and semi-annual fluctuations can be determined only when the series of observations extend over several years.

19. Pulu Sapudi. Near the eastern point of *Madura Isle.*

Long. 114°.3 E., Lat. 7°.1 S.

The tidal constants have been calculated from observations, taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of 5 consecutive years.

	1890—1891.		1891—1892.		1892—1893.		1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	10.5 cm.	339°	13.5 cm.	338°	13.8 cm.	341°	13.4 cm.	341°	13.2 cm.	352°	13.0 cm.	342°
M_2	27.9	336	27.7	338	28.1	340	20.3	343	24.6	340	25.8	339
K_1	39.2	305	36.6	305	34.3	301	36.8	310	37.9	308	37.0	306
O	25.4	280	23.9	278	24.5	278	24.8	278	21.6	280	24.0	279
P	11.1	315	12.2	291	8.6	254	14.4	301	14.1	311	11.3	297
N	4.6	317	4.4	313	5.4	327	5.8	312	6.5	321	5.3	318
K_2	4.1	342	3.8	348	4.8	335	3.5	318	3.3	290	3.9	326
S a	2.4	206	15.6	351	9.3	101	7.7	347	9.1	52	5.9	61
S sa	1.7	156	4.7	215	5.4	158	4.5	109	5.6	199	3.8	169
W	95.7		96.8		113.2		110.6		116.1		105.7	

From these data it appears that the annual oscillation is liable to great variations from the one year to the other: in the monthly means for the whole period, however, the motion, though of small amplitude, is well marked: the annual fluctuation causes high water about May 22 and low water about November 21; the semi-annual oscillation causes high water about mid-June and December and low water about mid-September and March.

Observations of tidal streams have been made during one year only; the constants for *Sapudi-strait*, as deduced from this series, are:

	A.	k.
S_2	15 %	308°
M_2	42	331
K_1	87	273
S a	38	194
W	11	to the North.

From these results the conclusion may be drawn that the sidereal K_1 stream is the strongest, that the monsoon-currents set to the north with maximum strength about October 4, and to the south about April 4; and that, taken over the whole year, the quantity of water passing the strait in a northerly direction surpasses by 11 % that flowing southward.

In the formulae given above a positive sign corresponds to a northerly, a negative sign to a southerly motion of the water.

20. De Bril. A reef situated in the eastern parts of the *Java-sea,* between the south western point of *Celebes* and the *Sabalana* or *Postillon Isles.*

Long. 118°.9 E., Lat. 6°.1 S.

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of 4 consecutive years.

	1890—1891.		1891—1892.		1892—1893.		1893—1894.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	5.0 cm.	150°	3.2 cm.	145°	4.2 cm.	155°	6.1 cm.	164°	4.7 cm.	155°
M_2	21.1	21	19.3	11	21.8	20	21.5	22	21.1	19
K_1	29.1	300	24.6	300	28.3	288	31.9	297	28.5	296
O.	18.6	276	16.8	271	17.8	277	18.3	277	17.9	275
P.	8.8	291	11.7	277	5.5	239	6.8	265	8.3	272
N	5.7	355	3.1	338	5.1	342	6.0	352	5.0	348
K_2	0.3	162	0.6	43	0.9	24	0.3	317	—	—
Sa.	—	—	—	—	—	—	—	—	10.5	354°

The annual variation shows considerable discrepancies for the different years, but it is well marked in the monthly means for the whole period: it causes high water about mid-March and low water about mid-September; no semi-annual oscillation can be traced in the records.

The current-observations show many irregularities and, consequently, great difficulties are experienced in the analysis. The results, as deduced from a series extending over two years are:

	A.	k.	Direction for positive sign.
M_2	26 %	329°	N 16° E
K_1	18	244	N 28° E
Sa.	16	108	N 54° W
W	19 to the W.	—	—

The semi-diurnal S_2 stream cannot be determined with any degree of accuracy; the monsoon-current sets to the N 54° W with maximum strength about July 9 and to the S 54° E about January 6; the east-monsoon currents are stronger, or of longer duration, than the west-monsoon currents, there being a surplus of 19 % of currents to the westward.

21. Makasser. South-west coast of *Celebes*. Long. 119°.4 E., Lat. 5°.1 S.

The tidal constants have been computed from observations made at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of 2 consecutive years.

The annual variation is well marked in the height of the water-level, as well as in the currents: no trace of a semi-annual fluctuation has been found.

In the constants, by which the tidal streams are determined, a positive sign corresponds to a transfer of water to the north, a negative sign to a southward current.

	Tides.						Tidal streams.					
	1894—1895.		1895—1896.		Mean.		1894—1895.		1895—1896.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	10.1 cm.	184°	13.2 cm.	198°	11.7 cm.	191°	58 %	93°	49 %	106°	54 %	100°
M_2	8.2	63	7.8	72	8.0	68	27	9	35	37	31	23
K_1	27.1	303	29.3	302	28.2	303	24	165	23	119	24	142
O	13.3	266	19.3	271	16.3	269						
P.	9.8	277	9.9	322	9.9	300						
N	3.6	332	1.9	328	2.8	330						
K_2	3.1	229	4.1	209	3.6	219						
Sa.	12.4	312	13.3	355	12.9	333	18	92	42	121	30	107
W	292		300		296		—11		—16		—14	

The mean water-level is highest about January 22 and lowest about August 22; the monsoon-currents set to the northward with greatest force about July 8 and to the southward about January 6. Taken over the whole year the quantity of water flowing out of the strait to the south is greater than that running in a northerly direction.

22. Kotta Baru. Long. 116°.7 E., Lat. 3°.2 S. Northern point of *Pulu Laut*, at the south-western entrance of *Makasser-strait*.

The tidal constants, which considerably differ from those calculated for *Makasser*, are computed from hourly eye-observations made during a period of two months on the occasion of the hydrographic survey in 1890.

	A.	k.
S_2	49.2 cm.	216°
M_2	37.0	160
K_1	41.1	339
O	14.2	313
P	13.8	308
K_2	13.6	123

23. Singapore. Long. 103°.9 E., Lat. 1°.3 N.

The tidal constants have been computed from observations taken by means of a self-registering tide-gauge from October 1882 to October 1883 under the super-intendence of Major H. E. Mc Callum, R. E. (Proc. Royal Society, Vol. XLV, 1889).

	A.	k.
S_1	1.3 cm.	211°
S_2	27.2	348
M_2	66.0	300
K_1	24.1	100
O	24.1	53
P	7.4	93
N	11.4	272
K_2	8.1	345
Sa	7.9	209
Ssa	7.9	234

24. Kuala Ladjau. Long. 103°.6 E., Lat. 0°.4 S. One of the outlets of *Indragiri-river*, at the east coast of *Sumatra*, between *Baso-* and *Kluwang-Isles*.

The tidal constants are computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during the period of one year, August 1895 to July 1896.

In the formulae for the tidal streams a positive sign corresponds to an eastward motion of the water (out of the river) and a negative sign to a westward movement.

	Tides.		Tidal streams.	
	A.	k.	A.	k.
S_2	26.5 cm.	145°	24 %	241°
M_2	90.3	98	71	114
K_1	54.9	182	20	268
O.	49.6	108		
P.	12.7	171		
N	15.9	65		
K_2	22.7	93		
Sa.	23.0	286	3.7	244
Ssa.	8.8	85	11.5	50
W	242.3		14 % to the East.	

From these results it appears that both, the annual and semi-annual, oscillations of the water-level are well marked: the former causes high and low water resp. about January 5 and July 7; the latter causes high water in mid-February and August and low water about mid-May and November.

The effect of the two superposed periodic motions will be a maximum about January or February and a minimum in July, the difference between these extreme heights amounting to about 60 cm.

The results of the current-observations exhibit the fact that only a small percentage of the observed directions (14 %) is due to the regular outflow of the river-water and that an annual, as well as a semi-annual, motion occurs; the latter to and fro movement of the water is not to be regarded as a tidal phenomenon, but as an effect of the rainfall in these regions which (e. g. at *Ringgat)* shows also two maxima and two minima.

This connection between the periodic motions of the water-level, the direction of the currents, and the rainfall is shown in the following table:

	Mean water-level.	Mean direction current.	Mean rainfall, Ringgat.
August	—31 cm.	— 0.7 %	—59 mm.
September	— 4	3.3	—20
October	12	14.3	17
November	25	9.3	90
December	16	— 2.7	47
January	16	— 2.7	29
February	17	—11.7	—47
March	5	8.3	38
April	1	3.3	46
May	— 9	7.3	—17
June	—10	— 7.7	—53
July	—34	—20.7	—71
Annual mean	242	13.7	188

25. Tandjong Buton.

Southern coast of *Lingga-Isle*. Long. 104°.6 E., Lat. 0°.2 S.

The tidal constants have been computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during the year September 1895 to August 1896.

A comparison of the constants for this place with those given for *Singapore* and *Kuala Ladjau* shows that, in the passages of the *Riouw* and *Lingga Archipelago*, the tides degenerate in the same manner as near *Sembilangan* in *Surabaya-strait* (vide § 13, page 181).

The M_2 tide, which near *Kuala Ladjau* has an amplitude of 90 cm. has worn off to an amplitude of 19 cm. and, consequently, the mono-diurnal tides K_1, O and P, which show about equal strength to those near *Kuala Ladjau*, come into prominence and the tides assume an almost exclusively mono-diurnal character; the S_2 tide also diminishes, but to a less degree, so that the proportion of the amplitudes of the S_2 and M_2 tides considerably increases and tends to unity.

The M_2 tidal stream, however, remains pretty strong and bears no relation to the feeble local M_2 tide.

This is proved by the kappa-numbers of the tides proper and the tidal streams which are almost equal, so that the epoch of strongest currents (for this partial tide) corresponds to that of high or low water and not to those of strongest rise and fall.

