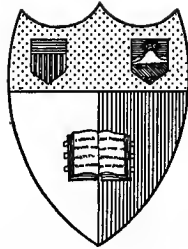


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OF
THE PACIFIC OCEAN.



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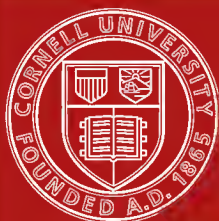
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GENERAL EXAMINATION

OF

THE PACIFIC OCEAN,

BY

CAPT. CHARLES PHILIPPE DE KERHALLET,
OF THE IMPERIAL NAVY, OFFICER OF THE LEGION OF HONOR,

FOLLOWED BY

NAUTICAL DIRECTIONS FOR AVOIDING HURRICANES.

TRANSLATED FROM THE SECOND FRENCH EDITION,

UNDER THE DIRECTION OF

COMMANDER CHARLES HENRY DAVIS, U. S. N.,

BY AUTHORITY OF THE AUTHOR.

BUREAU OF NAVIGATION.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1869.

†

NOTICE.

The copyright of this work having become the property of the government under the provisions of section 2 of "An act to establish a hydrographic office in the Navy Department," approved June 21, 1866, the present edition is published by the Bureau of Navigation.

BUREAU OF NAVIGATION, *June 30, 1869.*

EDITOR'S PREFACE.

DURING a recent cruise in the Pacific Ocean, in the command of the United States ship *St. Mary's*, the Editor learned to place such a high value upon this Memoir as to induce him to ask the Author's consent to its being translated into English for the benefit of American navigators. It is, beyond all question, a most accurate and reliable compendium of information concerning the Pacific Ocean, conveyed both in the text and by the maps, in a convenient and intelligible form, suited to the immediate practical use of the navigator. This translation, for the permission to make which the Editor here acknowledges his gratitude to the Author, is as literal as is consistent with English idioms and nautical phraseology; the divisions and subdivisions, and the forms generally of the original work, have been adhered to; the meteorological observations have been reduced from the French to the English standards, as also have the measures of length; the meridian of Greenwich has been substituted for that of Paris; and in all similar respects our own usages and style have been preserved.

The work contains sailing directions, extracted from English surveyors and navigators. Where the extract has been sufficiently long to make it at all desirable, the Editor, instead of re-translating them from the French, has taken them from the English originals; this has been the case with Hood, Hunter, Blackwood, Earle, King, McKenzie, Weddell, and Vancouver. "The directions for the outer route from Sidney to Torres Strait" have been taken from the Australia Directory, published by the Admiralty, Vol. II., 1859; the selections vary but slightly from those of Captain Kerhallet.

Two additions have been made to the original work; one consists of an extract from the paper of Lieutenant Silas Bent, U. S. N., on the Japan Stream; the other, of sailing directions for vessels doubling Cape Horn from the eastward, bound to San Francisco, by Mr. George W. Blunt, of New York.

C. H. DAVIS.

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T O T H E F I R S T E D I T I O N .

ROMME, in his highly esteemed work, entitled *Table of Winds, Currents, and Tides*, wherein are collected a large number of observations drawn from the voyages of the old navigators, in speaking of the Pacific Ocean, expresses himself thus : —

“ If the observations which have been made on the motions of the atmosphere in this ocean have been few, it must also be said that they merit great confidence, and that they should be collected with much care and great interest ; for the navigators by whom they were made seem to have been especially selected for enterprises so vast and important, and to have brought to them all the acquirements necessary for such researches.”

What Romme wrote, in 1817, of the undeniable talents and merit of the commanders charged with those great voyages of discovery, we may now repeat of the modern navigators, adding that their labors have furnished to the physical sciences most numerous and varied materials.

The late exploring voyages have introduced the knowledge of a multitude of facts important to navigation ; and although some of them might have been already pointed out, the greater part had been but very imperfectly studied.

It is especially to French navigators that we owe, in the latter period of exploration, the most interesting and the most complete records, particularly in the Pacific Ocean.

The voyages of Entrecasteaux, Baudin, Freycinet, and the more recent ones of Bougainville, Duperrey, Dumont-d'Urville,

Vaillant, and Du Petit-Thouars, have especially advanced our knowledge of the physical phenomena peculiar to this vast sea, and of its winds and currents.

Placed under the orders of commanders whose names have become historical in all the navies of the globe, officers of talent and hydrographical engineers of the highest merit have united in one common work, sustained in their fatigues by one noble aim, the conviction of the immense results to be acquired both for science and navigation.

It is but justice, then, to accord the gratitude due to those who made these long and laborious cruises, for their great services.

The physical portions of these voyages, drawn up by MM. Duperrey, Darondeau, De Tessan, Vincendon-Dumoulin, are models, — luminous synopses, full of facts based on observations recorded daily, and even momentarily, throughout the whole duration of the voyage.

These observations have confirmed the existence of facts mentioned by the old navigators, and have led to the discovery of entirely unknown phenomena.

In the late voyages, the temperature of the sea, constantly observed, has led to the determination of the course of the currents in the Pacific Ocean, which could not before be correctly understood. The currents of the atmosphere had scarcely been indicated; recent observations admit of their being studied and described almost with certainty.

Voyages of circumnavigation are in general very voluminous, and seamen can with difficulty obtain them, on account of their high price and their bulk. Besides, in each one of them we find observations peculiar to certain localities, and made during certain periods. These observations are only materials to be compared and discussed, in order to deduce from them the general laws which govern the winds and currents.

This is the work we have undertaken. We have not concealed from ourselves the difficulties of the task; neither have

we neglected any inquiry necessary to enable us to deduce conclusions which are general and intelligible, but which nevertheless are not to be depended on as absolute, from the voyages, and other works in which some of these laws have been already given.*

We propose to extract the portion important to navigation.

To this end we have collected one by one the details relating to the same locality, and we have only deduced from them a general rule when we have seen the same facts reproduced constantly or periodically.

After the study of winds and currents comes naturally its application to navigation. This constitutes the third part of the present memoir, which is by no means scientific, and which we have designed as much as possible to render a practical manual.

We conclude with a sketch of the routes to be followed in crossing the Pacific Ocean in all directions.

This also we have derived from actual voyages, comparing together a great number of routes, and pointing out the mean of those which have usually given the shortest passages. It is needless to observe, that those we have traced may be modified; we undertake only to select the routes which will approach most nearly the mean, with such qualifications as the winds and particular circumstances render necessary.

* We have consulted the voyages made from the year 1713 to the year 1842, under the orders of the commanders whose names follow:—

Frézier, 1713; Cook, 1768–1778; Bougainville, 1768; Surville, 1769; Marion, 1772; La Pérouse, 1785; Mears, 1788; Marchand, 1791; D'Entrecasteaux, 1793; Butler, 1794; Anson, Sharp, Byron, Wallis, Carteret, Hunter, Vancouver, 1790–1795; Broughton, 1795; Hogan, 1796; Fearn, 1798; Baudin, 1800; Krusenstern, 1804; Golowin, 1811; Kotzebue, 1813; Freycinet, 1817; Duperrey, 1822; Bougainville, 1824; Lütke, 1825; Beechey, 1825; Dumont-d'Urville, 1826; Downes and Reynolds, 1831; Vaillant, 1836; Du Petit-Thouars, 1837; Dumont-d'Urville, 1837; Wilkes, 1838–1842.

To these voyages we will add a table of winds, currents, and tides, by Romme; a collection of hydrographical memoranda, for the use of the Atlas of the Pacific Ocean, by Krusenstern; the Atlas of Berghaus and that of Johnston; the directions of King on the coast of Patagonia, &c., &c.

The general examination of the Pacific Ocean will complete the series of our similar investigations into the great seas of the globe. If they prove to be, as we hope they will, of some utility to navigators, we shall have attained the end proposed.

CHARLES DE KERHALLET.

PARIS, December 3, 1851.

PREFACE

TO THE SECOND EDITION.

To this new edition of the *General Examination of the Pacific Ocean*, we have made numerous and important additions, particularly in the chapter on winds and in that on navigation.

Among these additions, we will only mention: directions relating to the navigation of the east coast and of the northeast coast of Australia; routes to be pursued in sailing from the ports of India for those of this continent, and back again; those concerning the navigation of Torres and Bass Straits.

The growth of commercial relations gives to this information an interest that will doubtless be appreciated by those commanders who frequent these dangerous regions.

For Torres Strait we have collected the Directions of P. King, of Blackwood, and of Yule, officers of H. B. M. Navy; and we have added to them several articles published from time to time in the *Nautical Magazine*. We have translated King's directions; those of Blackwood and of Yule had been translated by M. Darondeau, hydrographical engineer, who has given them in the *Mélanges Hydrographiques*. In arranging them and blending them with each other, we have still preserved them verbatim, and we have thus been able to construct nearly complete sailing directions for the navigation of Torres Strait and the northeast coast of Australia.

For Bass Strait we have translated a part of the *Australia Directory*, published by the British Admiralty.

We have also given the routes for doubling Cape Horn and

passing from the Atlantic to the Pacific Ocean, pointing out the period which, according to different navigators, is the most favorable for making this passage.

We have further completed the directions for sailing on the west coast of America, from Cape Horn to Upper California.

Thanks to the numerous documents carefully collected by Captains Féréol de Leyritz and Le Rouxo de Rosencot, in command of the corvette *la Prudente* and of the brig *Obligado*, cruising in the Pacific Ocean, we have been enabled to give at the end of this work a table showing the length of passages between the principal ports of this sea. This information might, in many cases, be useful to seamen; and we are happy to express here to these two superior officers our gratitude for the assistance they were so kind as to afford us by communicating their observations.

Finally, an Appendix, at the end of the work, contains nautical directions to be followed when in the vortex of a hurricane or of a typhoon.* We owe this Appendix to the kindness of the learned hydrographical engineer, M. Keller. As we have already said in our *Considérations sur l'Océan Atlantique* and *sur l'Océan Indien*, these directions may render the greatest service to seamen, by pointing out to them the evolutions to be performed, (if, indeed, evolution is possible,) according to the position they may occupy in the circle of the tempest.

Such are the principal additions made to this new edition which we have revised and corrected. Without flattering ourselves that we have given a complete manual of navigation for this vast sea, which is every day more frequented, we hope that, with our work, it may be traversed by the most advantageous routes in every direction.

CHARLES DE KERHALLET.

PARIS, November 23, 1855.

* Consult, for the general rules observed in hurricanes, typhoons, &c., the *Considérations Générales sur l'Océan Atlantique*, or those *sur l'Océan Indien*.

N O T E .

WE give to the winds the name of the point of the compass from which they blow ; to the currents, that of the point of the compass toward which they run.

The direction of the winds, that of the currents, the courses, the trend of the land, and the bearings, are corrected for the variation of the magnetic needle, except when otherwise stated.

GENERAL EXAMINATION OF THE PACIFIC OCEAN.

CHAPTER I.

GENERAL WINDS.

THE immense extent of water, bounded on one side by Asia, the Philippine Isles, and New Holland, on the other by the western coast of America, extends from the Arctic to the Antarctic circle, over a space of 133° of latitude.

This vast sea was unknown to Europeans till the year 1513, and was discovered by Vasco Nuñez de Balbao, who saw it from the summit of one of the mountains situated near the Isthmus of Panama.

Magalhaën, known more commonly under the name of Magellan, navigated this sea from America as far as the Philippine Isles, and gave it the name of Pacific Ocean, in consequence of the constant fair weather that he met with during his voyage.

The Pacific Ocean, to which, in our opinion, the name of the Great Ocean would be more suitable in all respects, is vast, beyond all other oceans of the globe. It is the one least interrupted by extended tracts of land; and, in general, there are found there only small islands, either detached or united in groups.

In examining the form of this sea, it appears that it is very broad in its southern division, and that this breadth extends, nearly uniform, as high as the Tropic of Cancer. It

is only in the vicinity of this circle that the coast of Asia and the coast of America incline towards each other to meet at Behring's Straits, situated in about 65° north latitude.

The Pacific Ocean presents, in the forms of the shores which bound it, some remarkable traits of resemblance with the Atlantic Ocean. The west coast of South America projects much like the west coast of Africa, south of the Equator. The Gulf of Panama and the coast of Mexico have formations which offer some similitude with those of the Gulf of Guinea and the promontory of Africa; the Caribbean Sea, which runs up into the east coast of Mexico, seems to correspond to the gulf which is contained between the north coast of New Holland and the coasts of China, that gulf in which lie the Moluccas, the Philippine Islands, &c. Nevertheless, these two oceans, in their other divisions, whether north or south of the line, differ much in their extent, and in the form of the outlines of their shores.*

The Pacific Ocean is usually divided into two regions, separated by the Equator; but, to facilitate our studies of this sea, we will divide it into three regions: the first, as the most important,—the Equatorial Pacific Ocean,—will be comprised within the tropics; the second, the North Pacific Ocean, will be bounded by Behring's Straits and the Tropic of Cancer; the third, the South Pacific Ocean, will be comprised between the Tropic of Capricorn and the Antarctic Circle.

It was formerly believed that, over all the extent
 Equatorial
 Pacific Ocean. occupied by the Pacific Ocean, the trade winds blew
 Trade Winds. with as much and even more regularity than in the Atlantic Ocean. But recent and numerous observations have led to the opinion that there is not probably one half of this ocean subject to the constant influence of the trade winds; and it is now almost certain that the range for the southeast trade winds is only over that portion contained between the meridian of the Galapagos Islands (at 150 or 200 leagues from

* Romme, *Table of Winds, Currents, and Tides.*

the coast of America) and the meridian of the Marquesas Islands, or Archipelago of Nouka-Hiva ; and that the range for the northeast trade winds is over that part which, beginning at about 100 leagues off the coast of America, extends to the vicinity of the Ladrone Islands.

The numerous groups of islands lying west of the Marquesas Islands, and near New Holland, as well as those situated to the north of the Equator, in corresponding latitudes, seem to have the effect of changing the trade winds, in the west part of the Pacific Ocean, into periodical winds, or into monsoons and variable winds.

Thus it has been remarked, that in these groups the trade wind was only the prevailing one from the month of October till the month of May, in the belt lying to the north of the Equator ; from March to October, in that situated to the south of the Equator ; and that west winds, squalls, and rains took the place of it during the rest of the year. We shall return hereafter to this important fact, and we shall give unquestionable proofs of it, selecting from a great number of observations some of those taken from voyages of circumnavigation.

The belt over which the trade winds of the Pacific extend — that in which, as we have said, they blow with regularity — is contained between the Equator and the parallels of 30° north latitude and 30° south latitude.

After a great number of researches, we have been able to form the following table, from the routes taken in the Pacific Ocean by ninety-two vessels which crossed the line between the meridians of 101° 40' and 142° 40' west longitude. This table is still incomplete ; we believe, however, that it shows some important facts, although the results which it gives must only be received as approximations, since the means are not yet deduced from a very large number of observations.*

* We have, however, been able to render it much more complete than that given in the first edition, — thanks to the numerous details forwarded us by the kindness of Captain de Leyritz, who was in command for three years of the *Corvette la Pru-*

Table showing, according to the Months, the Limits of the Trade Winds, and the Breadth of the Zone of the variable Winds of the Equator.

Month.	Polar Limit of the Trade Winds.		Equatorial Limit of the Trade Winds. .		Breadth of the Belt of variable Winds North of the Equator.
	From N. E. Lat. North.	From S. E. Lat. South.	From N. E. Lat. North.	From S. E. Lat. South.	
January . .	21 ^o 0'	33 ^o 25'	6 ^o 30'	3 ^o 0'	3 ^o 30'
February . .	26 28	28 51	4 1	2 0	2 1
March . . .	29 0	31 10	8 15	5 50	2 25
April . . .	30 0	27 25	4 45	2 0	2 45
May	29 5	28 24	7 52	3 36	4 16
June	27 41	25 0	9 58	2 30	7 28
July	31 43	25 28	12 5	5 4	7 1
August . . .	29 30	24 18	15 0	2 30	12 30
September .	24 20	24 51	13 56	8 11	5 45
October . . .	26 6	23 27	12 20	3 32	8 48
November . .	25 0	28 39
December . .	24 0	22 30	5 12	1 56	3 16

Polar limit of the trade winds. It appears from this table, that the polar limit of the trade winds is variable, and that it removes more or less from the Equator, accordingly as the sun's declination is north or south.*

Equatorial limits of the trade winds. It appears, likewise, that the equatorial limit of the trade winds is variable according to the seasons; and it may be thought that the zone of variable winds which separates these limits is narrower in the winter than in the summer of the northern hemisphere.

dente, stationed in the Pacific Ocean. This superior officer made extracts from the log-books of a great number of vessels of the routes they took in these seas, and these materials have been very useful to us. We are therefore happy to express here our gratitude to Captain de Leyritz, for his attention in communicating them to us.

* In the month of August, Cook, going from New Zealand to Tahiti, took the S. E. trade winds in 19° 30' south latitude. In July, Carteret only found the S. E. trade winds in 16° south latitude. Vancouver, in March, lost the S. E. trades in 23° south latitude.

Cook, returning from Kamtschatka to the Sandwich Islands, only took the N. E. trade wind in 25° north latitude; this was in the month of November. Vancouver, going from Monterey to the same archipelago, only took the N. E. trade wind in 21° north latitude, and he had previously west winds variable to the S. W: King, in November, going from Kamtschatka to Macao, only took the N. E. trade in 25° north latitude. Vancouver, going from the Sandwich Islands to the N. W. coast of America, kept the trade wind as far as 30° north latitude.

It shows also that the belt of variable winds of the Equator is north of that circle, so far at least as may be judged from the observations that we have been able to collect. This belt has, besides, many affinities with that of the Atlantic Ocean. It is in fact wider on the meridians of 90° to 110° than on the meridians further west, those of 120° to 150° west longitude; that is to say, the breadth of the belt diminishes as we go west.

Belt of variable winds of the Equator.

There we meet with calms, light breezes, variable from N. W. to S. through the west, and often storms, squalls of wind and rain.*

The average northern limit of this belt is the parallel of 8° north latitude. Its southern limit is the parallel of 3° north latitude.

It sometimes happens, however, that the N. E. trade winds are in contact with the S. E. trade winds, and that the passage from one to the other takes place without experiencing any calms.†

* Dampier, crossing the belt of the variable winds of the Equator in the vicinity of the Galapagos, had moderate south winds. In returning to the north of these islands toward the parallel of 4° north latitude, he met with south winds, varying to S. W. by S. Cowley, in the neighborhood of these islands, felt the south winds in April. Vancouver, leaving the Iles de Cocos in 5° north latitude, had S. W. winds, variable to S. S. E. through the S., light, and broken by calms. He only took the S. E. trade wind after having crossed the line. M. Duperrey, being on the Equator and following it from about $147^{\circ} 20'$ east longitude, as far as $134^{\circ} 20'$ east longitude, left the N. E. winds in 8° north latitude, and met with variable winds from N. W. to S. S. E. round by W., with storms and rain.

† La Perouse, in May, left the S. E. trade winds in $5^{\circ} 49'$ north latitude, and took the N. E. trade winds in $6^{\circ} 10'$ north latitude. He had in the interval light breezes from the east, and no calm. He crossed the line in $118^{\circ} 40'$ west longitude.

The frigate *La Poursuivante*, going in April from Tahiti to the Sandwich Islands, crossed the line in $141^{\circ} 40'$ west longitude, and passed, without having any calms, from the S. E. winds to the N. E. in 8° north latitude. On her return course, in July, the same frigate crossed the line in $153^{\circ} 40'$ west longitude. She left the N. E. trade winds in $7^{\circ} 10'$ north latitude, and regained the S. E. trade winds in $4^{\circ} 57'$ south latitude; which gives to the zone of variable winds only $2^{\circ} 57'$ of width from north to south.

The ship *Alabama*, going in July from San Francisco to Tahiti, crossed the line in $127^{\circ} 40'$ west longitude; she left the N. E. winds in $7^{\circ} 41'$ north latitude, and caught

S. E. trade winds. At the distance of 150 or 200 leagues off the coast of America, between the parallel of 30° south latitude and that of 4° south latitude, gusts of wind or even showers are not generally met with. The trade wind varying from the E. to the S. E., blows constantly in the middle of this belt. In summer, the direction of the wind varies from E. S. E. to S. S. E., without ever drawing to the north. When the sun is in the northern hemisphere, the trade winds of the southern hemisphere blow more directly from the S. S. E., and, on the contrary, they blow more from the east when the sun is in the southern hemisphere.

In examining the preceding table, it appears that the polar limit of the trade winds from the S. E. seldom reaches the parallel of 30° south latitude. Their equatorial limit, on the contrary, often extends to the north of the Equator, as we have already said. It results from this, that the belt of the S. E. trade winds is generally wider than that in which the N. E. trade winds blow. The S. E. trade winds are more steady and less variable than the N. E. trade. In the belt which the former occupy, calms and storms are much less frequent; finally, it has been thought to be observed that, in this belt, the temperature was lower than in that of the N. E. trade winds,—a fact confirmed by observations made in the recent voyages of circumnavigation.

N. E. trade winds. The preceding table, compared with that established for the Atlantic Ocean, proves an assertion long since made; that is, that the polar limit of the N. E. trade winds in the Pacific Ocean is very nearly the same with that of the same wind in the Atlantic Ocean. It differs from it but very little.

In the northern hemisphere, when the sun is in that hemisphere, the N. E. trade winds blow more directly from the E., and they vary from the E. to E. N. E.; sometimes even

the S. E. trade winds in the same latitude. We have several other examples of the same fact in June, April, and February, for vessels crossing the line between the meridians of 144° and 155° west longitude.

drawing a little to the south. There are at these times frequent showers and squalls.

On the contrary, when the sun is in the southern hemisphere, the trade winds take a more northerly direction, varying from E. N. E. to N. N. E.

In this case, the equatorial limit of these winds approaches the Equator more than at any other season, but it never passes to the south of this circle.

The N. E. trade wind is particularly steady, and blows fresh in the middle of the belt which we have described, from the month of October until the month of May, when it reaches as far as to the Philippine Islands.

It is best then, at this season, in crossing the Pacific Ocean from east to west, to keep between the parallels of 13° and 14° north latitude.

The N. E. trade winds are, however, in general, less steady and less certain than the S. E. trade winds. In their variations they draw sometimes towards the south, as we have said, and they blow pretty frequently from E. S. E. Calms and squalls are likewise more numerous in the belt in which these prevail, than in that covered by the S. E. trade winds.

We have previously pointed out that the S. E. trade winds prevail regularly only in that space Monsoons * of the Pacific Ocean in the belt of the trade winds. comprehended between the meridian which passes to the east of the Galapagos Islands and that of the Marquesas, and the N. E. trades in that which, beginning 100 leagues off the coast of America, extends as far as the vicinity of the Ladrone Islands. In speaking of this fact as a general law, we have not pretended to say that it appears in every locality in identically the same manner, nor precisely at the same period.

* It would be more exact to designate the winds in question by the name of *alternating and periodical winds*, than by that of *monsoons*. In the Pacific Ocean, in fact, these winds, which Krusenstern, Romme, and several others name *monsoons*, do not blow, as in the Indian Ocean, from directly opposite points of the compass.

We have said that to the north of the Equator the N. E. trade winds prevail over the whole extent of the Pacific Ocean, from the month of October up to the month of May, or nearly so; and that to the south of the Equator, the S. E. trade winds blow from the month of March up to the month of October, although often undergoing changes in the archipelagos south of the Equator.

We have added, that these winds are replaced, in the west part of the Pacific Ocean, during the rest of the year, by variable winds, or by monsoons, contrary to the opinion which has so long prevailed in this respect. We shall go on, then, to cite some observations which will justify what we have advanced.

In the month of July, 1838, the corvette *Astrolabe*, sailing in the vicinity of the Low Archipelago, or Paumotu group, took the S. E. trade winds in 19° 50' south latitude. From the 15th of July, the time when she arrived in this latitude and 109° 40' west longitude, until the 28th of July, she experienced irregular winds, varying from N. N. E. to S. S. E., light, most frequently, and interrupted by winds from N. W. to S. W. by the W., blowing moderate breezes and good breezes.

From the 28th of July until the 5th of August, being in sight of the islands of Manga-Reva, or Gambier Islands, she experienced nine days of N. W. winds varying to the S. W. through the W., the N. W. winds giving strong breezes with weather generally fine, though cloudy. Up to the 15th of August, the prevailing winds were from N. W. to S. S. W., the weather overcast, cloudy, and sometimes turning to rain. The W. S. W. winds were the strongest. These winds were interrupted by light breezes from N. N. E. to S. E., passing through the east.

From the 15th of August to the 20th of the same month, during which time the corvette was in sight of the island of Clermont-Tonnerre, she had the same variable winds; and she experienced in the Marquesas Islands, at the end of August

Archipelago of
Paumotu, or
Low Islands,
and of Nouka-
lliva, or Mar-
quesas.

and at the beginning of September, variable winds from N. N. W. to S. S. W. by the W.*

M. Duperrey, in the same vicinity, found in April south winds varying through the W. to W. N. W.

It is apparent already, from these first observations, that, near these two archipelagos the S. E. trade wind is no longer a steady one. They confirm, moreover, the remark of Cook, which points out that, in the neighborhood of these islands, the trade wind is not a regular wind, and that it does not extend beyond the parallel of 20° south; that further south, in these regions, the winds are from the west, and restrict the trade winds to more or less narrow limits, according to the force with which they blow. Then, near these limits, the trade wind slackens very much.†

Krusenstern likewise points out, in the Marquesas Islands, S. W. winds which blow with considerable steadiness.‡

In the archipelago of Tahiti (Society Islands) the winds, during a part of the year, blow variably from S. S. E. to E. N. E., and sometimes, principally in July, from E. to S. S. E. The trade wind often blows with force in this archipelago; then the weather becomes cloudy, and there is occasionally rain.

Archipelago of
Tahiti, or So-
ciety Islands.

In October, November, December, and a part of January, the winds blow from W. to S. W.; they are interrupted by calms, light breezes from the east, and sometimes by squalls, bringing wind and rain.

In December and in January, the time when the sun is in these parallels, the weather and the winds are very variable. We have then moderate winds from W. N. W. to N. W., which last five or six days. With these winds the sky is overcast, and rain often falls. If they haul to the north, they slacken very much, and are replaced by winds from W. S. W.

* *Voyage de l' Astrolabe*. Physical Part, vol. i., by M. Vincendon-Dumoulin, p. 106 et seq.

† Romme, *Table of Winds*, &c.

‡ *Voyage of Krusenstern*, vol. i., p. 200.

to S. W. If they take a more southerly direction, they blow with great violence. The S. W. and W. S. W. winds are also more frequent than those from the north.*

We have here a second observation, tolerably complete and highly important, to make, namely, that this archipelago lies very near that part of the Pacific Ocean where the trade winds are regularly established all the year round.

We might cite analogous facts of the archipelago of the Tonga or Friendly Islands. In September, the winds there have been found S. E., replaced in October by winds from S. W. to S. S. W., and even by N. N. W. winds. The same observation has been made in New Caledonia.