On the other hand the kappa-numbers of the K_1 and O streams differ about 100° from those of the corresponding tides, which means that, if we consider the mono-diurnal tidal streams alone, the flood sets to the westward and the ebb to the eastward.

	Tides.		Tidal streams.	
	A.	k.	A.	k.
S_2	13.3 cm.	124°	6 %	0°
M_2	18.8	34	63	52
K_1	61.5	151	70	268
O	45.9	74	56	174
P	21.6	136		
N	4.1	15		
K_2	6.7	96		
Sa	11.7	273	25	262
Ssa	1.6	53	—	—
W	260.5		—14.5	

The constants for the annual variation show high water-level about December 23 and low water-level about June 23, that the seasonal currents set to the eastward with greatest strength about mid-December and to the westward about mid-June, and that, taken over the whole year, the westward currents are stronger, or of longer duration than the easterly currents.

26. Tandjong Kalean.

Banka-strait, northern entrance. Long. 105°.1 E., Lat. 2°.0 S.

The tidal constants have been computed from observations, taken at the hours 9 a. m., 2 p. m. and 6 p. m. during 4 years.

In the formulae for the tidal streams, a positive sign corresponds to an easterly (into the strait) a negative sign to a westerly current (out of the strait).

	Tides.									
	1890—1891.		1891—1892.		1892—1893.		1893—1894.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	9.9 cm.	217°	12.6 cm.	208°	12.6 cm.	195°	12.5 cm.	248°	11.9 cm.	241°
M_2	20.4	185	25.2	186	27.4	184	28.2	190	25.3	186
K_1	93.6	159	92.6	157	87.8	158	94.4	160	94.6	159
O.	56.0	96	53.6	94	47.3	92	61.4	91	54.6	93
P.	25.4	154	21.2	157	23.9	146	36.3	147	26.7	151
N.	7.1	202	3.8	144	4.8	158	5.7	160	5.4	166
K_2	1.9	248	3.5	189	7.4	234	1.1	304	3.5	244

	Tidal streams.									
	1890—1891.		1891—1892.		1892—1893.		1893—1894.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	21 %	158°	18 %	147°	17 %	156°	29 %	137°	21 %	150°
M_2	41	89	43	76	45	68	51	64	45	74
K_1	89	79	87	66	87	59	71	66	84	68
O.	49	12	46	357	41	359	48	2	46	3
W	—15		—17		—23		—26		—20	

From these results of the analysis it appears that, taken over the whole year, there is a considerable surplus of westward motion of the water under the *Banka* coast; or, i. o. w., that, on the whole, the quantity of water flowing out of the strait is greater than that entering the strait.

No constants for the annual and semi-annual motions are given, because they show considerable discrepencies for the different years. The following table exhibits the average monthly values of the height of the water-level and the direction of the currents, as deduced from the whole series of observations.

	Height of level.	Direction current.		Height of level.	Direction current.
January	— 0.3 cm.	— 4 %	July	— 2.5 cm.	— 7 %
February	— 3.8	10	August	— 2.3	—11
March	1.3	30	September	— 4.8	— 5
April	— 8.5	26	October	7.8	— 8
May	— 8.5	9	November	11.8	—14
June	— 0.5	— 6	December	10.8	—13
			Year	—	—20

27. Pulu Besar.

Southern entrance to *Banka-strait*. Long. 106°.1 E., Lat. 2°.9 S.

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of 5 years.

In the formulae for the tidal streams a positive sign corresponds to an eastward, a negative sign to a westward motion of the water.

	Tides.											
	1891.		1892.		1893.		1894.		1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	9.9 cm.	70°	9.5 cm.	65°	10.2 cm.	24°	12.9 cm.	61°	11.0 cm.	47°	10.7 cm.	53°
M_2	22.3	163	22.8	167	22.8	167	22.2	170	22.3	170	22.5	167
K_1	73.6	153	73.8	153	71.2	151	74.3	154	75.5	155	73.7	153
O	41.2	108	43.0	107	41.1	104	42.4	106	43.8	108	42.3	107
P	11.2	141	11.2	150	21.1	148	18.1	123	16.3	161	15.6	145
N	6.3	106	6.2	107	4.8	99	5.3	119	6.3	128	5.8	112
K_2	6.9	51	6.0	54	10.5	43	11.4	70	9.7	42	8.9	52
Sa.	—	—	—	—	—	—	—	—	—	—	12.0	262
Ssa.	—	—	—	—	—	—	—	—	—	—	2.4	180

	Tidal streams.					
	1891.		1892.		Mean.	
	A.	k.	A.	k.	A.	k.
S_2	21 %	257°	6 %	213°	13 %	248°
M_2	44	256	37	237	41	247
K_1	39	211	31	209	35	210
O	26	126	26	131	26	129
S a.	55	297	39	285	47	291
W.	— 6		1		— 3	

From these results it appears that, in the southern parts of *Banka-strait*, as in the northern parts, it is high water, caused by the annual fluctuation, about mid-December, when the west-monsoon is at its height and low water about mid-June, when the east-monsoon blows. In the *Java-sea* the reverse obtains the general level being higher during the east- than in the west-monsoon.

The currents flow with maximum strength to the eastward about mid-January and to the westward (into the strait) about mid-July.

28. Pulu Langkuas. Long. 107°.6 E., Lat. 2°.5 S.

A small isle near the north-western point of *Billiton Isle*, in the northern entrance to the *Gaspar-straits*.

Owing to the bad state of the sea, the tide-gauge has at times been washed away; consequently the series of observations are not continuous.

The tidal constants have been computed from four series of observations, taken at the hours 9 a. m., 2 p. m. and 6 p. m., each series extending over one year.

	1890—1891.		1891—1892.		1892—1893.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	3.3 cm.	64°	3.0 cm.	40°	2.5 cm.	7°	3.0 cm.	17°	3.0 cm.	43°
M_2	1.8	72	0.6	118	2.4	229	1.3	244	—	—
K_1	60.8	141	59.7	145	60.1	143	58.9	140	59.9	142
O.	38.9	84	37.7	87	36.8	88	38.1	85	37.9	86
P.	17.1	134	17.7	136	13.8	143	14.4	127	15.8	135
N.	1.4	54	2.8	67	1.5	11	1.3	253	—	—
K_2	2.4	327	2.3	45	2.8	199	3.9	12	—	—
S a.	—	—	—	—	—	—	—	—	20.6	283
S s a	—	—	—	—	—	—	—	—	2.0	138

The annual oscillation of the water-level is well marked in the monthly mean values for the whole series; it causes high water in the beginning of January and low water about July 1.

The semi-annual oscillation is smaller and causes high water about the end of May and November, low water about the end of August and February.

29. Ondiepwater Island. Long. 107°.2 E., Lat. 3°.3 S.

An isle opposite the south-western point of *Billiton Isle*, in the southern entrance to the *Clement-* and *Stoltze-straits*.

The tidal constants are computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during five consecutive years.

	1890—1891.		1891—1892.		1892—1893.		1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	7.3 cm.	32°	7.5 cm.	32°	7.2 cm.	55°	8.3 cm.	29°	6.9 cm.	63°	7.4 cm.	42°
M_2	7.9	60	7.9	63	8.5	72	7.2	67	7.2	68	7.7	66
K_1	54.1	142	53.6	144	55.1	146	52.4	144	49.4	143	52.9	144
O	27.5	95	30.6	99	25.4	104	28.3	98	28.0	97	28.0	99
P	12.0	147	12.8	142	13.5	145	10.5	145	11.0	134	12.0	143
N	3.8	81	3.7	42	1.7	112	1.8	51	2.4	58	2.7	69
K_2	4.6	126?	6.5	56	2.5	56	4.5	52	4.2	56	4.5	54
S a.	—	—	—	—	—	—	—	—	—	—	8.6	184
S s a. . . .	—	—	—	—	—	—	—	—	—	—	3.0	86

The annual and semi-annual oscillations of the water-level are well marked in the monthly means for the whole series: the former causes high water about September 24, and low water about March 25; the latter causes high water in the beginning of May and November, low water in the beginning of August and February.

30. Pemangkat. West coast of *Borneo*. Long. 109°.0 E., Lat. 1°.2 N.

The tidal constants have been computed from eye-observations taken at the hours 6 a. m., 2 p. m. and 6 p. m. near the outlet of the *Sambas Besar* river during a period of two years.

Owing to the fact, that the observations made at 6 a. m. and 6 p. m. correspond to symmetrical points in the S_2 curve, the constants for this tide cannot be computed directly from these data; this has been done, therefore, by making use of the „age of the tide" which has been deduced, as far as possible, from the records.

	Tides.						Tidal streams.					
	1892—1893.		1893—1894.		Mean.		1892—1893.		1893—1894.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	4.8 cm.	177°	4.2 cm.	177°	4.5 cm.	177°	—	—	—	—	—	—
M_2	27.7	111	23.8	111	25.8	111	29 %	48°	67 %	67°	48 %	58°
K_1	14.1	54	12.9	54	13.5	54	33	332	23	15	28	354
O	16.6	9	14.3	6	15.5	8						
P	4.6	224	4.3	216	4.5	220						
N	9.7	89	3.9	83	6.8	86						
K_2	1.5	328	2.7	350	2.1	339						
S a.	14.1	260	13.8	274	14.0	267						
S s a. . . .	2.4	104	—	—	—	—						

In the formulae for the tidal streams a positive sign denotes a motion of the water up the river, a negative sign corresponding to a downward motion.

The annual oscillation of the water-level is well marked in the monthly means; it causes high water about mid-December and low water about mid-June; no semi-annual oscillation can be ascertained from the available data with any degree of accuracy.

31. Pontianak. Long. 109°.3 E., Lat. 0°.0.

The capital of the residency, situated about 19 Kilometers from the entrance of the *Little Kapuas (Pontianak river)*.

The tidal constants are computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of three consecutive years.