In the month of December, 1838, the corvette *Astrolabe* found, in the vicinity of the Solomon Islands, winds blowing very strong and steadily from W. S. W. to S. S. W., with overcast weather and rain. †

In the Solomon Islands, the N. W. monsoon commences in December, or in January. ‡ Sometimes these two months are tolerably fine. In February and in March, high winds, heavy squalls, and abundant rains must be expected. April is generally a fine month. The winds then are variable, as also in May. During this latter month the weather is most commonly fair.

The S. E. monsoon is in greatest force in June ; abundant rains fall ; squalls are frequent, and the bad weather, interrupted by occasional successions of fine days, lasts up to the end of August. In September the monsoon begins to decrease, and from this period till the return of the N. W. monsoon the breezes are moderate.

To the eastward of these Islands, the N. W. monsoon is less constant. It also begins later toward the month of January, and blows fresh during sixteen or eighteen days. It

* Cook and Wallis.

† *Voyage de l'Astrolabe*. Physical Part, vol. i., by M. Vincendon-Dumoulin, p. 153, et seq.

‡ Captain Hunter. (*Nautical Magazine and Hydrographic Miscellanies*, 1846.)

slackens then, and the east winds, regaining the ascendancy, freshen and blow during about the same number of days. The west wind recommences then with a slight, sudden squall, and continues with squalls and rains, blowing all the time a strong breeze.

These alternations of west wind and east wind last up to the end of March, the period when the regular S. E. winds commence.

The farther we advance east, the more irregular the N. W. monsoon becomes, and it is no longer felt when beyond the Marquesas Islands.

In New Britain, as in New Ireland, it has been New Britain,
New Ireland. remarked that the S. E. trade wind was only the prevailing one from March to October. When the sun's declination is south, the west winds, varying from N. W. to S. W., take its place during the rest of the year.

In New Guinea, we distinguish two monsoons, New Guinea. which seem to be the continuation of those of the China Sea. One is N. W., the other is S. E. These monsoons become settled, the S. E. at the middle of May or in June, lasting till the month of October; the N. W., from November till May.

In the month of December we find, quite often, variable winds from N. N. W. to N. E.

Eastward of New Guinea, the wind is from the southeast, while the S. W. monsoon prevails north of the line.

In Torres Strait the N. W. monsoon commences Torres Strait. towards the end of October, and lasts until the middle of March. The S. E. trade winds blow feebly in April, increasing in force up to the month of June, and they are at times very strong in this month and during the month of July; they then diminish gradually in intensity, and become again very moderate.

In the Ladrone Islands, there has been found a Ladrone
Islands. settled monsoon from the west, from the middle of June till the middle of October. The season of rains lasts

during the months of July and August; frequently it is only distinguished by successive showers. During the west monsoon, the winds vary very much at the period of the syzygies, and they blow then with violence from all the points of the horizon.*

The typhoons and hurricanes which are encountered in the China Sea are reproduced in the neighborhood of these islands at the period of the change of the monsoons. The eastern limit of these tempests is found in the vicinity of their meridian.

From the 15th of October to the 15th of June, the weather becomes fair, and the east monsoon prevails steadily during this interval.

It is seen by these quotations, which, if we made them more numerous, would force us to go beyond the limit of our general investigations, that, as to the S. E. trade winds, the belt in which they blow permanently is limited at the west nearly by the meridian of the Marquesas or Archipelago of Nouka-Hiva, and that, as to the N. E. winds, the belt in which these winds blow without interruption does not extend at the west as far as the Ladrone Islands.

We will add some general observations on monsoons. That from the west, in the Pacific as in the Indian Ocean, is generally accompanied by a cloudy sky, by squalls, and by heavy rains; and sometimes the squalls are so violent as to make it necessary to take in all sail when the wind is abeam, and even when it is abaft the beam. Generally, they are ushered in by a strong wind from W. S. W., which lasts about one hour, and which continues to blow very hard, shifting to the N. W., during five or six hours. †

Hurricanes of the South Pacific Ocean. Between the parallel of 10° south latitude and the Tropic of Capricorn, there are at times hurricanes in the Pacific Ocean. They take place prin-

* Byron and Anson.

† Captain Hunter, (*Nautical Magazine*), from whom we borrow part of the following details, extracted from a very long and very interesting report.

cipally from November to April. This is another point of resemblance between this and the Indian Ocean.

Hurricanes are more frequent in the vicinity of the New Hebrides and of New Caledonia than anywhere else. They are also often encountered near the Tonga and Feejee Islands.

It may be said, in general, that wherever the S. W. monsoon extends, we are liable to meet hurricanes; or, more exactly, that the S. W. monsoon and the hurricanes are found between the same meridians, without however having the same limit in latitude. In fact, while the S. W. monsoon often only reaches the parallel of 13° south latitude, and but seldom passes those of 17° or 18° , the hurricanes extend as far as the tropic.

The hurricanes of the Pacific Ocean are not, however, so terrible as those encountered in the Indian and in the Atlantic Oceans; they take place oftener, and are more violent in the neighborhood of the islands than in open sea. In this sea, in short, these fearful phenomena are rare, and several years usually pass without their being felt.

The hurricanes of the southern hemisphere obey, like those of the Indian Ocean, a gyratory movement, in the direction of the hands of a watch, and a movement of general translation in a parabolic curve, of which the summit is tangent to the meridian, in the latitude of about 26° , and of which the branches open toward the east; the nearest to the Equator being directed toward the S. W., and the most distant toward the S. E., and, finally, the line of travel being towards the pole at the summit of the curve.*

About the archipelago of the Tonga or Friendly Islands, and perhaps everywhere else in the belt of which we are speaking, † there are at times sudden

Steady hurricanes of the South Pacific Ocean.

* M. Keller, hydrographic engineer, *Mémoire sur les Typhons de 1848 et les Ouragans*, page 40, extracted from the *Annales Hydrographiques*, 1849. We advise consulting this very important memoir for the discussion of the facts and the results which the author has obtained from them. (See also the *Considérations Générales sur l'Océan Indien*, page 57, 2d edition.)

† Captain Hunter.

squalls of extreme violence, blowing always from the same direction. They produce effects nearly similar to those of hurricanes. These tempests, says M. Keller, are only a particular case of the hurricanes of the southern hemisphere.*

The Ladrone Islands are sometimes ravaged by hurricanes. They are, it is said, most frequent in the months of June, July, August, December, and January. These hurricanes take place sometimes much farther to the east, and Captain Hunter mentions one of them (that experienced in 1832 by the ship *Japan*) which was felt in the parallel of 13° north latitude, and in the meridian of 148° west longitude, which is nearly the meridian of some of the Sandwich Islands.†

In that belt of the South Pacific Ocean in which we have said the S. E. trade winds were constant, we have not as yet had an instance of a hurricane. We perceive that in the same belt where the N. E. trade winds prevail, they are at times met with.

These facts confirm the observation that we have made on these winds, (page 7,) that they were less constant and less certain than those of the S. E.; for, in addition to this, squalls and storms are more frequent in the belt they occupy than in that of the S. E. trades.‡

We add here some further information on the subject of gusts of wind experienced to the east of the islands of Hawaii (Sandwich), in the belt of the N. E. trade winds, and near their northern limit.

The *Superbe*, a three-masted vessel, going from Valparaiso to San Francisco, in the month of September, was on the 16th in 15° 0' north latitude, and in west longitude 119° 50'. The wind was light from N. N. E.; the weather very squally; much rain and violent thunder-storm. At 4 o'clock in the evening

* Memoir of M. Keller, pp. 40 - 43.

† Ibid.

‡ See, for the laws that regulate hurricanes, the *Considérations Générales sur l'Océan Atlantique*, or those *sur l'Océan Indien*, and for the evolutions necessary to make when involved in these tempests, the Appendix to be found at the end of this work.

the weather assumed a worse and worse appearance, and during the night the wind increased rapidly. At 11 o'clock in the evening the wind gained suddenly such violence, that it was with difficulty they could save the foresail by hauling it up. For the space of an hour the sky was seamed with sharp flashes of lightning, and the claps of thunder succeeded each other with frightful noise. The hurricane only lasted short of five hours, after which the wind diminished in violence, and, *veering gradually toward the south*, it finished by moderating. At noon of the 17th, the weather had regained its serenity, and the breeze blew moderately from the east.*

On the 3d of October, 1854, the brig *Giffard*, then in 25° 32' north latitude and 137° 40' west longitude, had a good breeze from the N. E., the weather being dull and overcast. A thick belt of clouds appeared in the east. The barometer varied from 29.69 to 29.80. At midnight the breeze freshened, with squalls, accompanied by rain. The *Giffard* steered N. W. by W.

On the 4th of October the squalls became heavier, and the rain more violent. At noon the latitude was found to be 27° 40' north, and the longitude 134° 10' west. The barometer read 29.61. At 1 o'clock it fell to 29.29, and the wind increased; the rain at the same time became continuous. The captain, suspecting that he was entering gradually into a typhoon, or into a tempest of the rotatory kind, the wind being E. S. E. and the course W. N. W., which showed that the vessel was in the north part of the belt occupied by the hurricane, decided to work in such a manner as to let the centre of the storm pass ahead of him. The wind being east, he hove to, with her head to the N. N. E. At 4 o'clock P. M.

* Passage of the *Superbe* from Valparaiso to San Francisco in August, September, and October, 1851. It is to be regretted that the captain of this vessel had not followed exactly the variations of the barometer at the same time with those undergone by the wind. However, it appears from what he shows, that in this hurricane the wind turned from left to right, and that the ship passed some distance from the centre.

the barometer marked 29.29; at midnight, 29.21, the wind blowing from E. S. E.

On the 5th of October the wind was very violent, and the rain incessant. He still kept her hove to.

At 4 A. M.	the barometer stood at	^{in.} 29.21,	the wind at	S. E.
At 8	“ “ “ “	29.10,	“	S. S. E.
At noon	“ “ “ “	29.02,	“	S. S. E.
At 2 P. M.	“ “ “ “	28.98,	“	S. by E.

The wind rises then to extreme violence, the rain is incessant, the sea a sheet of foam.

At 4 P. M.	the barometer stands at	^{in.} 28.82,	the wind at	S.
At 8	“ “ “ “	28.74,	“	S. S. W.

At this hour the vessel was struck by a sea on the starboard side, in such a manner that, by the combined action of the sea and the wind, which had now reached its highest degree of violence, she was partly dismasted and thrown down on her port beam. At midnight the barometer stood at 28.74, and the wind blew with the same fury.

On the 6th of October, at 11 o'clock, the barometer began to rise; at 2 o'clock it read 28.90, and the wind (W. S. W.) moderated a little. The rain continued to fall with the same obstinacy.

At 4 A. M.	the barometer stands at	^{in.} 28.98,	the wind at	W. by S.
At 8	“ “ “ “	29.10,	“	W. by S.
At noon	“ “ “ “	29.29,	“	W.

The wind at this hour is more moderate, though still blowing in heavy squalls. The opinion of Captain Briard, of the *Giffard*, is, that the hurricane travelled toward the N. W., but that on the 5th it took its direction toward the north, for they experienced the most violent wind when the centre was to the N. W. of them.

The *Giffard* was skilfully handled by her captain, and this vessel must have been very near (on the 4th and 5th especially) the place where the hurricane, after having followed

its curve from east to west, turned toward the north to describe its curve from west to east. This observation is valuable, because we have very few on the course of the hurricanes of the Pacific Ocean, either in its northern or in its southern division.*

From what precedes, it may be concluded that the Pacific Ocean is far from deserving this name. In our opinion we ought definitively to reject this title, as equally incorrect with that of the South Sea, which has also been given to it, and we ought only to designate it under the title of the Great Ocean, which suits it perfectly.

To terminate what we have to say on the belt of the trade winds of the Pacific Ocean, we think it ^{Archipelago of Hawaii or Sandwich Islands.} useful to give some information on the climate of the Sandwich Islands, or Archipelago of Hawaii, with a summary of the observations made by the learned Doctor Rooke, on the winds which blew during the year 1837, and part of 1838 and of 1839, at Honolulu. This point is very interesting, on account of its isolated position in the midst of the Pacific Ocean, and its vicinity to the polar limit of the N. E. trade winds.†

The climate of these islands seems to differ but little from that of the Antilles.‡ The N. E. trade winds are the usual winds. In December, the thermometer falls on an average to 71° Fahrenheit; in August and September it rises to 80°. The mean temperature for the year 1838 was 77° F. Cook says that snow covers the summits of the mountains in December.

At the end of November and in December, the land winds blow during several days, and then a great deal of rain falls. In the year 1838, the quantity which fell was 20.473 inches.

From December to March, in the interior of these islands,

* *Nautical Magazine* of 1855, pp. 71, 72.

† Observations communicated to Admiral Du Petit-Thonars. *Voyage of the Venus*, Physical Part, drawn up by M. de Tesson, hydrographic engineer, vol. iv. p. 452.

‡ Romme, *Table of Winds*, &c.

the rains are more abundant than in the Antilles, and yet the weather is fair on the coast during the same interval. Then the wind never ceases to blow from E. S. E. to N., varying by a few points to the south and to the north, but for a short time only.

During these same months, the land and sea breezes succeed each other without interruption, day and night.

These islands do not appear to have, like the Antilles, a winter season, or a season of hurricanes and of violent winds.*

We give the summary of the observations of Doctor Rooke on the climate of these islands.

In the year 1837, the trade winds blew during 295 days; winds from the south, 44 days; the variable winds, 26 days. The month of January was the one in which there were most days of variable winds. During this year, there were 285 fair days, 37 rainy days, 43 days of variable weather.

In the year 1838, from January to June, there were 137 days of trade winds, 24 days of south winds, 20 days of variable winds. The month of March was the one that contained most days of variable winds.

In the year 1839, from January to July, there were counted 159 days of trade winds, 38 days of south winds, 15 days of variable winds. January is the month which presented the greatest number of days of variable winds. There were, during this period, 168 fair days, 24 rainy days, and 20 days of variable weather.