In the formulae for the tidal streams a positive sign corresponds with an upward, a negative sign with a downward motion of the water.

	Tides.							
	1892—1893.		1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_2.	3.9 cm.	172°	5.4 cm.	178°	5.9 cm.	174°	5.1 cm.	175°
M_2	11.5	172	12.5	176	13.3	170	12.4	173
K_1	31.7	147	34.7	149	32.1	145	32.8	147
O	25.6	73	25.2	73	30.0	72	26.9	73
P.	9.5	133	10.5	161	7.7	148	9.2	148
N.	3.1	153	3.2	141	2.4	165	2.9	152
K_2	2.0	184	1.7	181	2.1	101	1.9	153
S a.	10.2	245	12.2	15	17.8	305	9.1	310
S s a	6.9	157	6.8	146	5.5	161	5.4	162
W	54.3		55.2		54.3		54.6	

	Tidal streams.							
	1892—1893.		1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_1.	—	—	—	—	—	—	16 %	110°
M_2	40 %	66°	53 %	62°	26 %	70°	40	66
K_1	89	91	87	93	79	97	85	94
S a.	17	19	19	12	15	22	17	18
W	—37		—30		—31		—33	

From these results its appears that the average annual water-level remains remarkably constant from the one year to the other and that the annual oscillations of the mean height — as dependent on the influence of the monsoons upon the average water-level of the sea — slightly varies, the epoch of highest water being January 29 and of lowest water July 31.

The semi-annual pulsation of the water-level is well marked and very constant, causing high water about mid-June and December and low water about the middle of the equinoctial months.

The constants by which the characteristics of the tidal streams are determined show, that about one third of the observed directions are due to the outflow of the water; that the K_1 currents predominate, and that the annual variation is remarkably constant, causing a maximum of seaward motion about April 8 and a minimum about October 8; this is in conformity with the results of the rainfall-observations which show a minimum from July to September and a maximum in the period October to March.

The observations also exhibit a well marked daily variation; if we consider — as is probable — that this diurnal fluctuation is due, not to the effect of a tidal current S_2, but to a meteorologic influence S_1 e. g. of land- and seabreezes, which causes the water to flow off more rapidly at night- than during day-hours, we find for the kappa-number corresponding to the average motion 110°, or, for the epoch of minimum outflow, $110°/15 = 7^h\ 20^m$ p. m. and for that of strongest downward current $7^h\ 20^m$ a. m.; this outcome of the observations points to another probable cause of this diurnal variation viz. a diurnal inequality in the rainfall.

32. Sukadana. Long. 109°.9 E., Lat. 1°.2 S.

West coast of *Borneo*, on the east-side of a large and shallow bay formed castward of *Maja* island.

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of two years.

	Tides.						Tidal streams.	
	1893—1894.		1894—1895.		Mean.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_1	—	—	—	—	—	—	50 %	221°
S_2	8.1 cm.	344°	9.5 cm.	355°	8.8 cm.	350°	—	—
M_2	10.4	330	11.7	325	11.1	328	8	182
K_1	56.7	146	65.5	136	60.9	141	100	82
O	33.5	99	39.0	96	36.2	98	—	—
P	10.3	123	4.6	170	6.9	137	—	—
N	0.5	352	1.7	337	1.1	345	—	—
K_2	5.9	352	10.4	329	8.0	341	—	—
S a	20.8	260	30.5	306	25.7	288	29	17
S s a	8.3	109	4.5	161	6.4	135	—	—
W	136.7		138.0		137.4		25	

The annual and semi-annual variations of the water-level are well marked in the monthly mean values; the former causes high water on January 9 and low water on July 9, the latter high water about the end of May and November, low water at the end of August and February.

In the formulae for the tidal streams a positive sign corresponds to a landward, a negative sign to a seaward motion of the water. The diurnal variation, as evident in the average values for the three hours at which the observations have been made, has been regarded as caused by a meteorological tide S_1; it is pretty strong and probably due to the situation of the place at the end of a bay and causes — on the average — high water about 3 o'clock at night.

The K_1 stream is by far the strongest; the meaning of the amplitude 100 % is, that at the time of greatest velocity, this partial stream is never outdone by any other motion or i. o. w. that at those epochs (twice a day) the probability of its occurrence is 100 % or certainty.

The meaning of 25 % for the total average is, that, taken over the whole year, the flood-motions surpass the ebb-motions, or that the flood is of longer duration than the ebbing.

33. Tjilatjap. Long. 109°.0 E., Lat. 7°.7 S.

Indian Ocean, south coast of *Java*.

The tidal constants are computed from observations made by means of a self-registering instrument, from June 1889 to May 1892.

	1889—1890.		1890—1891.		1891—1892.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_1	1.7 cm.	74°	1.5 cm.	67°	2.4 cm.	76°	1.9 cm.	72°
S_2	24.5	312	24.7	311	25.5	310	24.9	311
M_2	48.9	249	49.8	249	50.0	248	49.6	249
K_1	18.6	279	19.1	278	18.9	279	18.9	279
O	11.2	267	11.9	269	12.0	269	11.7	268
P	5.0	279	4.4	271	4.4	271	4.6	274
N	9.0	224	10.3	227	10.0	220	9.8	224
K_2	6.5	300	7.5	316	7.2	318	7.1	311

The annual and semi-annual fluctuations cannot be ascertained with any accurracy from the results of the three years.

34. Labuan. Long. 105°.2 E., Lat. 6°.4 S. *Indian Ocean*, west coast of *Java*.

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. from December 1894 to November 1895.

	Tides.		Tidal streams.		
	A.	k.	A.	k.	Direction pos. sign.
S_2	8.6 cm.	240°	29 %	59°	N 18° W
M_2	21.3	196	—	—	—
K_1	7.9	242	—	—	—
O	5.5	227			
P	1.8	19			
N	3.1	180			
K_2	4.0	307			
S a	3.7	324	—	—	—
S s a	6.6	174			
W	216.1		32		S 53° W

According to the constants of the annual fluctuation S a it is high water about mid-February and low water about mid-August; the semi-annual tide S s a causes high water about mid-June and December and low water about the middle of the equinoctial months; these results, as deduced from a series of observations extending over one year only, must be accepted with some reserve until they are corroborated by the outcome of other series.

Observations of current-directions have been made, but, as far as they go, they do not indicate well marked tidal or seasonal currents; the results of the investigation only point to a pretty strong S_2 stream and a perennial current to the S W.

35. Java's fourth Point. Long. 105°.9 E., Lat. 6°.1 S. *Sunda-strait.*

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of five consecutive years; the constants by which the tidal streams are determined have been calculated from two series of observations each extending over the period of one year.

	Tides.											
	1890—1891.		1891—1892.		1892—1893.		1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	12.8 cm.	287°	12.8 cm.	279°	12.5 cm.	272°	13.4 cm.	282°	12.4 cm.	278°	12.8 cm.	280°
M_2	21.5	208	23.4	207	26.7	212	26.4	205	23.1	216	24.2	210
K_1	6.9	237	5.3	223	7.8	223	7.1	215	7.1	230	6.8	226
O	2.8	210	3.9	206	3.7	216	3.1	234	3.3	215	3.4	216
P	2.3	176	3.3	293	0.3	191	2.1	184	1.9	133	1.7	171
N	4.0	196	3.2	190	4.2	201	4.5	183	4.4	180	4.1	190
K_2	2.1	289	2.8	289	1.9	273	3.8	286	1.9	15	2.5	299
S a	15.3	130	16.3	305	3.4	293	13.6	222	5.6	138	1.4	220
S s a	3.4	138	4.8	280	10.1	157	7.2	113	6.5	156	5.6	149
W	44.1		51.8		58.3		57.8		57.7		53.9	

	Tidal streams.					
	1890—1891.		1891—1892.		Mean.	
	A.	k.	A.	k.	A.	k.
S_2	11 %	316°	21 %	304°	16 %	310°
M_2	24	275	19	246	22	261
K_1	63	337	51	315	57	326
O	32	304	24	309	28	307
W	19 to S W.		30 to S W.		25 to S W.	

From these results it appears that in *Sunda-strait* the annual oscillation is very small; consequently the constants of S a considerably vary from the one year to the other; the semi-annual pulsation is better marked; it causes high water about June and December 5 and low water about the beginning of the equinoctial months.

The tidal streams evidently bear no relation whatever to the local tides, but are caused by a periodical egression of water from the *Java-sea*, in which the water-level principally oscillates according to the period of the mono-diurnal K_1 tide.

The results of this inquiry clearly show that in *Sunda-strait* there is a considerable perennial current to the south-westward, whilst no trace of monsoon-drift-current has been found.

36. Padang, Emma-harbour.

Long. 100°.3 E., Lat. 1°.0 S.

West coast of *Sumatra*.

The tidal constants are computed from observations made by means of a self-registering tide-gauge from July 1893 to June 1895.

	1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.
S_1	1.3 cm.	85°	1.3 cm.	28°	1.3 cm.	57°
S_2	14.0	220	14.8	217	14.4	219
M_2	32.4	174	33.9	176	33.2	175
K_1	12.6	275	12.8	278	12.7	277
O	7.5	266	7.4	264	7.5	265
P	4.2	276	3.7	277	4.0	277
N	6.6	161	7.9	152	7.3	157
K_2	4.0	208	4.0	206	4.0	207
S a.	7.8	154	7.9	133	7.9	144
S s a.	7.0	125	6.0	114	6.5	120
W	—9.8		—11.6			

According to the constants of the tide S a it is high water on August 14 and low water on February 13; the semi-annual fluctuation causes high water on May 21 and November 20 and low water on August 20 and February 19: consequently the maximum in August of S a is compensated by the minimum of S s a in the same month, but in February both minima coincide so that — on the average — the height of the water will then be about 15 cm. below mean water-level.

37. Ajerbangies.

Long. 99°.4 E., Lat. 0°.2 N.

West coast of *Sumatra*.

The tidal constants have been calculated from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of four consecutive years.

Observations of current-direction have been made also, but no outcome of this inquiry can be given here, because no tidal streams can be traced in the records; nor has it been possible to state a distinct seasonal to and fro motion of the water; the only well marked result is that, taken over the whole year, there is a pretty strong perennial current (35 %) to the southward.

	1891—1892.		1892—1893.		1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.	A.	k.
S_2	13.2 cm.	207°	17.8 cm.	192°	11.7 cm.	211°	15.7 cm.	201°	14.5 cm.	203°
M_2	27.2	154	23.8	165	26.9	163	31.4	159	27.3	160
K_1	15.1	273	14.7	280	16.8	258	20.0	276	16.6	272
O.	5.5	202	5.1	271	5.9	249	6.7	239	5.8	240
P.	2.1	165	8.1	243	8.8	194	6.5	160	4.3	198
N.	5.5	129	4.5	144	2.7	132	5.2	140	4.6	141
K_2	1.4	193	1.8	186	7.5	186	2.6	165	3.3	183
S a.	—	—	—	—	—	—	—	—	7.8	122
S s a.	—	—	—	—	—	—	—	—	4.6	106
W	134.1		126.1		117.1		130.0		127.0	

The annual and semi-annual fluctuations of the water-level are well marked in the monthly mean values for the whole period. The annual motion causes high water about July 23 and low water about January 21; the semi-annual tide causes high water about mid-May and November and low water about mid-August and February.

The effect of the two superposed periodical motions is a long period, viz. from April to November, in which the average height remains slightly above mean water-level, and a short period, viz. December to March, during which it sinks much more below mean water-mark than it is above it in the other months because both periodical motions coincide in causing a minimum about the end of January.

38. Pulu Tello. Long. 98°.3 E., Lat. 0°.1 S. One of the *Batu-Islands* group; *Indian Ocean* near *Sumatra's* west coast.

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during the year September 1895 to August 1896.

In the formulae for the tidal streams a positive sign corresponds to a northward, a negative sign to a southward motion of the water.

	Tides.		Tidal streams.	
	A.	k.	A.	k.
S_2	12.1 cm.	202°	5 %	135°
M_2	25.9	168	87	93
K_1	10.4	278	20	268
O	5.3	255		
P	3.2	288		
N	5.3	151		
K_2	2.9	177		
W	79.9		8 to the North.	

The period of one year is evidently too short to allow reliable constants for annual variation either of the average height or of the direction of the currents being deduced; these fluctuations, if any, are very feebly marked.

39. Natal. Long. 99°.1 E., Lat. 0°.6 N. West coast of *Sumatra*, in the bay of *Natal*.

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of two years, viz. June 1894—May 1896.

	1894—1895.		1895—1896.		Mean.	
	A.	k.	A.	k.	A.	k.
S_2	14.1 cm.	204°	13.5 cm.	207°	13.8 cm.	206°
M_2	28.6	172	29.6	177	29.1	175
K_1	13.0	279	10.8	272	11.9	276
O	6.3	253	5.9	262	6.1	258
P	0.2	261	3.4	284	1.8	273
N	5.2	163	7.0	150	6.1	157
K_2	3.3	216	3.5	229	3.4	223
S a.	10.0	163	4.9	61	7.5	112
S s a.	6.9	331	6.9	92	6.9	212
W	66.6		75.8		71.2	

From these results it appears that the constants relating to the annual and semi-annual fluctuations show considerable differences in the two series; the average kappa-number for S a accords well with that found for *Ajerbangies*, but the kappa-number for S s a widely differs.

40, 41. Gunung Sitoli and **Siboga.**

The former place is the capital of *Nias-Island* and is situated in Long. 97°.6 E., Lat. 1°.3 N; the latter place is situated on *Sumatra's* west coast near the entrance of *Siboga river* in Long. 98°.8 E. and Lat. 1°.7 N.

The tidal constants have been computed from observations made at the hours 9 a. m., 2 p. m. and 6 p. m. during the period of one year.

	Gunung Sitoli.		Siboga.	
	A.	k.	A.	k.
S_2	10.2 cm.	190°	3.1 cm.	138°
M_2	15.7	156	10.1	162
K_1	8.7	279	13.8	293
O	2.9	236	4.8	268
P	1.3	313	3.8	321
N	2.7	127	1.1	170
K_2	0.9	226	7.4	245
S a	11.6	156	5.5	88
S s a	4.0	108	5.8	166

According to the kappa-numbers of the annual fluctuation S a it is high water at *Gunung Sitoli* about August 26, and low water about February 26; at *Siboga* high water about mid-June and low water about mid-December.

The kappa-numbers of S s a show that the semi-annual variation of the water-level causes high water at *Gunung Sitoli* about mid-May and November, low water about mid-August and February; at *Siboga* high water in the middle of June and December, and low water about mid-September and March.

42. Baros. Long. 98°.4 E., Lat. 2°.0 N. West coast of *Sumatra.*

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during a period of three years.

	1893—1894.		1894—1895.		1895—1896.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_2	18.5 cm.	195°	15.9 cm.	207°	14.1 cm.	199°	16.2 cm.	200°
M_2	26.2	157	24.2	164	23.9	176	24.8	166
K_1	12.2	311	15.3	263	11.0	283	12.8	286
O	6.6	276	4.7	228	5.4	247	5.6	250
P	8.5	304	5.9	208	4.0	296	6.1	269
N	4.2	151	6.0	194	5.3	168	5.2	171
K_2	6.0	195	5.7	211	2.4	191	4.7	199
S a	—	—	—	—	—	—	4.8	284
S s a	—	—	—	—	—	—	2.5	261
W	72.8		96.6		110.0		93.1	

The annual and semi-annual fluctuations, though small and variable (as to amplitude and argument) from the one year to the other, is well marked in the monthly mean values for the whole period of three years.

According to the annual variation it is high water about the beginning of January and low water about the commencement of July; the semi-annual fluctuation causes high water about mid-May and November, and low water about the middle of February and August.

Near *Padang* and *Ajerbangies* the annual variation causes high water in July and August: this difference is probably due to the direction of the perennial currents, which near the equator run to the south, and in higher latitudes to the northward along *Sumatra's* west coast.

The results of an inquiry into the laws followed by the currents are very scanty; no trace has been found of tidal streams or annual variation; the only reliable outcome is that, taken over the whole year, the average directions of the currents at the hours 9 a. m., 2 p. m. and 6 p. m. are respectively: to the N 25° W, N 15° E and N 67° E, which show the influence of the land- and seabreezes and give evidence of a perennial current to the northward.

43, 44. Melabuh. Long. 96°.1 E., Lat. 4°.1 N. **Pulu Rajah.** Long. 95°.4 E., Lat. 4°.8 N. *Atjeh's* west coast.

The tidal constants have been computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during the period of one year; at the former station from August 1895 to July 1896, at the latter place from September 1895 to August 1896.

At *Pulu Rajah* the direction and velocity of the currents have been recorded as well; but, the tides being very feeble, it seems advisible not to publish the results concerning these phenomena before the series of observations extend over some more years.

The same remark applies to the annual and semi-annual variations.

	Melabuh.		Pulu Rajah.	
	A.	k.	A.	k.
S_2	9.4 cm.	218°	5.4 cm.	193°
M_2	14.1	194	3.7	216
K_1	8.1	301	8.7	311
O	4.5	283	1.2	244
P	2.7	345	8.0	156
N	2.7	192	1.1	133
K_2	2.7	253	5.4	95

45, 46. Oleh-leh and **Segli.**

Both places are situated at the north coast of *Atjeh*; the former in Long. 95°.3 E., and Lat. 5°.6 N; the latter in Long 96°.0 E., and Lat. 5°.3 N.

The tidal constants have been computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during the period of one year.

	Oleh-leh.		Segli.	
	1895—1896.		1895—1896.	
	A.	k.	A.	k.
S_2	15.6 cm.	331°	22.8 cm.	313°
M_2	22.3	289	33.8	273
K_1	6.4	336	13.7	309
O	3.3	317	4.3	288
P	2.2	338	4.3	84
N	3.5	294	8.6	287
K_2	2.3	274	7.3	336
S a	—	—	14.4	153
S s a	—	—	6.9	147

The annual and semi-annual oscillation of the mean water-level, as determined from this series for *Oleh-leh* cannot be regarded as sufficiently accurate; these seasonal fluctuations are evidently so small, that observations extending over many years will be required in order to obtain reliable average values.

At *Segli* these periodical variations are well marked: the annual oscillation causes high water about August 23 and low water about 22 February; the semi-annual fluctuation causes high water in the beginning of June and December, and low water about the beginning of September and March.

At *Segli* no current observations have been made; at *Oleh-leh* the outcome of the investigation is that two well marked tidal streams have been proved to exist viz. the S_2 stream with an amplitude of 50 % and the kappa-number 291°, and the M_2 stream with an amplitude of 54 % and a kappa-number 250°; in these formulae a positive sign corresponds to an eastward, a negative sign to a westward motion of the water.

From the differences (40°) between the kappa-numbers of the tides proper and the tidal streams it appears that the currents set to the eastward with greatest velocity about 1.3 hours before the moment of high water and, consequently, continue flowing in the same direction 1.7 hours after that epoch. The results of the observations give no evidence of any well marked seasonal or perennial currents.

47. Belawan Deli. Long. 98°.7 E., Lat. 3°.8 N.

East coast of *Sumatra, Malakka-strait.*

The tidal constants have been computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. from July 1895 to June 1896.

	A.	k.
S_2	29.3 cm.	76°
M_2	45.7	29
K_1	10.9	336
O	3.1	257
P	5.6	216
N	7.9	16
K_2	3.5	32
Sa	11.1	116
Ssa	4.9	305
W	115.7	

The annual and semi-annual variations of the average water-level seem to be well marked at this place; the constants of Sa and Ssa show that the former tide causes high water about the middle of July, and low water about the middle of January; the latter causes high water about February and August 22, and low water about May and November 23.