North Pacific Ocean. The region of the *North Pacific Ocean* is contained, as we have said, between Behring's Straits and the Tropic of Cancer. We shall distinguish in this region two zones: the temperate zone, and the frigid zone. We will speak first of the temperate zone.

Temperate Zone. In the temperate zone of the North Pacific Ocean, that comprised between the parallels of 50° and 30° north latitude, the winds blow during all seasons from all directions.

* Cook, Romme.

It has been remarked, however, that from the month of May until the month of October,—that is to say, during the fair season,—the prevailing winds were those from W. to S. W., and that from November to April the prevailing winds were those from W. to N. W. Thus, during the year, the west winds varying from N. W. to S. W. are the general or prevailing winds in this zone.

Other navigators say also that, from the coasts of Asia as far as the meridian of Behring's Straits, the winds are usually from W. S. W., and that they become W. N. W. and N. W. east of the meridian of these straits.

Be that as it may, an indisputable proof of the predominance of west winds in this zone is that which may be drawn from the return voyages from Manilla to Acapulco, made every year, at the same periods, by the galleons of Spain. These ships took their departure regularly from the Philippines in the month of July, and shaped their course between the parallels of 34° and 37° north latitude. Their average passage was from 90 to 100 days, to traverse a space of 2,400 leagues.

In going further north than the parallels that we have just mentioned, to that of 40° north latitude, gusts of N. E. wind are often experienced. However, Anson says that between this last parallel and that of 50° north latitude, during the summer months, the west winds are still more regular than between those of 30° and 40° , and that they are as much so as the trade winds of the contiguous zone.*

The winds of which we have just spoken do not present any of the characteristics of monsoons, and they blow at no determinate periods. The S. E. winds blow frequently during the winter. Sometimes the N. W. winds are those which are oftenest felt during the summer.

In this region, the S. E. winds at all seasons are accompanied by bad weather, rain, or fogs. The N. W. winds, on the contrary, bring fair weather, generally dry and cold.

* Anson, Meares, p. 234.

The W. S. W. winds bring usually dark and rainy weather. The winds from the south to the east are in general very strong, and those from the east, on the N. W. coast of America, for example, often precede a tempest, during which they blow from E. S. E. and from S. E. to return to the west, bringing back fair weather.*

Frigid Zone. There are few observations on the Frigid Zone of the North Pacific Ocean, which a very small number of navigators have visited.

Beyond the parallel of 60° north latitude, the breadth of the ocean rapidly diminishes, and it terminates in a basin of small extent. It is during the fair season that explorations have been made in these latitudes.

Behring's Straits. In Behring's Straits, winds from the north and from the south have been those most commonly met with, which is explained by the configuration of the land here; for, in all straits which are bounded on both sides by high lands, the wind generally blows in the direction of the channel.†

South of these straits the winds are very variable, and it has been, we believe, observed that those from the south were the most frequent. These variations of the wind are easily explained. In fact, the basin of this sea, locked in between two continents, of which the mountains are always covered with snow, must be subject to numerous changes of temperature, which necessarily react on the currents of air. We have, however, observations which prove that, in the Aleutian Isles, the prevailing winds are those from the S. and S. W.

We will return to this subject when we point out the winds prevailing along the coasts of the Pacific Ocean, in making the tour of this vast sea.

South Pacific Ocean. The region that we have named the *South Pacific Ocean* extends from the Tropic of Capricorn to the Antarctic Circle. We will divide this region, like the pre-

* Cook, Vancouver, La Pérouse, Meares.

† Cook, King, Kotzebue, Krusenstern.

ceding, into two zones; one temperate, from the tropic as far as the parallel of 50° of south latitude; the other frigid, between this last parallel and the Antarctic Circle.

In the temperate zone of the South Pacific Ocean, ^{Temperate Zone.} the winds during all seasons blow from all directions. Nevertheless, in this region, as in that which corresponds to it in the North Pacific Ocean, the prevailing winds are those from the west, varying from N. W. to S. W. These winds sometimes extend as far as the tropic, and even to the parallel of 20° south latitude, chiefly in the west part of the Pacific Ocean.

West winds, varying to the N. W., appear to be the prevailing ones during the summer, and those from W. to W. S. W. and to S. W. during the winter. The N. W. winds are generally fresh, and often blow with violence.

The S. W. winds are temporarily replaced by south winds, which are also very violent, and which bring rain. Sometimes also there are east winds, variable to the S. E., which are pretty constant, especially in June and July.*

Generally the N. W. winds, even when they are violent, are accompanied by fair weather. This rule is however subject to exceptions, particularly near the islands and the lands situated in this region. In their vicinity there are likewise S. W. and S. E. winds, the former violent and accompanied by rain; the latter, in general, moderate and rainy.

Thus, in the vicinity of New Zealand, where the N. W. winds are prevalent, they bring at times tempests, particularly in February; in March and in April, the weather is very rainy; in May, the west winds are felt, with rain; in October, gusts of wind from the south; and in November the N. W. winds prevail, and are accompanied by squalls.†

In the frigid zone, but little explored, and that ^{Frigid Zone.} only during the summer, it is difficult to name the prevailing winds.

From the month of November to the month of March, the

* Romme, p. 73, et seq.

† Cook, Forster, Romme, p. 75.

N. W. winds were those which Cook principally met with between the parallels of 35° and of 67° south latitude. But, in his exploration of the Antarctic regions, he remained a long time in the temperate region of which we have just now spoken. His observation, therefore, is not conclusive. He remarks, besides, that from November to December the weather was without storms, and the winds without violence.

In the voyage made to the south pole by the *Astrolabe*, under the orders of Admiral Dumont-d'Urville, we see that, during his stay in the vicinity of and above the parallel of 60° south latitude, the winds varied very much during the months of December and January, and in the following proportion.*

West winds, varying from W. N. W. to S. S. W., 12 days; east winds, varying from N. E. to S. S. E., 12 days; winds from the S. to the S. S. W., 2 days. The S. E. winds were the only ones that brought tempests, and, in general, these winds were the strongest. The others were moderate; those from the N. E., however, brought some strong breezes.

North of the parallel of 60° of latitude, the prevailing winds blew from the west, varying from the N. W. to the S. W., during the stay of the *Astrolabe* in those latitudes, in January, February, and March of the year 1838; and in December and January of 1840.

In the two explorations of the Antarctic regions, made in 1839 and 1840 by the American Captain Wilkes, U. S. N., we have found, as to the winds, the following results: north winds, 7 days; south winds, 5 days; east winds, varying from the N. E. to the S. E., 38 days; west winds, varying from the N. W. to the S. W., 40 days. These explorations took place in the months of January, February, March, and April.

To the observations of Admiral Dumont-d'Urville and to those of Captain Wilkes we will add those of Captain Sir

* *Voyage de l'Astrolabe au Pôle Sud*. Physical Part, drawn up by M. Vincendon-Dumoulin, hydrographic engineer, vol. i. p. 288, et seq.

James Ross, who advanced into the frigid zone of the Pacific Ocean on the meridian of $160^{\circ} 15'$ west longitude, as far as the parallel of $77^{\circ} 49'$ south latitude. These observations comprise an interval of 3 months and 17 days.

December, 1841. East winds, varying from N. N. E. to S. S. E., 12 days; west winds, 2 days; winds from north, 2 days; breezes light or only fresh.

January, 1842. East winds, variable from N. N. E. to S. S. E., $15\frac{1}{2}$ days; west winds, variable from N. N. W. to S. S. W., $12\frac{1}{2}$ days; south winds, 2 days; north winds, 1 day; 1 day, gust of wind from N. W.; 2 days of strong breezes from the south; the others fresh or moderate.

February. East winds, variable from N. N. E. to S. S. E., 14 days; west winds, variable from N. N. W. to S. S. W., $11\frac{1}{2}$ days; north winds, 2 days; south winds, $\frac{1}{2}$ day; $\frac{1}{2}$ day, very fresh N. N. E.; S. W., tolerably fresh during 1 day; the other breezes fresh or moderate.

March. East winds, variable from N. N. E. to S. S. E., 5 days; west winds, variable from N. N. W. to S. S. W., $20\frac{1}{2}$ days; north winds, 1 day; south winds, $4\frac{1}{2}$ days; N. N. E., very fresh during $\frac{1}{2}$ day; S. W., pretty fresh, 1 day; the other winds blew in strong breezes, good breezes, and often moderate.

We may then, by these observations, be led to think that in the frigid zone of the South Pacific Ocean, and during the summer, the east and west winds blow about in equal proportions; nevertheless, we can decide nothing from so small a number of observations.

To finish the study of the winds in the Pacific Ocean, it yet remains to show the observations made on those which blow along the coasts of the basin of this sea. These winds are of great importance to navigation; therefore, while generalizing as much as possible, we shall be forced to enter into some details more particularly relating to certain localities.

We will begin with the west coast of America.

The most dangerous winds in the group of the South

S. Shetland
Isles. Shetland Islands are those from the east, which are frequent there. They blow with violence, accompanied by snow.

In the years 1820, 1821, and 1822, four fifths of the gusts of wind in this group were from the east. In fair weather the N. E. and S. W. winds blow about equally, without remaining long steady at these points. The S. W. winds blow with a clear sky; they dispel the fogs or snow brought by the N. W. winds. Gusts of wind from this last direction are rare, and they are at times very strong. Land winds are very rare, says Robert Fildes, and I have remarked that these winds are generally light, and accompanied by dull weather. This captain adds, that in doubling Cape Horn from east to west, if you meet contrary winds, instead of beating or lying to, according to the strength of these winds, you can run to the south with the certainty of soon finding east winds which will allow you to make westing enough to double Cape Horn, or at least to allow you, with the wind from S. W., to pass well clear of the west part of Terra del Fuego.

Winds in the
vicinity of
Cape Horn. In the vicinity of Cape Horn the west winds prevail during the greater part of the year. Those from the east only blow in the winter months, and they are at times violent. It is very rare to meet with them in summer.*

December, January, and February, which are the summer months, have some fine days; but the west winds which prevail at this season are often violent, and accompanied by heavy rains.

March is the worst month of the year,—as the equinoctial months generally are in all parts of the world. In this month tempests are experienced. It is not, however, as rainy as the summer months.

It is in April, May, and June that we find the pleasantest

* Cook, Frézier, La Pérouse, Duperrey, Vaillant, Du Petit-Thouars, Hanet-Cléry. See especially King, *Sailing Directions for Patagonia*, translated into French by M. Darondeau, hydrographic engineer. Paris, 1835; Dépôt Général de la Marine.

weather, notwithstanding there are sometimes gusts of wind. At this period the east winds are frequent, and we may count on the fair weather that they bring.

June and July have many resemblances; however, in July the east winds are more frequent.

August, September, and October are about the worst months of the year, if we except the month of March. This is the period in which the west winds prevail, almost always violent, accompanied by rain, snow, hail, and cold.

We give below some more particular observations on these winds.* Those from the north almost always commence with a moderate breeze; the weather is North Breeze. dark, and the sky more overcast than with the east wind.

These winds from the north are generally accompanied by a fine rain. According as they freshen, they haul gradually to the westward, and they blow with force between the north and the northwest.

The sky then becomes loaded with heavy clouds; the weather grows dark, and much rain falls.

When the violence of the N. W. wind is laid, which takes place after an interval of 12 or 15 hours, and sometimes even while it is still blowing fresh from this quarter, the wind shifts suddenly to the southwest, and blows with S. W. Breezes. more strength than before. This wind soon drives the clouds before it, and a few hours after it begins to blow the weather becomes very clear. There are only from time to time heavy squalls.

The wind holds, in general, several days from the southwest, blowing strong; then it moderates, and is succeeded by two or three days of fine weather.

The north winds are those which generally blow in summer, and it is uniformly the case that all the shifts of wind from north to south are made by the west during this season, which would hardly merit the name of summer if the days were not

* King, *Sailing Directions for the Coast of Patagonia*, translated (into French) by M. Darondeau.

longer, and if the atmosphere were not then warmer than at any other period of the year. We find at this season heavier rains and winds than in winter.

Breezes from the east. The winds from the east are always light, and they bring fine weather when they begin to make themselves felt. They increase gradually in strength, and then the weather clouds. They cease sometimes after having blown very fresh, diminishing by degrees; at other times they shift suddenly to blow in another direction.

It is remarked also that the bad weather never comes suddenly from the east, and that the southwest winds and the south winds never shift suddenly to the north; but the winds from the south and southwest rise, on the contrary, suddenly and with violence.

It is a circumstance to which attention ought to be paid, to prepare for the shifting of the wind when at sea.

South Breezes and S.W. gales. South breezes and southwest squalls are preceded and announced by heavy banks of great white clouds which rise in those directions. The edges of these clouds are very clean, and their appearance is rounded and solid.

The north and northwest winds are preceded by clouds flying very low; the sky is obscure, and other clouds appear above at a great height. The sun pierces them with difficulty, and presents a reddish aspect.

For some hours or a day before a north or a west wind, it is not possible to take the altitude of the sun, although it is visible, because the fog in the higher parts of the atmosphere prevents his disk from being distinct and well defined.

Sometimes, with a little breeze varying from N. N. W. to N. N. E., there are several days of fair weather. These winds are then succeeded by south breezes and much rain.

The most common weather, in these latitudes, is a fresh wind from the N. W. varying to the S. W., and accompanied by a cloudy sky.

Lightning is rarely seen there, and thunder seldom heard. Violent squalls, coming from the south or S. W., are foretold

by masses of clouds, and they are often accompanied by snow or by hail of large size, which renders them still more terrible.

Finally, it has been remarked that, on the west coast, which forms the promontory of Cape Horn, the winds often blow from the south, while they are violent from the west off its extremity. This same remark applies also to the Cape of Good Hope and to Van Diemen's Cape.*

What we have just said of the winds in the vicinity of Cape Horn, may be applied to all the Magellanic territory. Winds of the Straits of Magellan.

The west winds prevail during the greater part of the year at the entrance of the Straits of Magellan, in the Pacific Ocean. They blow especially with violence during the month of March, and in this month they often give rise to tempests. They are accompanied by rain, and at times by snow. The sea becomes very high in these winds.

According to several navigators, the west winds prevail, principally during the summer, on all the coast of Patagonia and Terra del Fuego, and during the greater part of the year, that is to say, from July to March; during the winter they are sometimes interrupted by east winds, holding on pretty long, which bring fine weather.†

In December, January, and February there are west winds, varying from N. W. to S. W., blowing at times with violence. In March, as we have said, the weather is always bad. In April, we find the prevailing winds from E. N. E. to E. S. E., interrupted by occasional fresh winds from the west.

In the straits, the winds are very variable, as in all narrow and indented channels. According to Anson, the most favorable month to pass through them from east to west is December; because, he says, at this period the breezes are in general moderate, especially at the commencement of the month.‡

It was long believed that, from the Straits of Magellan

* Horsburgh, *India Directory*.

† Anson, Cook, Duperrey, Terry.

‡ King, *Sailing Directions for the Coast of Patagonia, &c.*, pp: 162, 197.

as far as Panama, the winds along the west coast of America had an almost constant tendency to blow from the south toward the north, being modified according to the direction of the coast. This fact, true for a certain portion of the coast, is not so for that of Chili.

On this latter, there are two monsoons,* which, without being so regular as those of the Indian Ocean, are nevertheless well defined.†

The winds from the N. and N. W. are settled in winter; that is to say, from May to September.

From the middle of September until the month of May, the winds from S. to S. E. prevail, and they blow sometimes with great strength.

The two directions, north and south, by which we designate the monsoons, indicate only that the winds blow oftenest in these directions, inclining more or less to the west or to the east. Therefore, we think that it would be better to designate these winds under the name of alternate periodical winds, than under that of monsoons.

The bad weather season lasts from the end of May to September. During these three months we meet with calms, light breezes, occasional winds from W. to S. W., and, besides, very bad weather. There are, at the beginning of the season and during its continuance, gusts of north wind and much rain, which falls not only along the coast, but also at a great distance out at sea. However, the north winds are not in general very violent.

The fair season lasts from September to May; that is to say, during about nine months. The sky is then generally clear, and comparatively little rain falls. There are, however, in the summer, though rarely, strong north winds, and from time to time two or three days of continued and abundant rain. These changes in the fair weather are

* We recall here what we have said of these monsoons.

† Frézier, Vancouver, Anson, Zarate, Romme, Krusenstern, Vaillant, Du Petit Thouars.

more rare and less marked north of the parallel of 31° south latitude, than south of this parallel.

Most usually a fresh breeze from the south rises a little before midday (an hour sooner or later); it blows until sunset, and sometimes until midnight. In the middle of summer it often happens that it becomes violent enough to prevent ships from reaching the anchorage, among others that of Valparaiso, notwithstanding any precautions that can be taken beforehand. The habitual strength of this sea breeze, thus called, although it blows along the coast, is frequently such, that with a good ship it is often necessary to have two reefs in the top-sail in beating to windward.

This is also the average strength of the south breeze Breeze from the south. out at sea, between the parallels of 35° and of 25° south latitude; however, this breeze is not as strong during the day in the offing as near the land, and it does not fall during the night. In sight of the coast the breeze is fresher, and it ceases almost as it does in the harbors, where it is generally calm during the night, till the land breeze rises from the eastward. This light breeze, coming from the Cordilleras, is never to be feared, and it only lasts some hours. With these winds the sky is almost always clear. In summer, when it becomes cloudy, it is a certain sign of little wind, or that there will be none at sea; it is also an indication of probable rain. In winter, when the sky is overcast, it foretells some wind from the north, accompanied by rain.

On the coast of Chili, as in all the southern hemisphere, the course of the winds is from the north toward the west. Those which blow strongest and occasion the most sea are to the west of north. It is best, therefore, as much as possible, in anchoring, to cast anchor under shelter of lands or rocks which project to the west, and not of those which give shelter only from the north winds. In summer, anchor near the land, so as not to be swept out to sea by the southern breezes. In winter, it is necessary to keep a greater distance from it, without however keeping too far out, for near

the coast the wind is less strong, and there is the benefit always of a lull, produced by the meeting of the outside undulation with the one which the land sends back.

North winds. The north winds, as they are called, are in general distinctly characterized; the sky is clouded; there is little or no wind except it is from the east; the swell comes from the north; the tide is greater than usual; the distant land is remarkably distinct, and elevated by refraction; finally, the falling of the barometer is one of the surest prognostics of these winds. All north winds are not gales of wind, and sometimes several years pass without one being felt that merits this name. However, it is rare that many years pass without some ships being driven on shore.

Thunder and lightning are rare. On the coast of Chili there has never been seen an east wind blowing in a manner to trouble vessels. West winds are only felt when a north wind turns, before the sky clears and the wind diminishes. North winds do not often blow more than one day and one night, and generally do not last so long.

The violence of the south winds only lasts some hours. Some seamen say that the force of the north winds is not felt north of Coquimbo. There are, however, many instances of gusts of wind and heavy seas at Copiapo.*

Chiloé. At Chiloé, it rains constantly during the whole year, and the southern monsoon lasts longer there than at Valparaiso.

Valdivia. At Valdivia the west winds are frequent, and especially violent.

Concepcion. At Concepcion, the periodical winds of which we have just spoken are regular and settled, as well as at Valparaiso. At this last place, winter and the north winds often do not begin till the middle of May, and they last into September, diminishing successively in intensity. But sometimes the north winds blow with violence from the month of April. The northern monsoon lasts about four months.

* Captain Fitz-Roy.

The fair or dry season, as well as the south winds, succeed the north winds, and last till the month of May. These breezes, varying from S. W. to S. E. through the south, are sometimes very violent, and ships in the roads of Valparaiso often drag their anchors.*

The monsoons of which we have just spoken extend at farthest from 70 to 80 leagues at sea.

On this coast, in the environs of Coquimbo, the monsoon of the north winds lasts only three months. Coquimbo. There are felt, during the night, land breezes which rise toward midnight, and which cease soon after sunrise. The climate in this locality is so uniform that it has been surnamed *La Serena*.

At Copiapo, it happens sometimes that pretty Copiapo. strong northwest winds are experienced, and it is a little north of this point that we cease to find the periodical winds of the coast of Chili.

On the coast of Chili they do not feel the tornados which are found on the coast of Mexico. Neither do they take place on the coast of Peru.

On the coast of Bolivia, from Copiapo to Cape General winds on the coast of Bolivia and Peru. San Francisco, in 1° north latitude, we find all the year general breezes, springing principally from the S., and varying to the S. S. E. and the S. S. W., with a constantly overcast sky.†

These winds seldom become stronger than a fresh breeze, and often, on certain portions of the coast, they have hardly sufficient strength to allow a ship to effect her passage from one port to another. This is principally the case between Cobija and Callao.

Sometimes during the summer there are three or four successive days of dead calm, with a perfectly clear sky. The days when the sea breeze makes itself felt, it generally commences toward 10 o'clock in the morning; at first it is

* Krusenstern, p. 54.

† Anson, Frézier, Zarate, Krusenstern, Vaillant, Du Petit-Thouars.

variable and light, gaining strength gradually up to 1 or 2 o'clock in the afternoon; it then sets steadily in till sunset, at which moment it begins to slacken. A little while after the sun has disappeared there is dead calm, and toward 8 or 9 o'clock in the evening light land breezes are felt, which last till the rising of the sun. At this moment there is dead calm until the time when the sea breeze sets in. The land breezes blow from N. W. to N. N. E., varying as far as E. S. E. The sea breezes vary from S. S. W. to S. W., and at times to W. S. W. These breezes have then much affinity with the tropical winds.*

During the winter, from April to the month of
 Fogs.

August, light north breezes, accompanied by thick fogs and a very dark sky, must be frequently expected. These circumstances are very rare in summer, even although the summits of the mountains may be covered with mist.

North of Callao the steadiness of the winds may be in general more depended on. The sea breeze is established with great regularity, and attains greater strength than anywhere else in the southern portions of the coast. Toward the boundary of Peru, near Payta, and at sea off Cape Blanco, there is quite often a breeze that requires two reefs in the topsail.

It is remarked, that if moderate winds prevail in
 Gales.

general on the coast of Peru, there are heavy squalls coming down from the mountains after the sea breeze has set in; they might occasion damage, if, on entering the roadsteads, care were not taken to take in sail suitably.

The only difference that there is between winter and summer in the prevailing winds, is the frequency of light breezes from the north during the winter. However, the difference of climate is greater than would be supposed in so low a latitude. In summer the weather is superb, and the thermometer in the interior of a ship is seldom below 70°, and often above 80½°, while in winter the weather is cold and damp,

* Captain Fitz-Roy.

with thick fogs or a very dull sky. It is necessary then, for the health of the crew, to dress the people in woollen clothes.*

The general winds of the coast of Peru extend 500 miles at sea,† and beyond, they take a direction more from the east, so that at 600 miles from the coast we usually find the south-east trades.

Sometimes, and principally from Chili to Callao, the breezes veer to the W. S. W. They reach to 90 or to 120 miles off the coast, and are especially fresh at 45 or at 60 miles.‡

On this coast there is generally fog in the morning, and abundant dews during the night. Fogs, dews.

Between Pisco and Callao, the winds vary from S. S. W. to S. E. Between Callao and Guayaquil Pisco. the south winds range from the S. W. from the month of November to the month of May, and there are sometimes W. S. W. breezes, especially during the summer.

At Lima it never rains; but the weather is always clouded. From March to September it is fair; Lima. in summer, thunder-storms are experienced, and in October there are heavy fogs.

At Callao the gusts are not felt which are frequent on the coast that extends from this point to the south. Callao.

Those winds from N. to N. N. W., rather rare at Callao, are fine breezes. Those from the W. to the N. N. W., when they blow, are light. During the summer the usual breezes are those from S. W. to W. S. W., and during the winter those from the S. veering sometimes to the S. E.

At Payta, and near Cape Blanco, there are no north breezes; the usual wind blows from the south, Payta and
Cape Blanco. and seldom from the southeast.

It is natural to believe, when obliged to shape a course from the north to the south, that in beating near the coast to take advantage of these variable winds, there are no great

* Captain Fitz-Roy.

† Dampier.

‡ Vaillant, Du Petit-Thouars

difficulties to encounter in the navigation. But it is not so. The land breezes are oftenest light near the capes, and there are frequent calms found in the vicinity of those which are very projecting. Another cause still of the obstacles experienced in taking this course, is the current, constantly running toward the north or the northwest, met with on these shores.

M. Humboldt, however, shows that Spanish ships sometimes take their course along the land in sailing from the north to the south, but only in going from Guayaquil to Lima; because in this part, he says, the land breezes blow for 18 hours, and the sea breezes for 6 hours. They make a S. S. W. course, consequently, with the land breezes, and they run toward the shore with those from sea. In these tacks they should not stand farther than from 50 to 70 leagues off shore.*

This navigation, called by the Spaniards navigation *por el meridiano*, has the advantage of avoiding the gusts of wind which often take place during the months of August, September, October, and November, between the parallels of 28° and 33° south latitude, to which the navigation *por altura* is exposed, which consists in standing off shore, crossing the belt of the trade winds, and not standing in again until sufficiently to windward to fetch the place of destination.

Galapagos Islands. In the Galapagos Islands in November, December, and January there are storms, rain, and gusts of wind. The weather is fine during the months of May, June, July, and August.

Monsoons from Cape San Francisco to Cape Corrientes. Between Cape San Francisco and Cape Corrientes the winds blow from the north varying to the N. E. from September to March. Then they change to the S. E. and to the S. W. during the rest of the year. Thus ships from Peru and Guayaquil to Panama profit by the south winds for going, and the north winds for their return.†

* De Humboldt, *Essai politique sur la Nouvelle-Espagne*.

† Dampier.

On this fraction of coast, from June to November, violent squalls are often encountered, and frequent calms are experienced. In the neighborhood of the island of Gorgona it rains during nearly the whole year, principally in the months of June, July, and August.

In the Bay of Panama, the winds vary from east to north from the month of September till the month of March, and they blow from S. to S. S. W. during the rest of the year.

The dry season is that during which the winds from E. N. E. are well set in; this is from December to April or May.* The rainy season begins in April or May with showers. The rain increases then gradually, and it is especially abundant in June, July, and August. In September the rains diminish, and finish in November, or at the latest in December.

In the Bay of Panama, the alternate breezes from sea and land are felt. The first blow from the S. S. W., the last come from the north, variable to the N. N. E. These breezes are not very regular except during the dry season; they have but little regularity in the damp season, and cease with the rainy season.

From the west extremity of the Bay of Panama up to about the parallel of 30° of north latitude, there are found on the coast of Mexico periodical winds which have been called monsoons:

On this coast, from the month of November till that of April, we find the winds from the N. W. to the N. E., by the N., and from the month of May up to the month of October, we have them from the S. W. to the S. E.; † nevertheless, it cannot be said that these winds are regular, like those of the monsoons of the Indian Ocean.

These monsoons extend to 40 and even to 50 leagues from

* Dampier.