48. Tandjong Tiram. Long. 99°.5 E., Lat. 3°.3 N. East coast of *Sumatra*, *Malakka-strait*.

The tidal constants have been computed from eye-observations made at the hours 9 a. m., 2 p. m. and 6 p. m. during the year July 1895 to June 1896.

	Tides.		Tidal streams.	
	A.	k.	A.	k.
S_2	34.2 cm.	124°	37 %	245°
M_2	71.2	78	99	175
K_1	10.8	276		
O.	0.7	144		
P.	17.6	155		
N	14.8	68		
K_2	7.4	137		
Sa	29.2	108		
Ssa	4.9	71		
W	125.1		4 to the northward.	

The annual variation of the mean water-level is strongly marked and causes high water about June 8, and low water about December 8; the semi-annual oscillation is small, its kappa-number shows that it causes high water about the end of April and October, low water about January and July 26.

The currents are principally tide-currents; in the formulae a positive sign denotes a northward, a negative sign a southward motion of the water.

As the differences of the corresponding kappa-numbers of tides and streams are about 90°, it can be stated that the flood sets to the south and the ebb to the north.

There is also a trace of a perennial current to the northward but this outcome of the inquiry wants corroboration by continued observations; the results give no evidence of any well marked seasonal currents.

49. Bengkalis. Long. 102°.1 E., Lat. 1°.5 N. Situated on the west coast of *Bengkalis Isle*, in *Brouwer-strait*, southern parts of *Malakka-strait*.

The tidal constants have been computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. from July 1895 to June 1896.

In the formulae for the tidal streams a positive sign corresponds to a north-westward, a negative sign to a south-eastward motion of the water.

	Tides.		Tidal streams.	
	A.	k.	A.	k.
S_2	38.9 cm.	282°	22 %	46°
M_2	76.8	208	70	358
K_1	5.7	118	15	285
O.	23.6	127		
P.	12.6	77		
N	10.5	213		
K_2	5.0	281		
Sa	36.4	201		
Ssa	8.1	194		
W	173.3		12 to the N W.	

Owing to the influence of the *Siak* river the annual variation of the mean height of the water is strongly marked; it causes high water about mid-October and low water about mid-April.

The semi-annual fluctuation causes high water about May and November 8 and low water about February and August 7.

The M_2 tidal stream runs with greatest velocity to the south-westward about one hour before the moment of high water and consequently continues to flow in the same direction for about 2 hours whilst the water is falling.

The results of the investigation do not give evidence of an annual variation in the direction of the currents; they show merely a surplus transfer of water to the north-westward amounting to about 12 %.

50, 51, 52, 53. British North Borneo.
Labuan. Long. 115°.2 E., Lat. 5°.2 N.
Gaya. Long. 116°.1 E., Lat. 6°.1 N.
Kudat. Long. 116°.8 E., Lat. 6°.9 N.
Sandakan. Long. 118°.1 E., Lat. 5°.9 N.

At these four places tidal observations have been made at the hours 6 a. m., 9 a. m., noon, 3 p. m. and 6 p. m. under the superintendence of Dr. H. M. Walker, Principal Medical Officer; as the series commenced on January 1, 1896, observations made during six months are available whilst these lines are being written.

From these 910 records the K_1, P, O, M_2 and N tides have been calculated; the S_2 tide and the annual variation cannot well be computed before the series extend over at least one year.

The results given here are, therefore, to be considered as provisional.

	Labuan.		Gaya.		Kudat.		Sandakan.	
	A.	k.	A.	k.	A.	k.	A.	k.
M_2	22.4 cm.	294°	19.5 cm.	278°	20.1 cm.	270°	37.4 cm.	305°
K_1	46.4	312	43.5	302	33.8	325	57.7	282
O	28.4	276	27.1	274	26.1	275	25.4	299
P	19.0	345	10.3	355	25.7	310	38.7	182
N	4.6	281	4.4	260	4.1	238	6.5	271

54, 55. Kema, Long. 125°.1 E., Lat. 1°.4 N., at the most eastern point of *North-Celebes*, and **Gorontalo,** Long. 123°.1 E., Lat. 0°.5 N. in the *Gulf of Tomini* or *Gorontalo*.

The tidal constants have been computed from observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during the period of one year.

	Kema.		Gorontalo.	
	A.	k.	A.	k.
S_2	30.2 cm.	192°	20.5 cm.	173°
M_2	21.1	161	15.4	117
K_1	17.6	254	25.0	293
O.	11.4	252	12.2	237
P.	14.1	211	5.4	5
N.	1.6	186	1.9	78
K_2	8.8	287	4.1	175
Sa	29.1	107	10.0	231
Ssa	2.6	289	4.3	208

According to the constants of the annual variation Sa it is high water of the mean water-level at *Kema* about July 8 and low water about January 8; at *Gorontalo* this variation seems to be of a quite different kind, the kappa-number showing that it is high water about November 10 and low water about May 12.

Observations of current-directions have been made at both places, but it seems advisable not to publish the results before the series of observations extend over some more years.

56, 57. Ternate and Batjan.

Ternate lies on the east coast of *Ternate Island*. Long. 127°.4 E., Lat. 0°.8 N.

Batjan. Long. 127°.5 E., Lat. 0°.6 S. is situated at the head of a deep bay, in the middle of the west coast of *Batjan Island*.

	Ternate.				Batjan.			
	Tides.		Tidal streams.		Tides.		Tidal streams.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_2	23.1 cm.	197°	20 %	194°	13.5 cm.	172°	15 %	321°
M_2	31.2	163	84	70	7.9	79		
K_1	15.6	247	33	233	21.2	261		
O	10.8	237			9.3	213		
P	7.1	267			9.1	258		
N	4.3	143			1.9	117		
K_2	6.1	182			3.9	252		
Sa	6.9	357	29	253	—	—		
Ssa	1.8	145	—	—	—	—		
W	68.2		15 to the N.		75.8		16 to the S W.	

In the formulae relating to the tidal streams a positive sign corresponds to a motion of the water to the northward at *Ternate* and to the north-westward at *Batjan;* these results, as deduced from observations made during one year only, cannot be regarded as well established and want corroboration by continued inquiry.

58, 59. Amboina and Gamsungi.

Amboina is situated in Long. 128°.2 E., Lat. 3°.7 S.; *Gamsungi* lies on the most eastern point of *Halmaheira Island* in Long. 128°.8 E., Lat. 0°.2 N.

At the former place observations have been made by means of a self-registering tide-gauge during the period of one year; at the latter station the series of eye-observations, taken at the hours 9 a. m., 2 p. m. and 6 p. m., extend over a period of two years.

	Amboina.		Gamsungi.					
			1893—1894.		1894—1895.		Mean.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_1	1.9 cm.	125°	—	—	—	—	—	—
S_2	16.7	90	19.8 cm.	187°	14.1 cm.	191°	17.0 cm.	189°
M_2	44.3	25	15.6	142	11.2	138	13.4	140
K_1	29.7	314	17.4	276	13.8	272	15.6	274
O	21.4	304	9.9	210	6.5	210	8.2	210
P	9.0	310	6.1	295	3.5	280	4.8	288
N	10.0	5	1.0	139	1.7	163	1.4	151
K_2	3.7	79	5.0	180	3.4	206	4.2	193
Sa	—	—	11.5	315	0.6	196	—	—
Ssa	—	—	4.9	72	2.0	128	—	—
W	—		80.9		85.2			

The annual and semi-annual variations cannot be ascertained with any degree of accurracy; the second series of observations at *Gamsungi* shows values of tidal constants for these fluctuations which widely differ from those calculated from the first series, so that no average value can be deduced.

60, 61. Banda and Dammer.

Two little isles in the *Banda-sea;* the former situated in Long. 129°.9 E., Lat. 4°.5 S.; the latter in Long. 128°.7 E., Lat. 7°.1 S.

The tidal constants have been computed from eye-observations taken at the hours 9 a. m., 2 p. m. and 6 p. m. during the period September 1895 to August 1896.

	Banda.				Dammer.			
	Tides.		Tidal streams.		Tides.		Tidal streams.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_2	22.0 cm.	101°	6 %	315°	21.6 cm.	92°	15 %	11°
M_2	56.5	36	60	62	47.2	29	94	299
K_1	28.9	310	18	344	30.9	315	—	—
O	18.6	299			14.0	288		
P	9.0	275			5.8	300		
N	10.4	2			6.4	359		
K_2	5.0	71			2.0	148		
Sa	14.9	351	23	323	—	—	9	320
Ssa	4.9	4	—	—	—	—		
W	158.8		—17		171.6		1	

According to the kappa-number of Sa it is high water at *Banda* about mid-March, and low water about mid-September; the monthly means of the height of the water at *Dammer* do not show any well marked annual variation.

In the formulae relating to the tidal streams a positive sign corresponds to a motion of the water to the south-eastward at *Banda*, and to the eastward at *Dammer*.

At the latter place the relation existing between tides and tidal streams may be called „regular" because the difference between the corresponding kappa-numbers of tide and stream is almost exactly 90°; consequently this relation can be formulated by the statement that the flood sets to the east and the ebb to the west.

The M_2 stream at *Dammer* is preponderant to such a degree that the seasonal currents play a subordinate part: the results show that there is a feeble drift-current which sets to the east about February 9 and to the west about August 10.

At *Banda* the difference between the kappa-numbers of tides and streams widely differ from 90°; consequently the relation between the two phenomena is not of a regular, but of a rather complicated kind; and it cannot be stated in a general way that the flood sets to the one and the ebb to the opposite direction.

The principal (M_2) tide-stream sets to the south-eastward with a maximum velocity of 0.9 hours after the epoch of high water, so that, as a rule, the water flows to the south-eastward 2.1 hours with rising and 3.9 hours with falling water.

The kappa-number of the drift-current Sa is almost exactly the same as that found for *Dammer*; this current runs to the S E with maximum velocity about February 12, whilst the value for W shows that there is a surplus transfer of water to the north-westward amounting to about 17 %.

62, 63. Bima and Kupang.

The former place is situated in the deep bay of *Bima* on the north coast of *Sumbawa Isle* in Long. 118°.7 E., Lat. 8°.4 S.; the latter station lies near the south-western point of *Timor Island* in Long. 123°.6 E., Lat. 10°.2 S.

The tidal constants are computed from a series of observations made at 9 a. m., 2 p. m. and 6 p. m. at *Bima* and at 7 a. m., 2 p. m. and 5 p. m. at *Kupang;* both series extend over one year.

	Bima.				Kupang.			
	Tides.		Tidal streams.		Tides.		Tidal streams.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_2	13.8 cm.	42°	11 %	138°	28.2 cm.	22°	5 %	28°
M_2	29.2	8	83	93	52.1	322	100	235
K_1	33.1	316			23.1	294		
O	11.6	253			10.4	331		
P	7.6	318			7.1	107		
N	3.0	304			8.2	301		
K_2	2.2	28			7.9	32		
Sa	3.7	291			2.3	54	5	330
Ssa	4.8	226			3.9	188	—	—
W	94.3				105.0			

At both places the annual and semi-annual variations, if any, are small, and the results deduced from observations made during one year only cannot be regarded as sufficiently established.

The tidal streams are of the regular description, the difference between the kappa-numbers of tides and corresponding tidal streams being about 90°; in *Bima-bay* the ebb-stream sets to the north (positive sign) the flood-stream to the south; at *Kupang* the flood runs to the N E (positive sign) and the ebb to the S W.

The observations, as far as they go, give no evidence of other tidal or pseudo-tidal motions of the water.

64, 65. Bonerate and **Saleyer.**

Both tidal stations are situated on islands in the *Sunda-sea;* the former in Long. 121°.2 E., Lat. 7°.4 S.; the latter in Long. 120°.5 E., Lat. 6°.1 S.

The tidal constants have been computed from observations of tides and streams taken at 9 a. m., 2 p. m. and 6 p. m. during a period of one year viz. August 1895 to July 1896.

	Bonerate.				Saleyer.			
	Tides.		Tidal streams.		Tides.		Tidal streams.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_2	5.5 cm.	131°	26 %	126°	12.3 cm.	61°	30 %	320°
M_2	14.3	358	27	45	38.0	359	68	279
K_1	11.1	42	6	142	37.4	291	55	265
O	9.2	236			23.1	279		
P	19.1	303			8.6	246		
N	1.8	353			10.8	336		
K_2	10.3	266			5.8	344		
Sa	—	—	19	251	6.9	224	35	145
Ssa	—	—	—	—	5.1	37	—	—
W	83.8		23		212.5		14	

At *Bonerate* the tidal constants, which want corroboration by comparison with the outcome of other series of observations, are very peculiar and, if compared with those calculated for *Saleyer,* irregular. In the formulae relating to the tidal streams a positive sign corresponds to a motion of the water to the northward, a negative sign to a southward movement.

At *Saleyer* the M_2 and S_2 streams appear to be of a regular description, the difference between the kappa-numbers of tide and stream being about 90°; consequently it can be stated that the flood sets to the north and the ebb to the south; at *Bonerate* the tidal stream appears to run to the northward with greatest intensity about 1.5 hours after the epoch of high water.

66, 67. Kadjang and **Bonthain.**

Both stations are situated on the south-western neck of land of *Celebes:* the former on its east coast in Long. 120°.3 E., Lat. 5°.4 S., the latter on the south coast in Long. 119°.9 E., Lat. 5°.6 S.

The tidal constants have been computed from observations made at the hours 9 a. m., 2 p. m. and 6 p. m. during the period August 1895 to July 1896.

These constants clearly show how the tide-wave, egressing from *Makasser-strait* and mixing with that coming from the east and the south, causes tides to arise of quite abnormal qualities.

At *Kadjang* the tidal constants exhibit about the same characteristics as at *Dammer* and *Kupang;* but just round the corner, at *Bonthain,* the tides are of a quite different kind: the M_2 tide almost vanishes, the S_2 tide becomes prominent to a quite abnormal degree, and the mono-diurnal tides come into prominence in the same way as at *Makasser* and *de Bril.*

	Kadjang.				Bonthain.	
	Tides.		Tidal streams.		Tides.	
	A.	k.	A.	k.	A.	k.
S_1	17.6 cm.	89°	23 %	315°	20.3 cm.	154°
M_2	37.4	3	—	—	8.7	44
K_1	20.9	303	26	237	22.2	325
O	15.4	266			4.0	266
P	15.0	282			16.2	260
N	6.1	336			4.0	54
K_2	1.0	341			6.6	206
Sa	47.3	359	40	93	13.8	259
Ssa	12.6	155	—	—	17.2	275
W	172.0		6		117.9	

According to the kappa-numbers of the annual variation it is high and low water near *Kadjang* resp. about the dates of the spring- and autumn-equinoxes; the constants calculated for *Bonthain* however seem to prove that there high water occurs about December 9 and low water about June 9; nor do the constants of the semi-diurnal tides at both places agree, though the oscillation seems pretty well marked.

The relation of tidal streams to tides at *Kadjang* appears to be very irregular; as it has been impossible to find any trace of an M_2 current, the regime of the streams, mostly dependent on the S_2 and K_1 currents, must exhibit the characteristics of the tides at *Bonthain* and *Makasser;* a great percentage, however, of the observed directions has to be ascribed to the rather strong seasonal drift-currents, which set to the N E about mid-June and to the S W about mid-December; in the formulae relating to the streams the former motion corresponds to a positive, the latter to a negative sign.

68, 69, 70. Donggala, Tontoli and **Posso.**

The first place is situated on the west coast of *Celebes* in *Makasser-strait* near the entrance of *Palos-bay* in Long. 119°.7 E., Lat. 0°.7 S.; the second on the north coast of *Celebes* at the northern entrance to *Makasser-strait,* in Long. 120°.9 E., Lat. 1°.0 N.; *Posso,* a new station, lies on the southern shore of *Tomini* (or *Gorontalo*) *Gulf* in Long. 120°.9 E., Lat. 1°.4 S.

The tidal constants for all these places have been computed from observations made at the hours of 9 a. m., 2 p. m. and 6 p. m.

	Donggala.				Tontoli.		Posso.	
	1894.		1895.		1895—1896.		1895—1896.	
	A.	k.	A.	k.	A.	k.	A.	k.
S_2	48.0 cm.	212°	37.8 cm.	206°	33.4 cm.	192°	21.1 cm.	167°
M_2	12.8	164	33.4	152	17.7	223	24.0	125
K_1	40.0	299	23.2	278	18.6	254	16.2	265
O	7.3	261	7.3	254	12.3	238	14.8	186
P	20.0	7	12.7	313	6.2	67	11.3	269
N	2.1	110	3.4	136	4.1	145	1.8	102
K_2	17.0	136	8.5	213	6.9	26	4.7	170
Sa	10.6	260	19.6	358	—	—	10.4	16
Ssa	6.0	350	7.2	278	—	—	1.5	137
W	127.5		114.2				122.0	

The results of the observations made at *Donggala* and *Tontoli* are not satisfactory.

At the former place the two series show considerable discrepancies, especially so in the constants for the M_2 tide; as this disagreement cannot be ascribed to an error in the computation, which has been controlled in the usual manner, it must be due either to careless observation, or to disturbing influences of currents which in *Makasser-strait* are pretty strong and irregular.

The results of the second series seems much better than those of the first; consequently no average values have been given and in the tide-chart only the data of the second series are used.

It is difficult to tell why the constants for *Tontoli* show so many abnormalities that they cannot be accepted before further information has been obtained by continuation of the observations.

It is, however, quite possible that here, where many waves meet, the tides are very abnormal, whilst also the fact that the currents at this crossway are strong and of a very irregular discription (the cape north of *Tontoli-bay* is called *Stroomen-kaap)* impairs to a great extent the exactness of the readings.

71, 72, 73. Taruna, Galela and **Edi.**

The first place is situated on the west coast of *Sangi Island* in the *Celebes-sea* in Long. 125°.5 E., Lat. 3°.7 N.; the second place in the head of *Galela-bay* at the northern point of *Halmaheira* or *Djilolo Island* in Long. 127°.8 E., Lat. 1°.8 N.; the third station lies on the east coast of *Atjeh* in Long. 97°.8, Lat. 4°.9 N.; the results for the latter station are given here instead of on page 203, owing to the reason mentioned in the beginning of this chapter.

At all places the observations have been taken at the hours of 9 a. m., 2 p. m. and 6 p. m. during the period of one year.

At *Taruna* the results are hardly satisfactory and, the kappa-number of the K_1 tide being probably erroneous, it has not been made use of in drawing the chart of cotidal lines. At *Galela* the amplitudes of the mono-diurnal tides K_1, O and P are small so that the constants of these partial tides must be accepted under reserve until testified by other series of tidal observations.

	Taruna.		Galela.		Edi.	
	A.	k.	A.	k.	A.	k.
S_2	23.4 cm.	209°	33.0 cm.	234°	23.5 cm.	356°
M_2	41.8	169	30.0	191	47.4	315
K_1	8.6	109	5.6	261	17.0	321
O	10.1	227	9.1	206	5.3	289
P	30.2	303	6.9	355	5.5	89
N	5.6	166	5.1	188	6.6	304
K_2	4.1	203	4.3	32	8.7	337
Sa	25.9	64	16.5	340	13.3	136
Ssa	5.5	48	4.3	97	6.8	143

74—80. At the following places the observations have — up to the present — been carried on during a period less than a complete year; consequently only the constants of the M_2 tide have been calculated in order to be able to make use of these provisional data in drawing the cotidal lines in the M_2 chart.