† Krusenstern, *Winds and Currents of the Pacific Ocean*. Johnston, *Physical Atlas of the Pacific Ocean*.

the shore. At 70 leagues the northeast trade winds are usually felt.*

Disturbances in the monsoons of the coast of Mexico. On this coast, between the parallels of 10° and 20° north latitude, W. and W. N. W. winds are often met with. We find also tornados and weather

similar to that which has been observed on the corresponding west coast of Africa; that is to say, calms which last during the night, and towards the morning light land breezes,

Land breezes. which cease about 8 o'clock.†

Winds from S.S.W. to S.S.E. The winds from S. S. W. to S. S. E., which blow from the month of May into October, winds which the Spaniards have named *vendavales* (strong south wind), are accompanied by heavy rains and by tornados, or by calms, which last sometimes several days, with continual thunder and lightning. Sometimes the rain even falls 25 days in succession.

Gusts of wind. Gusts of wind take place usually from the southwest during the months of July, August, September, and October. They are called *Tapayaguas*, on the coasts of Nicaragua and of Guatemala.

It is then very dangerous to enter the ports of Mexico, and the Spaniards never went to San Blas and to Acapulco before the end of the month of November, and only after the season of tempests had passed.

Certain navigators even assert that fair weather cannot be counted on before the month of January.‡

Winds from N. W. to N. E. Winds from N. W. to N. E. prevail, as we have said, during the winter. From November to April, the weather is fair on the coast of Mexico. The Spaniards call this season *Verano de la Mar del Sud* (Summer of the South Sea); while it lasts, however, violent winds from the N. N. E. to the N. E., with a clear sky, are often experienced.

Winds of Papagayos and Tehuantepec. These winds are designated by the name of *Papagayos* and of *Tehuantepec*. M. de Humboldt says that they extend from the Gulf of California to the

* Anson, Krusenstern.

† Dampier.

‡ Krusenstern, Colnet.

Bay of Panama; that is, from the parallel of 22° north latitude to the parallel of 7° north latitude. It is between the parallels of 9° 30' and of 10° 45' north latitude that they blow with most force.

During the months of May, June, and July these same winds blow from the north during three or four successive days, and often day and night during a whole week.*

Between the parallels of 13° and of 15° north latitude, especially in February and March, there ^{Calm.} are prolonged calms, comparable to those of the Gulf of Guinea. Cases are cited in which they have lasted twenty-six successive days, and that at a distance of eighty miles from the coast.†

In the vicinity of Acapulco, during the winter, ^{Acapulco.} the winds blow from the west, and oftenest very fresh from the N. W. At this period, also, we must take care not to make land south of this port, and must go up to the north sufficiently to approach the coast with the favorable winds from the N. W., apprehending the currents along the land, which run to the S. E. at this season.

The only favorable chance left, on making the ^{Land breezes near Acapulco.} land to the south of Acapulco, would be to take advantage of the land breezes which, although light, blow during the whole night, from the E. to the E. N. E., and last till 8 or 9 o'clock in the morning.‡

In the winter months, as we have said, the ^{Cape Corrientes and Cape San Lucar.} winds are from the N. E. and from the N. W. in the vicinity of Cape Corrientes and of Cape San Lucar; but they are not in general accompanied by fine weather, as in the higher latitudes. The north winds usually become settled in the month of November. Sometimes, however, at the end of September and in the month of October, we meet in the neighborhood of these capes winds from the N. N. E. varying to N. N. W., which veer to the west in proportion to the approach to the shore. We have in this

* De Humboldt, Dampier.

† De Humboldt.

‡ Krusenstern.

case rain and continual storms near Cape Corrientes and Cape San Lucar.*

Prevailing winds on the coast of Upper California. On the coast of Upper California, and south of Cape Mendocino, winds from the N. W. are prevalent during the summer; that is to say, from May to November; and they blow during this period almost without interruption.

In the month of November, S. W. winds, varying to S. E., set in with showers and rain, and if they go over to the N. W. the sky becomes clear.

In October there is sometimes felt on this coast a dry and burning wind, coming from the east, resembling the sirocco; it is not of long duration. In the months of March and of April the winds are variable. On this coast, in summer as well as in winter, fogs are frequent.†

Cape Mendocino. To the north of Cape Mendocino, according to Vancouver and the Spanish navigators, the weather is generally bad, stormy, and violent gusts from the southeast are felt.

To the south of this cape the winds are in general moderate, and the weather fair. In the winter, says Krusenstern, the winds from the south are almost always manageable in the vicinity of this cape.

Alternate land and sea breezes on the coast of Upper California. On some parts of the coast of Upper California near Monterey, and between this point and the parallel of 30° north latitude, we have alternating land and sea breezes. The land breeze blows during the night from the east, varying from N. N. E. to S. S. E.; the other prevails during the day, and blows without violence from N. W. to N. N. W.‡

Prevailing winds of the N. W. coast of America. On the N. W. coast of America, from Cape Mendocino as far as Cook's Inlet, situated in 60° north latitude, the winds are variable. However, the greater number of navigators agree in saying that the pre-

* Colnet, Krusenstern.

† Captain Hagemeister, Krusenstern.

‡ Vancouver, Du Petit-Thouars.

vailing winds are those from the west, varying from S W. to N. W., with foggy weather.*

The weather is generally fine, with the winds from north to west, and it becomes clouded and rainy when they go round to the southwest.

During the summer, from Cape Mendocino as far as to 57° north latitude, the prevailing winds near the coast are those from N. N. W. to N. W.; they are at times interrupted by light winds from the southwest, bringing fog and rain.

When the winds go round from west to south, and turn toward the east, it is the usual sign of a tempest; the return of the west wind announces fair weather.

North of Cape Mendocino, during winter and spring, the southwest winds are prevalent, and they blow with violence at this period.

The preceding information concerning the winds of that part of the central coast of America which lies between Cape San Francisco and Cook's Inlet, accords almost perfectly with the following, due to Lieutenant Wood, commander of the *Pandora*, who remained four years in the Pacific Ocean, principally on this portion of the coast. We have considered, however, that it was useful to give these new directions, which are more extensive, separately, so that they may be compared with the preceding. They form, besides, a complete work. Lieutenant Wood says of the winds of the central coast, and on the northwest coast of America, as follows: † —

“Along the whole of the coast from the river Guayaquil, in latitude 3° south, to Guascames Point in 2° north, the wind is mostly from south to west all the year round; the exceptions are few, and generally occur in the fine season. Both in beating up this coast to the southward, and in running down it, the former in the months of May and June, the latter in those of October, November, and January, we had the wind from S. S. E. to W. (by the

From the River
Guayaquil
to Point
Guascames.

* Cook, La Pérouse, Vancouver, Lutkć.

† Nautical Magazine of 1850, p. 473.

south), with a constant current to the northeastward, the only difference being that the winds were lighter, and the weather finer in May and June as we got to the southward; whilst the contrary took place in October and November; and in January the weather was generally fine with moderate breezes.

Choco Bay. “After entering the Bay of Choco, of which Point

Guascames forms the southern horn, the winds become more variable; but during the time we were in the bay (from the end of January to the middle of March) it never blew very fresh, though the weather was often unsettled and heavy rains frequent. The prevailing wind was from southwest, but northwesterly winds were not uncommon.*

Point Chirambira to the Gulf of San Miguel. “When past Chirambira Point (the northern horn of Choco Bay) we had the wind more from the northward, and in the latter end of March had to beat up to Panama Bay against northwesterly and northeasterly breezes, blowing a fresh breeze at times, especially as we approached the bay.

“In surveying this last-named part in January, 1848, we found the winds more variable, heavy rains almost always accompanying a change to southwest, from which quarter we once or twice had a stiff breeze.

Gulf of San Miguel to the Gulf of Dulce, including the Bay of Panama. “Between the southern point of the Gulf of San Miguel and the Gulf of Dulce, including Panama Bay and the coast of Veragua, the winds are regulated by the seasons. Towards the end of December

Dry season.
From December to May.

the northers begin to blow. These are fine, dry breezes, which generally come on in the afternoon, and blow very fresh from N. N. E. to N. N. W. till near midnight, with a perfectly clear and cloudless sky, and the air so dry and rarefied that objects on a level with the horizon are distorted and flattened, and the same effects

* According to this, the northwest winds would be much less frequent, and above all less regular, than Dampier makes them in speaking of the coast between Cape San Francisco and Cape Corrientes. (See p. 33, et seq.)

are caused as are seen during an easterly breeze off our own coast. Though generally a double-reefed topsail breeze, they occasionally blow much harder, especially off the coast of Veragua, where, in the months of January and February, even a close-reefed topsail breeze is not uncommon. During even the strongest of these, a dead calm often prevails ten or fifteen miles off the land, the only evidence of the gale that is blowing within a few hundred yards of you being the agitation of the water, which is raised into short, hollow waves, which break on board of and tumble you about awfully.

“Towards the end of March up to the middle of Rainy season.
April, the northers begin to cease, and are suc- From May to
ceeded by calms and light sea and land breezes, December
with occasional squalls from the southwestward. As April advances, the squalls get stronger and more frequent, and by the early part of May the rainy season generally sets in; during the greater part of which south and southwesterly winds prevail: these are not very violent within the Bay of Panama; but from Punta Mala westward, gales from the above quarters are frequent, and sometimes severe, bringing a heavy sea with them.*

“From the Gulf of Dulce, proceeding westward From the Gulf
along the shores of Costa Rica, Guatemala, and of Dulce to
Mexico, we find the winds still follow the changes the Gulf of
Fonseca.
of the seasons, modified however by locality. For instance, whenever the northers prevail, we find them blowing off the shore at nearly right angles to the run of the coast; thus, as soon as the coast of Nicaragua is approached, (which takes a more northerly direction than that before mentioned,) we find during the fine season the northers exchanged for The Papa-
breezes called *Papagayos*. These blow from N. N. E. gayos.
to E. N. E. or E., and are accompanied by the same clear, fine weather as the northers; the prevailing wind, however,

* It is evident that, as to the winds prevailing in the Bay of Panama, Dampier and Wood agree perfectly. (See p. 35.)

Dry season. during this season (from January to April) is from
 From January southeast to northeast. From May to November,
 to April. which is the rainy season, the weather is mostly bad,
 Rainy season. gales from the west and southwest with thunder,
 From May to lightning, &c., being frequent, and at times violent.
 November.

Gulf of Fonseca “After passing the Gulf of Fonseca, where the land
 to the Gulf of again trends nearly due west, the northerly winds
 Tehuantepec. are lost, till, on reaching the Gulf of Tehuantepec,
 we meet them once more, but under a different name, and
 assuming a more violent character.* Along this portion, where
 the mountains approach, and even in some places form the
 coast line, the winds during the fine season are the usual
 tropical land and sea breezes; the former from N. W., the
 latter from S. to W. S. W. and W. The remaining months
 are marked by even worse weather from the same quarters as
 is found on the Nicaragua coast.†

From the Gulf “The heavy blasts which blow over the Isthmus of
 of Tehuantepec Tehuantepec derive their source from the country
 to Point they cross. They seem to be caused by the northers
 Texupau. in the Gulf of Mexico,‡ which here find a vent
 through the opening formed between the Mexican
 Dry season. and Guatemalian mountains. They blow with great
 From Decem- force from north to N. N. E., and raise a very high, short sea;
 ber to April. their force is felt several hundred miles off the coast. During
 the season when they prevail (December to April), every
 preparation should be made to meet and carry sail through
 them: if this can be done they are soon crossed, and 200 to
 250 miles of westing (or easting) made; otherwise, if you are
 obliged to heave to, 36 to 118 hours of heavy weather may
 be expected, exposed all the while to a very high and short
 sea. In the rainy season these cease; but the weather here,

* These winds are called *Tehuantepec*.

† This information is much more detailed and more precise than that we have previously given, although it is nearly the same in the main. (See p. 36.) The west and southwest breezes are tho-c called *Vendavales*.

‡ See *Considérations Générales sur l'Océan Atlantique*.

as along the whole coast of Mexico, is then very bad, gales and strong breezes from S. E. to S. W. constantly occur, whilst squalls, accompanied by thunder and lightning, with heavy and almost incessant rain, characterize the season throughout. These gales are at times very severe, rendering the navigation of such a coast very unpleasant, as, with one exception, there is scarcely any shelter from them to be found. During the fine season, however, nothing can be more regular or quiet than the weather on the Mexican coast; a regular sea breeze sets in about noon, beginning from S. S. W. to W. S. W., and getting more westerly as the sun goes down, decreasing with it, and gradually sinking into a calm as the night closes in. This is succeeded by the land wind off the shore, which is more irregular in its direction and force; but these winds, and the method of making a passage to the westward along the coast, have been so well and so truly described by Dampier and Basil Hall, that nothing remains but to add my testimony to the correctness of the accounts they give, as far as their phenomena fell under my own observation.*

Rainy season.
From April
to September.

“As soon as the coast begins to trend northerly again, which it does about Texupan Point, we meet the northerly winds which blow down the Gulf of California, and which are found pretty steady during the fine season a few miles off the coast: by taking advantage of these, and the daily variations caused by the land and sea breezes, the passage is made from this point to San Blas and Mazatlan; but it is always a tedious beat, owing to a contrary current and frequent calms.

“From Cape St. Lucas to San Diego, or from 23° to 32° north, the general direction of the wind is from west to north; but during the winter months, or from November to April, this coast is subject to violent

From Cape St.
Lucas to San
Diego.

* This manner of navigating is the one which ought to be followed wherever the alternating breezes exist. We have spoken several times of it. You must be off shore when the sea breeze begins, and near shore when the land breeze begins, and regulate your tacks and their length accordingly.

gales from the S. E., which, as most of the bays and anchorages are open towards that quarter, are much dreaded. This is especially the case along the northern portion of this division, as towards Cape St. Lucas they are less frequent; however, they always give ample warning of their approach. The only way, therefore, of making a passage up this coast is by standing off upon the starboard tack; as you get out, the wind draws to the eastward, till either the variables are reached, or you can fetch your port on the other tack. In the summer season the only alteration is that the wind is more westerly in the mornings, and draws round with the sun as the day advances.