Wynkoops-bay. Long. 106°.5 E., Lat. 7°.0 S.
South coast of *Java*. A = 27.7 cm., k = 223°.
Singkel. Long. 97.8 E., Lat. 2°.3 N.
West coast of *Sumatra*. A = 23.1 cm., k = 189°.
Telok Semawé. Long. 97°.2 E., Lat. 5°.2 N.
North coast of *Atjeh*. A = 51.1 cm., k = 281°.
Bagan Api-Api. Long. 100°.8 E., Lat. 2°.2 N.
Malakka-strait. A = 161.5 cm., k = 322°.
Sungei Kakap. Long. 109°.2 E., Lat. 0°.1 S.
West coast of *Borneo*. A = 14.8 cm., k = 106°.
Lirong. Long. 126°.7 E., Lat. 3°.9 N.
Talauer Islands, Celebes-sea. A = 39.9 cm., k = 171°.
Tual. Long. 132°.7 E., Lat. 5°.6 S.
Isle of *Key, Harafura-sea*. A = 43.8 cm., k = 43°.

TABLE V. EXHIBITING THE FACTORS BY WHICH THE AMPLITUDES OF THE TIDES K_1, O AND K_2 HAVE TO BE MULTIPLIED FOR DIFFERENT YEARS.

(See § 15, p. 184).

	K_1.	O.	K_2.		K_1.	O.	K_2.
1890	1.03	1.05	1.05	1908	1.01	1.01	1.01
1891	1.06	1.10	1.15	1909	1.04	1.07	1.09
1892	1.09	1.14	1.23	1910	1.07	1.12	1.19
1893	1.11	1.17	1.29	1911	1.10	1.15	1.25
1894	**1.11**	**1.18**	**1.32**	1912	1.11	1.18	1.30
1895	1.11	1.18	1.31	1913	**1.11**	**1.18**	**1.32**
1896	1.10	1.16	1.27	1914	1.11	1.17	1.30
1897	1.08	1.13	1.20	1915	1.09	1.15	1.25
1898	1.05	1.08	1.11	1916	1.07	1.11	1.17
1899	1.01	1.02	1.01	1917	1.06	1.06	1.07
1900	0.97	0.96	0.92	1918	1.00	0.99	0.97
1901	0.93	0.89	0.84	1919	0.96	0.93	0.88
1902	0.90	0.84	0.78	1920	0.92	0.87	0.81
1903	0.88*	0.81*	0.75*	1921	0.90	0.83	0.77
1904	0.88*	0.81*	0.75*	1922	0.88*	0.81*	0.75*
1905	0.90	0.83	0.77	1923	0.89*	0.81*	0.75*
1906	0.93	0.88	0.82	1924	0.91	0.85	0.79
1907	0.96	0.94	0.90				

TABLE VI. SHOWING SOME CHARACTERISTICS OF THE TIDES AT DIFFERENT PLACES.

(See p. 177—178).

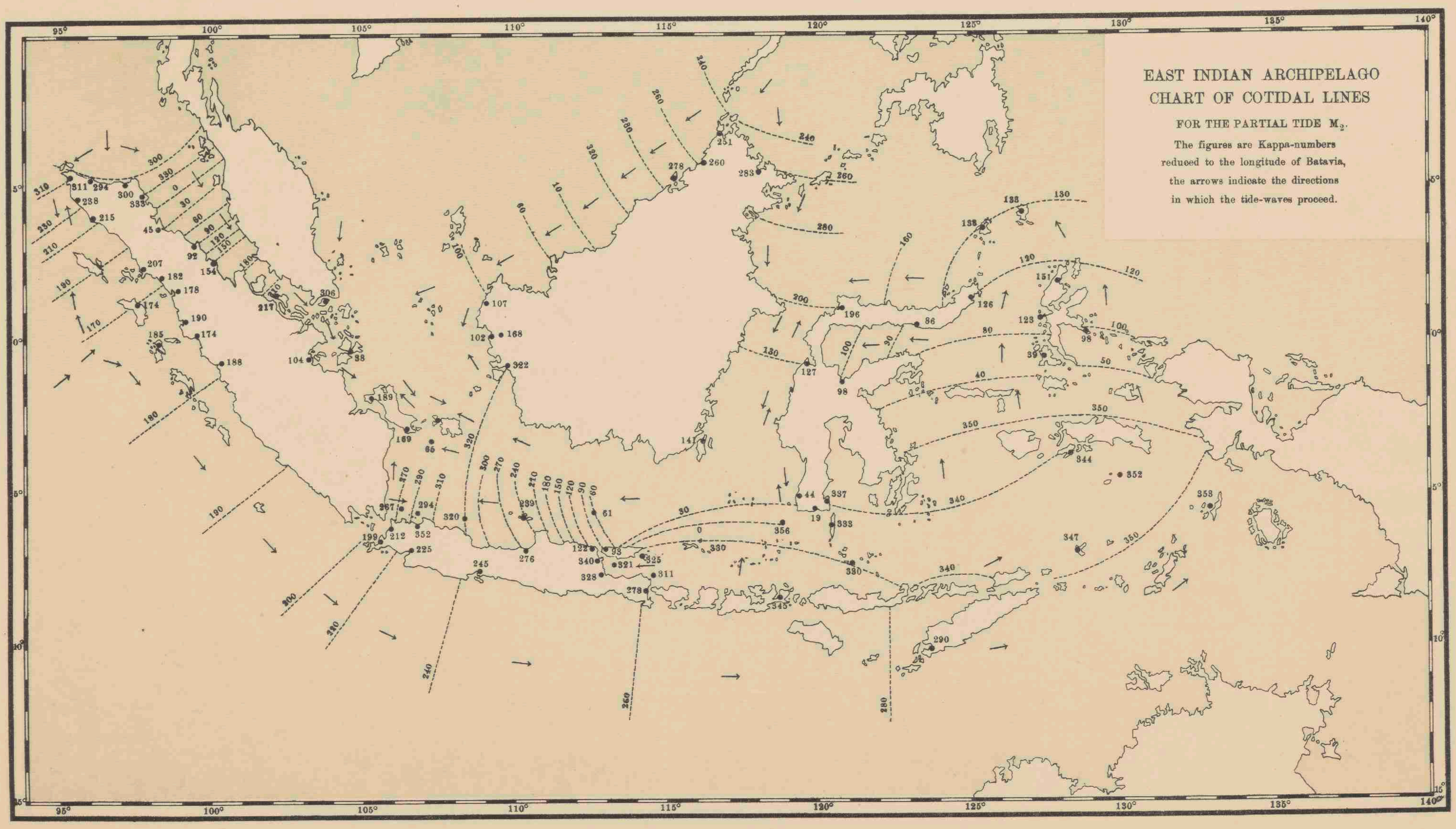
	Amplitude.		Amplitude.			Argument.	
	$M_2 + S_2$	$K_1 + O$	$\frac{K_1 + O}{M_2 + S_2}$	$\frac{S_2}{M_2}$	$\frac{O}{K_1}$	$S_2 - M_2$	$K_1 - O$
Tandjong Priok	10.9 cm.	40.4 cm.	3.71	1.06	0.51	— 61°	24°
Edam Island	8.5	22.8	2.68	0.77	0.51	— 21	13
Duizend Isles	6.3	34.7	5.51	6.88	0.24	105	27
Boompjes Island	17.4	23.2	1.33	0.51	0.45	—104	— 14
Karimon Djawa Isles.	7.2	27.0	3.75	2.43	0.16	98	95
Semarang	8.0	22.6	2.83	0.70	0.24	—123	132
Bawean	8.4	67.8	8.07	1.15	0.58	— 56	26
Udjong Pangka	8.8	74.3	8.44	1.93	0.47	—121	47
Arisbaya	8.7	75.9	8.72	2.78	0.47	— 95	64
Sembilangan	33.7	71.9	2.13	0.87	0.53	9	41
Surabaya	70.7	74.1	1.05	0.60	0.58	4	34
Pasuruan	90.0	70.6	0.78	0.51	0.59	3	28
Gading	89.6	71.9	0.80	0.51	0.56	2	39
Karang Kleta	88.6	72.2	0.82	0.49	0.60	5	29
Zwaantjes-droogte	68.7	68.8	1.00	0.52	0.46	11	34
Meinderts-droogte	36.0	56.5	1.57	0.42	0.59	9	31
Banjuwangi	74.4	41.5	0.56	0.74	0.54	55	37
Pulu Sapudi	38.8	61.0	1.57	0.50	0.65	3	27
De Bril	25.8	46.4	1.80	0.22	0.63	136	21
Makasser	19.7	44.5	2.26	1.46	0.58	123	34
Kotta Baru	86.2	55.3	0.64	1.33	0.35	56	26
Singapore	93.2	48.2	0.52	0.41	1.00	48	47
Kuala Ladjau	116.8	104.5	0.90	0.29	0.90	47	74
Tandjong Buton	32.1	107.4	3.35	0.71	0.75	90	77
Tandjong Kalean	37.2	149.2	4.01	0.47	0.58	55	66
Pulu Besar	33.2	116.0	3.49	0.48	0.57	—144	46
Pulu Langkuas	3.0	97.8	3.26	∞	0.63	—	56
Ondiepwater Island	15.1	80.9	5.36	0.96	0.53	— 24	45
Pemangkat	30.3	29.0	0.96	0.17	1.15	66	46
Pontianak	17.5	59.7	3.41	0.41	0.82	2	74
Sukadana	19.9	97.1	4.88	0.79	0.59	22	43
Tjilatjap	74.5	30.6	0.41	0.50	0.62	62	11
Labuan	29.9	13.4	0.45	0.40	0.70	44	15
Java's 4th Point	37.0	10.2	0.28	0.53	0.50	70	10
Padang	47.6	20.2	0.42	0.43	0.59	44	12
Ajerbangies	41.8	22.4	0.54	0.53	0.35	43	32
Pulu Tello	38.0	15.7	0.41	0.47	0.51	34	23
Natal	42.9	18.0	0.42	0.47	0.51	31	18
Gunung Sitoli	25.9	11.6	0.45	0.65	0.33	34	43
Siboga	13.2	18.6	1.41	0.31	0.35	— 24	25
Baros	41.0	18.4	0.45	0.65	0.44	34	36
Melabuh	23.5	12.6	0.54	0.67	0.56	24	18
Pulu Rajah	9.1	9.9	1.09	1.46	0.14	— 23	67
Olehleh	37.9	9.7	0.26	0.70	0.52	42	19
Segli	56.6	18.0	0.32	0.68	0.31	40	21
Edi	70.9	22.3	0.32	0.50	0.31	41	32
Belawan Deli	75.0	14.0	0.19	0.64	0.28	47	79
Tandjong Tiram	105.4	11.5	0.11	0.48	0.06	46	132
Benkalis	115.7	29.3	0.25	0.51	4.14	74	— 9
Kema	51.3	29.0	0.57	1.43	0.65	31	2
Gorontalo	35.9	37.2	1.04	1.33	0.49	56	56
Ternate	54.3	26.4	0.49	0.74	0.69	34	10
Batjan	21.4	30.5	1.43	1.71	0.44	93	48
Amboina	61.0	51.1	0.84	0.38	0.72	65	10

	Amplitude.		Amplitude.			Argument.	
	$M_2 + S_2$	$K_1 + O$	$\frac{K_1 + O}{M_2 + S_2}$	$\frac{S_2}{M_2}$	$\frac{O}{K_1}$	$S_2 - M_2$	$K_1 - O$
Gamsungi	30.4 cm.	23.8 cm.	0.78	1.27	0.53	49°	64°
Banda	78.5	47.5	0.61	0.39	0.64	65	11
Dammer	68.8	44.9	0.65	0.46	0.45	63	27
Bima	43.0	44.7	1.04	0.47	0.35	34	63
Kupang	80.3	33.5	0.42	0.54	0.45	60	— 37
Bonerate	19.8	20.3	1.03	0.39	0.83	133	166
Saleyer	50.3	60.5	1.20	0.32	0.62	62	12
Kadjang	55.0	36.3	0.66	0.47	0.74	86	37
Bonthain	29.0	26.2	0.90	2.33	0.18	110	59
Donggala	71.2	30.5	0.43	1.13	0.32	54	24
Tontoli	51.1	30.9	0.61	1.89	0.66	— 31	16
Posso	45.1	31.0	0.69	0.88	0.91	42	79
Galela	63.0	14.7	0.23	1.10	1.63	43	55
Taruna	65.2	18.7	0.29	0.56	1.17	40	—118

TABLE VII. AMPLITUDES AND KAPPA-NUMBERS, REDUCED TO BATAVIA LONGITUDE, MADE USE OF IN THE TIDE-CHARTS.

		Longitude East.	Latitude.	M_2		K_1	
				A.	k.	A.	k.
1.	Bengkalis	102°.1	1°.5 N	76.8 cm.	217°	5.7 cm.	123°
2.	Bagan Api-Api	100.8	2.2 N	161.5	154	—	—
3.	Tandjong Tiram	99.5	3.3 N	71.2	92	10.8	283
4.	Belawan Deli	98.7	3.8 N	45.7	45	10.9	344
5.	Edi	97.8	4.9 N	47.4	333	17.0	330
6.	Telok Semawé	97.2	5.2 N	51.1	300	—	—
7.	Segli	96.0	5.3 N	33.8	294	13.7	320
8.	Oleh-leh	95.3	5.6 N	22.3	311	6.4	348
9.	Pulu Rajah	95.4	4.8 N	3.7	238	8.7	323
10.	Melabuh	96.1	4.1 N	14.1	215	8.1	312
11.	Singkel	97.8	2.3 N	23.1	207	—	—
12.	Baros	98.4	2.0 N	24.8	182	12.8	295
13.	Siboga	98.8	1.7 N	10.1	178	13.8	301
14.	Gunung Sitoli	97.6	1.3 N	15.7	174	8.7	288
15.	Natal	99.1	0.6 N	29.1	190	11.9	284
16.	Ajerbangies	99.4	0.2 N	27.3	174	16.6	280
17.	Pulu Tello	98.3	0.1 S	25.9	185	10.4	287
18.	Padang	100.3	1.0 S	33.2	188	12.7	284
19.	Labuan, Java	105.8	6.4 S	21.3	199	7.9	244
20.	Wynkoops-bay	106.5	7.0 S	27.7	225	—	—
21.	Tjilatjap	109.0	7.7 S	49.6	245	18.9	277
22.	Kupang, Timor	123.6	10.2 S	52.1	290	23.1	277
23.	Java's 4th Point	105.9	6.1 S	24.2	212	6.8	227
24.	Duizend Isles	106.5	5.6 S	0.8	267	28.1	165
25.	Pulu Edam	106.8	6.0 S	4.8	294	15.1	142
26.	Tandjong-Priok	106.9	6.1 S	5.3	352	26.7	143
27.	Boompjes-Island	108.4	5.9 S	11.5	320	16.0	100
28.	Karimon Djawa Island	110°.4	5°.9 S	2.1 cm.	239°	23.3 cm.	353°
29.	Semarang	110.4	7.0 S	4.7	276	18.2	22
30.	Bawean	112.7	5.9 S	3.9	61	43.0	320
31.	Udjong Pangka	112.6	6.9 S	3.0	122	50.6	320
32.	Arisbaya	112.8	6.9 S	2.3	93	51.5	320
33.	Sembilangan	112.7	7.1 S	18.0	345	47.0	312
34.	Surabaya	112.6	7.2 S	44.3	340	46.9	312
35.	Gading	112.9	7.2 S	59.2	332	46.0	302
36.	Karang Kleta	112.8	7.3 S	59.3	330	45.0	298
37.	Pasuruan	112.9	7.6 S	59.6	328	44.5	298
38.	Zwaantjes-droogte	113.1	7.5 S	45.3	321	47.2	301
39.	Banjuwangi	114.4	8.2 S	42.8	278	27.0	292
40.	Meinderts-droogte	114.4	7.6 S	25.3	311	35.6	295
41.	Pulu Sapudi	114.3	7.1 S	25.8	325	37.0	299
42.	Singapore	103.9	1.3 N	66.0	306	24.1	103
43.	Tandjong Buton	104.6	0.2 S	18.8	38	61.5	153
44.	Kuala Ladjau	103.6	0.4 S	90.3	104	54.9	185
45.	Tandjong Kalean	105.1	2.0 S	25.3	189	94.6	161
46.	Pulu Besar	106.1	2.9 S	22.5	169	73.7	154
47.	Ondiepwater Island	107.2	3.3 S	7.7	65	52.9	144
48.	Pulu Langkuas	107.6	2.5 S	0.0	—	59.9	141
49.	Sukadana	109.9	1.2 S	11.1	322	60.9	138
50.	Sungei Kakap	109.2	0.1 S	14.8	102	—	—
51.	Pontianak	109.3	0.0	12.4	168	32.8	145
52.	Pemangkat	109.0	1.2 N	25.8	107	13.5	52
53.	Labuan (Borneo)	115.2	5.2 N	22.4	278	46.4	304
54.	Gaya	116.1	6.1 N	19.5	260	43.5	293
55.	Kudat	116.8	6.9 N	20.1	251	33.8	315
56.	Sandakan	118.1	5.9 N	37.4	283	57.7	271
57.	Tontoli	120.9	1.0 N	17.7	196	18.6	240
58.	Donggala	119.7	0.7 S	33.4	127	23.2	265
59.	Kotta Baru	116.7	3.2 S	37.0	141	41.1	329
60.	Makasser	119.4	5.1 S	8.0	44	28.2	290
61.	De Bril	118.9	6.1 S	21.1	356	28.5	284
62.	Bonthain	119.9	5.6 S	8.7	19	22.2	312
63.	Kadjang	120.3	5.4 S	37.4	337	20.9	290
64.	Saleyer	120.5	6.1 S	38.0	333	37.4	277
65.	Bonerate	121.2	7.4 S	14.3	330	11.1	28
66.	Bima	118.7	8.4 S	29.2	345	33.1	304
67.	Dammer	128.7	7.1 S	47.2	347	30.9	293
68.	Tual	132.7	5.6 S	43.8	353	—	—
69.	Banda	129.9	4.5 S	56.5	352	28.9	287
70.	Amboina	128.2	3.7 S	44.3	344	29.7	293
71.	Batjan	127.5	0.6 S	7.9	39	21.2	240
72.	Gamsungi	128.8	0.2 N	13.4	98	15.6	252
73.	Ternate	127.4	0.8 N	31.2	123	15.6	226
74.	Posso	120.9	1.4 S	24.0	98	16.2	251
75.	Gorontalo	123.1	0.5 N	15.4	86	25.0	277
76.	Kema	125.1	1.4 N	21.1	126	17.6	236
77.	Taruna	125.5	3.7 N	41.8	133	—	—
78.	Lirong	126.7	3.9 N	39.9	133	—	—
79.	Galela	127.8	1.8 N	30.0	151	5.6	240


EAST INDIAN ARCHIPELAGO
CHART OF COTIDAL LINES
FOR THE PARTIAL TIDE K_1.
The figures are Kappa-numbers
reduced to the longitude of Batavia,
the arrows indicate the directions
in which the tide-waves proceed.


EAST INDIAN ARCHIPELAGO
CHART OF COTIDAL LINES
FOR THE PARTIAL TIDE M_2.
The figures are Kappa-numbers
reduced to the longitude of Batavia,
the arrows indicate the directions
in which the tide-waves proceed.