From San
Diego to San
Francisco.
S. E. gales.

“From San Diego to San Francisco the wind prevails from the northwestward nearly all the year round. This coast is subject to the same southeasterly gales as the coast of Lower California, but they are more frequent here, and blow with greater force. All its bays and roadsteads are similarly exposed, with the exception of the above-named ports, which are perfectly secure, and defended from all winds. During the winter, therefore, vessels always anchor in a convenient berth for slipping, with springs and buoys on their cables, so that on the first appearance of heavy clouds approaching from the southeast, with a swell rolling up from the same quarter (the invariable signs of the coming gale), they may be able to slip and go to sea without loss of time. These gales last from twelve hours to two days, and are accompanied by heavy rain which lasts till the wind changes, which it often does very suddenly, and blows as hard for a few hours from the northwest, when the clouds clear off and fine weather again succeeds. Off Conception Point gales and strong breezes are so frequent as to obtain for it the appellation of the Cape Horn of California. They are mostly from north to west, and frequently blow with great force, especially in the winter, when they sometimes last for three days together, without a cloud to be seen, till they begin to moderate. But here one of the most remarkable features of this coast

first shows itself, viz. the frequent and dense fogs, which, during more than half the year, render the navigation from San Diego northward most unpleasant. In making the land, the only way to deal with them is to feel your way into the coast with the lead during the day-time, as it frequently happens that a thick fog prevails at sea, while at the same time, within a mile or two of the land, a beautiful, clear, bright sky and open horizon are to be found: if disappointed in this, you have but to wear, haul off again, and heave to till the desired change does take place.

“From San Francisco northward to the Juan de Fuca Straits, the northwesterly are still the prevailing winds; in the months of June, September, and October, we found them almost constantly so: hard gales from all points of the compass, however, may be looked for here at all seasons; especially during the winter, and the equinoctial months. These begin generally from southeast to southwest, bringing thick, rainy weather with them. After blowing from these quarters for some hours, they fly round to the northward (by the west), with little, if any warning, except the increased heaviness of the rain, and blow even harder than before.* During the spring, easterly and northwesterly breezes are more prevalent than at other seasons. In the summer months, westerly winds and fine weather prevail, but from the end of July to the end of August the fogs are so frequent that many weeks will sometimes pass without a clear day.”

From San
Francisco to
Vancouver
Island.

Such are the observations of Captain James Wood on that part of the coast of America comprehended between Guayaquil and Vancouver Island. We have thought it right to give entire this remarkable paper, which contains a complete study of the winds prevailing on this coast, now become so important by the extension of its commercial relations.

* These shifts of the wind present the same character as those that happen in the Bay of Biscay and on the west coasts of Europe.

New Arch-
angel.

According to observations made at New Archangel, situated in $57^{\circ} 3'$ north latitude, it appears that the prevailing winds in winter are east winds, accompanied by rain and snow. At the commencement of December there are frequent squalls and tempests, which is not the case during the summer. Toward the end of this month the aurora borealis is very vivid.*

According to the tables given by Lutké, and which comprehend two years of observations, in which, unfortunately, he does not give the direction of the winds in the port of New Archangel, it appears that during the years 1828 and 1829 there were; on an average, 170 days of calm, 132 days of moderate winds, and 63 days of high winds.

In the same tables, we find that during the year there were on an average 74 days of clear weather, 174 days of rain or snow falling at intervals, and 117 days of rain and snow falling without interruption.†

Such are the principal remarks that we have to make on the winds of the northwest coast of America.

Behring's
Straits.

As we have already said, in Behring's Straits, during the summer, the winds most frequently met with are those from north and from south.

In the space of sea bounded to the north by the lands of this strait, to the south by the Aleutian Islands, to the east by the northwest coast of America, and to the west by the coast of Kamtschatka, the winds are very variable. It has however, we think, been observed, that the prevailing winds were those from south to southwest.

We find in the voyage of Lutké a table which confirms this remark. This table contains observations made three times a day at the settlement of Iloulouk (in the island of Oonaslaska), situated in $53^{\circ} 52'$ north latitude, and in $166^{\circ} 25'$ west longitude; they give for a year the following results:—

Winds from the north, 92 days; from N. N. W., 49; from N. W., 59; from W. N. W., 32; from W., 85; from W. S. W.,

* Captain Hagemester, Krusenstern.

† *Voyage de Lutké.*

45 : from S. W., 106 ; from S. S. W., 41 ; from S., 170 ; from S. S. E., 34 ; from S. E., 49 ; from E. S. E., 15 ; from E., 23 ; from E. N. E., 6 ; from N. E., 42 ; from N. N. E., 21.

We see from these results, that the prevailing winds were those from the south, which blew 170 days, and those from southwest 106 days.

We shall pass now to the west coast of the basin of the Pacific Ocean, and we will follow it from north to south to study its winds.

On the coast of Kamtschatka, we may, in general, say that the winds from the west prevail during the winter ; that is to say, from the end of September to the month of May,* and that during the summer the prevailing winds are from the east, varying from the northeast to the southeast.†

Winds of the coast of Kamtschatka.

In the winter, with the variable west winds, there are often violent tempests ; in the summer, the winds from the west generally bring clear weather. Those from the east, on the contrary, bring heavy weather, accompanied by snow or rain. The winds are light for the most part during the summer, and frequent calm is experienced during this season.

Although Commodore Krusenstern ‡ says that he does not think that, during the summer, the east winds are the prevailing ones on the coast of Kamtschatka, judging from those that he felt on this coast in 1804 and in 1805, we think, notwithstanding the high respect that must be entertained for the opinions of this illustrious navigator, that the following observation is positive on this subject.

It is the table of winds drawn up at Petropawlawski, for the months of May, June, July, and half of September, 1837, by the Governor-General Schakof ; we extract it from the much more extensive one to be found in the voyage of the frigate *Venus*, commanded by Admiral Du Petit-Thouars. §

* Cook.

† Romme.

‡ *Essay on the Winds and Currents of the Pacific Ocean*, p. 17.

§ *Physical Part*, drawn up by M. de Tesson, hydrographic engineer, vol. iv. p. 441.

According to this table, the winds blew, on the average, from north, 7 days (snow); from N. E., 7; from the E., 28 (snow, rain, overcast weather); from E. S. E., 3; from S. E., 30; from the S., 8; from S. W., 7 (clear weather); from the W., 5 (clear, fine weather); from N. W., 22 (light, interrupted by calms); from N. N. W., 2; calms, 19 days.

We see from this summary, that the winds from the east and southeast were much the most frequent, and that their prevalence within the period indicated is indisputable, at least according to these observations. Cook, who remained in this vicinity from the month of May till the month of November, describes the same facts. For the winds of October, he gives the west winds as constant.

In the Sea of Okhotsk, according to the observations made at the settlement of that name, it was found, during eight years,* that through the months of June, July, and August, the general winds were from S. E. to E.; they rarely blow from any other quarter. These winds are moderate, and usually accompanied by fogs and rains.

In September, toward sunset, the wind hauls from the south gradually toward the west and northwest, and it blows during the night pretty fresh from this quarter. Toward ten o'clock in the morning it slackens, and turns then toward the south; during all this month the sky is serene and the winds moderate.

From the middle of October to December, heavy tempests and gusts of wind from E. to S. E. are experienced; the fair weather usually returns as soon as the wind goes round to the N. and N. W.

Through December, and until the month of April, the winds blow constantly from N. to N. E., with a clear sky.

In April and May the winds are moderate, blowing from the north during the night, and from the south during the day.

According to this view, it appears that at Okhotsk the pre-

* Captain Minitzkoy, Krusenstern.

vailing winds are those from the east during the whole year, and that west winds are very rare there. These observations apply especially to the northern part of the sea of this name, of which we have but little information.

On the coast of Tartary, in the islands of Japan, as far as the island of Formosa, we find, in the course of the year, two regular monsoons of unequal duration.

Monsoons of the coast of Tartary, of the islands of Japan, and of the north coast of China.

The S. W. monsoon, varying to S. S. W. and to S. W., begins in July and lasts till the month of October. That from the N. E., varying to N. N. E. and to N., replaces it at the end of October, and terminates in June.

S. W. monsoon.

N. E. monsoon.

In the belt occupied by these monsoons, the rainy season, for all the coasts that look to the west, is the period during which the S. W. monsoon blows; while, on the contrary, it is then that the dry season takes place on the coasts with an eastern exposure. While the N. E. monsoon blows in its turn, the coasts looking to the east have rains, while those with a western exposure have the dry season. These monsoons extend in the Pacific Ocean from the coast as far as the meridian of 144° East.*

Rainy seasons and dry seasons.

In the vicinity of Japan, at the end of August and in September, the west winds are sometimes felt, blowing with extreme violence; at the period of the S. W. monsoons water-spouts are frequent in this neighborhood.

It is also in these latitudes that the region of the typhoons of the Pacific Ocean lies. We have already spoken of these rotatory tempests, in the *Considerations generales sur l'Océan Indien*; they take place at all seasons, but only between May and December. The zone in which the typhoons prevail may almost be bounded; on the north, by a curved line, passing through the middle of the island of Nippon and a little to the south of the island of Chusan, situated near the coast of China; on the south, by the

Zone of the Typhoons of the Pacific Ocean.

* Berghaus, Johnston, *Cartes physiques de l'Océan Pacifique*.

line which, running about midway from Cape Tourane and Cape Padaran, would pass by the north point of the island of Palawan, the north point of Mindanao, the island of Pelew, and which would come to an end south of the archipelago of the Caroline Islands.

The eastern boundary of this zone of typhoons is found to be nearly the meridian of 146° East longitude, passing near the archipelago of the Ladrone Islands, and to the east of this archipelago.

It must be understood, however, that these limits are by no means fixed, and that they are pointed out only as comprehending a space in which the typhoons most commonly commit their ravages.

It has been remarked that typhoons were so much the more violent as they took place in a higher latitude. They make themselves felt most commonly at the period of the change of the monsoons, that is to say, in May, June, October, and November.

Although a typhoon is usually announced by several indications, there do not, however, exist any sure means of foreseeing them so certainly as to take the necessary precautions in time; the falling of the mercury in the barometer is the only certain indication of it. It is, then, very important in this region to observe with attention the oscillations of the mercury in this instrument; they very seldom mislead.*

All the islands contained between the coast of China and the north coast of New Holland, or Australia, as well as the seas which separate them, are subject to the periodical effect of the monsoons of the Indian Ocean. These monsoons blow from the S. W. and S. E. from the month of April till the month of October; from the N. E. and N. W. from the month of October till April.

North of the equator, the S. W. monsoon is the period of

* Krusenstern, page 29.

rains in this region. South of the equator, the S. E. monsoon is the period of the dry season.

The N. E. monsoon is, north of the equator, the period of the dry season; south of this circle, that from N. W. is the period of the season of rains.

The limits we have just laid down for the monsoons must not, however, be taken in an absolute manner, nor the period of their change regarded as fixed. The general rule that we have pointed out is subject to many modifications, especially in the vicinity of the islands of which we are now speaking, and the period of the changes of the monsoon is rather variable. According to the localities it takes place 15 or 20 days sooner or later, and there is even the difference of one or two months in the China Sea and among the islands of the Pacific Ocean.

The channel which separates Formosa from China, Island of Formosa. and which is called Formosa Strait, lies from N. E. to S. W.; it seems to be the seat of continual storms. They have there heavy squalls and great rains in the S. W. monsoon. Between this island and the Philippines, gusts of wind have been experienced at all seasons.

The Philippine Islands, the island of Gilolo and New Guinea, form in reality the western boundary of that part of the Pacific Ocean which now occupies us. Monsoons in the Philippine Islands.

The monsoons in the Philippine Islands are subject to nearly the same laws as in the China Sea. The S. W. monsoon makes itself felt toward the end of S. W. Monsoon. May on the west coast of these islands; it is in full force toward the month of July.

The N. E. monsoon begins in October, and lasts N. E. Monsoon. till the month of April. The rains on the west coast fall from June to the middle of September, during the S. W. monsoon; there is at this period magnificent weather on the east coast of these islands; during the N. E. monsoon, on the contrary, there is fine weather on the west coast and

great rains on the east coast. They last sometimes 15 days without cessation.

The S. W. monsoon, like that from N. E., does not blow invariably from this direction.

Thus we find the following observations on these monsoons in the account of a voyage to Cape Horn, Peru, the Philippine Islands, etc.*: —

“On the northern part and on the east coast of the island of Luzon, the north winds blow sometimes with great violence, especially from the commencement of December till toward the middle of February. These winds are accompanied by rain and squalls, and when they blow, the coasts are excessively foggy, which renders it difficult and dangerous to make the land at this period.

“In the month of February, the north winds are usually replaced by general breezes from E. to N. E., which last into April, with constant fair weather.”

According to the same navigator, the S. W. monsoon is subject to similar variations.

“In the Strait of San Bernardino, and especially on the east coast of the island of Luzon, the winds, during the S. W. monsoon, usually blow from the S. to the S. W., and are always intermixed with N. E. breezes varying to the S. E.

“These latter gain the greater ascendancy over the former in proportion to the distance from the island of Luzon and the approach to the Ladrone Islands.

“The monsoons, says M. Legentil, do not change in the Philippines with the same regularity as in the China Sea. Besides, the S. W. winds, which are constant at sea, are not so at Manilla. They blow generally in periods of 15 days or 3 weeks, in the intervals between which they cease and allow the other winds to prevail, especially those from the south to the east. These periods, when they are not accompanied by rains, are called *collas secas*.

Gales of wind
called *Collas*.

“Around the island of Luzon are experienced from time

* Le Marquis de Ponterat, p. 133.

to time, from the end of June to the commencement of October, *gales* of wind, known in the islands by the name of *collas*. We give the precursory signs of these tempests, called also *tempestades* and *vaguios*.

“At the moment when the sun rises, and at the approach of the *collas*, it is generally very fine weather; the mountains only are crowned with a light mist, resembling smoke. In the course of the morning this mist spreads over the whole sky, which it covers with a transparent veil, that does not shut out the rays of the sun. At the same time, it thickens round the mountains, where it is not long in forming thick clouds. In the afternoon, a terrible storm breaks forth; it lasts one hour and a half, or two hours at most, after which the sky clears again, and the night is magnificent.*

“However, the duration of the *collas* is sometimes seven or eight hours, and even fifteen. They begin commonly with much rain and wind, and always terminate with storms, accompanied by thunder and heavy rains. The wind then blows strong from the S. W. to N. W., and it sometimes happens that it is very violent; it begins to make itself felt at the time of full moon, and always at the renewing of one of its phases. These kinds of winds extend their influence to a great distance, and it is only in this manner that those of the S. W. monsoon reach to the Ladrone Islands.”

The tempests of which we have just been speaking are especially known in the Philippine Islands under the name of *tempestades*, given them by the Spaniards; and under that of *vaguios*, given them by the Indians. In these tempests, which are extremely formidable, the wind blows from all points of the compass with equal violence. They take place principally toward the end of July, and at the beginning of the month of August.

There are other storms experienced at the Philippines at the period of the change of monsoons, as in the Indian Ocean;

* Legentil et Mallat, *Les Philippines*, vol. i. pp. 110, 199.

and at Manilla they principally dread those which take place at the full moon of the month of October.*

We will, in order to complete these references on the Philippines, give for each month the most circumstantial observations that have been made on the winds.†

The heat in the Philippines is rather great, but the constant humidity of the soil, joined to the land and sea breezes, which are felt alternately on the coasts, make it less sensible than would naturally be supposed. During the continuance of the winds from N. E., there is even a certain degree of freshness experienced.

The greatest heats begin in the middle of March, when the breezes from E. and S. E. set in. These breezes last about two months, when they give place to the S. W. winds, called *vendavales*. This transition occasions a great struggle, which brings on the storms and tempests of which we have spoken.

We give here the observations made by Legentil on the climate of Manilla for one year (1767).

Climate of
Manilla.

January.

In January, winds from the north, fine weather, often overcast, but little rain; thermometer standing at a minimum of 66°, and a maximum of from 89°.3 to 93°.6 of Fahrenheit.

February.

N. E. winds in February; fine weather during the first half of the month; overcast during the second half; without rain; thermometer, minimum 61°.2, maximum 93°.7.

March.

In March the winds begin to vary. Fine weather, some storms toward the end of the month; thermometer from 68° to 103°.3.

April.

On the 6th of April the wind hauls to the south, and is variable; the weather fine in the morning; lightning almost every evening; several storms and several days of rain during the last half of the month; great heat; thermometer, at sunrise, 75°.2; at the hottest time of the day, from 103°.3 to 107°.6.

* Zarate, Romme.

† *Les Philippines*, by Mallat, vol. i. p. 108, et seq.

In May, variable winds, most frequently from E. to S.; thunder every evening, and rain in torrents; thermometer, at sunrise, from $79^{\circ}.5$ to $81^{\circ}.7$; at its maximum, from $101^{\circ}.7$ to $107^{\circ}.6$.

May.

During the first half of June, variable winds, blowing from all points of the horizon; few storms, but much lightning. From the 14th to the 19th, winds E. S. E. and S. E., accompanied by violent storms. During the rest of the month, winds very variable, very little storm or rain; thermometer at sunrise, from $77^{\circ}.7$ to $81^{\circ}.3$; at its maximum, from 99° to $105^{\circ}.4$; once it rose to $110^{\circ}.1$, on the 20th of the month.

June.

During the first half of July, E. and S. E. winds, at times N. E., the mornings fine, the evenings bad, the nights magnificent; in general it rains more at Manilla in the day than in the night. The rest of the month, west winds and no storms. From the 1st to the 15th, minimum of the thermometer, from $79^{\circ}.5$ to $81^{\circ}.7$; maximum, from 100° to 108° . From the 16th to the 31st, minimum, from $77^{\circ}.7$ to $79^{\circ}.5$; maximum, from 100° to $102^{\circ}.2$. The west wind always depresses the thermometer.

July.

During the whole month of August, winds very variable, with storms whenever the wind does not blow from the west. This month is the worst that has been observed since the beginning of the year; tempests, rain in torrents, and great changes in temperature. From the 1st to the 20th, thermometer minimum from $79^{\circ}.5$ to $81^{\circ}.7$; maximum, from $96^{\circ}.8$ to $103^{\circ}.1$. From the 21st to the 31st, the maximum was only from $85^{\circ}.6$ to $90^{\circ}.3$.

August.

In September, west winds; fickle weather, often stormy; very little rain; thermometer minimum, from $75^{\circ}.2$ to $79^{\circ}.2$; maximum, $96^{\circ}.8$.

September

Till the 20th of October, winds very variable, and weather much warmer in the sensation than shown by the thermometer, which does not rise above $99^{\circ}.3$ and stands almost always at from $90^{\circ}.3$ to $95^{\circ}.7$; several great gusts of

October.

wind (particularly on the 23d), accompanied by torrents of rain.

November. In November, winds N. E.; very fine weather, some days overcast, but little rain; maximum of thermometer, from $91^{\circ}.5$ to $95^{\circ}.7$; one day (the 25th), $98^{\circ}.1$; minimum, from 73° to $75^{\circ}.2$.

December. Winds N. E. in December; bad weather till the 5th; variable from the 6th to the 17th; minimum of thermometer, from $70^{\circ}.9$ to $75^{\circ}.2$; maximum, the five first days, from $80^{\circ}.6$ to $84^{\circ}.9$; from the 6th to the 17th, from $90^{\circ}.3$ to $93^{\circ}.6$; the rainy days, from $82^{\circ}.4$ to $84^{\circ}.9$; from the 18th to the 31st, from $89^{\circ}.2$ to $91^{\circ}.4$.

Rain. The quantity of rain that falls in Manilla is, on an average, in ordinary years, $115^{\text{in}}.750$; the maximum, $134^{\text{in}}.648$; the minimum, $99^{\text{in}}.215$.

Periodical winds of New Guinea. We have, in the beginning of this chapter, spoken of the winds of New Guinea, principally on the N. E. coast, and we have said that the S. E. trade winds only prevailed there from June till October. During the rest of the year, variable winds from N. W. to N. E. are felt on the N. E. coast. In March, April, and May there are storms and some showers. From June to September, there are continual rains on the S. W. coast of this island. The fine weather is settled from October to March.

Between this island and that of Java, the monsoons do not change till about six weeks after those of the China Sea.

Island of Waygiou. At the island of Waygiou, it has been remarked that the winds were in general light, and blew from S. S. E. to S. W.

Torres Strait. We have mentioned the periodical winds of Torres Strait, and those which prevail among the islands situated in that part of the Pacific Ocean;—we will not return to this subject.*

To terminate the study of the winds of this sea, it only remains now to speak of the winds of Australia, principally on the east coast.

* See the *Directions for the Navigation of this Strait*, Chapter III.

On the east coast of Australia, from Torres Strait to the Tropic of Capricorn, the winds blow from the S. E. from the end of April till the month of September. Winds on the east coast of Australia.

The winds from N. W. begin in October, and last till the month of April.* The N. W. monsoon is the period of rains and of bad weather; the S. E. is the fair season.

From the Tropic of Capricorn to Bass's Strait, the S. E. winds blow from October to April and bring fair weather, with alternate land and sea breezes when near the coast. There are, however, some exceptions to this rule, principally toward the south part of this coast, where gusts of wind from the S. W. and strong breezes, varying between N. and N. E., bring much rain, and sometimes storms with thunder. These winds in general are not of long continuance. In summer a warm N. W. wind, coming from the land, is almost always followed by a sudden squall, varying from S. E. to S. S. W. When near the coast, these squalls are much to be apprehended. They produce a considerable effect on the thermometer. Thus, in one case, Flinders saw it fall from 100°.4 Fahr. to 64°.4.†

West winds varying from N. W. to S. W., though principally the latter, begin in May and last until September.

The west winds, during the period when they prevail, generally bring fine weather; and when these winds turn to the south or to the east during this period, there is rain. It is the reverse in the season in which the S. E. winds prevail. These vary as far as N. E. by E.

It may be said, in general, that during the winter the weather is very variable, with all the winds coming from sea, and that even with N. W. and N. winds there is often rain, though the winds blowing in this direction are light.

It remains to say, that the land and sea breezes during the summer are more regular near the tropic than farther south, and that the winds during the winter haul more to the

* Flinders, Krusenstern.

† *Australian Directory*, p. 203.

S. E. in these latitudes, than they do between the parallel of 30° N. latitude and Cape Howe.

There are also sometimes, at the time of the S. E. monsoon, winds from north or south, but they do not last long.

Below is a condensed table of the winds which have prevailed at Port Jackson during one year, which we have verified from a great number of voyages, and which proves the truth of the general law we have just pointed out.*

January. — East winds prevailing, often light and interrupted by calms, bringing storms on passing to the S. W.

February. — East winds, varying from N. E. to S. E., prevailing, interrupted by some winds from N. W. to S. W. through the west, with heavy rains.

March. — S. E. winds prevailing, interrupted by south winds with rain.

April. — West winds prevailing, variable from N. W. to S. W., blowing at times with violence.

May. — West winds prevailing. Same weather as in the month of April.

June. — West winds prevailing, variable from S. S. W. to N. N. W.; in general moderate, with fine weather.

July. — Same weather as in the month of June.

August. — Same weather as in the preceding month, with some winds from south to east bringing dull weather and rain.

September. — Winds W. N. W. to W. S. W. prevailing, interrupted by some breezes from the east.

October. — East winds, variable from N. E. to S. E.

November. — S. S. E. winds prevailing, turning at times to south, and even to S. S. W.

December. — Winds from E. N. E. to S. S. E. prevailing, interrupted by some winds from S. S. W. to S.

Barometer at Port Jackson. One remark to be made on the barometer at Port Jackson is, that, whenever the wind blows from south through the east or the west, the barometer rises, even though

* Bougainville (the *Thetis*), Baudin, Freycinet, Duperrey, Du Petit-Thouars, Dumont d'Urville, Flinders, Krusenstern, D'Entrecasteaux.

the weather be very bad. On the contrary, it falls when the winds blow from the north toward the east or the west, even when the weather is fine. These observations were made in the months of June and July. They were repeated in November and in December. In August, notwithstanding very changeable weather, the barometer but rarely indicated these fluctuations.*

In Bass's Strait the most frequent winds are those from west to S. W. In summer, from January to March, N. E. winds are met with, which are pretty frequent at this season.† They bring clear weather; their continuance cannot, however, be counted on.

We usually find the same winds and the same weather in Bass's Strait as on the south coast of Australia. In the east part of this Strait, however, the weather and the prevailing winds approach more nearly to those of the east coast of this continent. In this part of the Strait, the gusts of wind which are most violent are usually those from the S. E.

In Bass's Strait the most frequent gusts of wind commence at N. N. W., and turn by W. to S. W., in which direction they almost always cease. If, however, before arriving at S. W., the direction of the wind changes, and if it comes round from the west toward the north, the bad weather may be expected to last. The barometer, however, indicates the weather perfectly. This is seldom fine when the barometer is at 29ⁱⁿ.88 or at 29ⁱⁿ.92; and with the barometer at 29ⁱⁿ.65, it is necessary to be prepared for bad weather.

In the east of the Strait and on the east coast of Van Diemen's Land, the N. E. winds are often felt. They seldom blow with violence. Gusts of wind are commonly between the S. W. and S. E., and principally from the latter direction: this coast must then be approached with caution between Cape Howe and Cape Wilson.

* *Voyage of the Thétis and of the Espérance*, Meteorological Observations, vol. ii p. 139. *Voyage of the Venus*, vol. iv. p. 267, Physical Part.

† Flinders.

On the coasts of Van Diemen's Land, the prevailing winds are those from W. N. W. varying to N. W. These last are constant, especially from the month of April till the middle of October. From the end of October well into March, the N. W. winds are interrupted by pretty frequent S. E. winds, which sometimes become in their turn the prevailing winds during this period.*

During the year 1834 the winds blew in the following directions in the proportions shown in the table: † —

N. W.	266	S. E.	102
N.	179	S. W.	78
S.	156	W.	72
E.	106	N. E.	28

General
remarks.

In general, on all the coasts of Australia, it may be said that the winds come from sea during the summer. Thus, when the sun is in the southern hemisphere, the general winds on the N. W. of this continent blow from the W.; from S. W. on its west side; from S. W., S., and S. E. on its southern coast; and from between S. E. and east, on its east coast. ‡

Another general remark is, that the west winds prevail near Cape Van Diemen or South Cape, especially when the sun is near the Tropic of Cancer, and that on the west coast which forms this promontory the winds often blow from the south, while they are blowing strongly from the west at sea and in the vicinity of its extreme point. The S. E. and S. winds are pretty frequent near the Cape, in the month of February, in March, and a part of April.

White squalls. In the Pacific Ocean, squalls called by seamen *white squalls* are met with. Nothing foretells their approach, and for that very reason they are more dangerous.

* This table is deduced from meteorological observations made at Hobartton during the years 1841 and 1842. *Magnetical and Meteorological Observations, Hobartton, Van Diemen Island*, vol. i., London, 1850.

† Montgomery Martin, *History of the British Colonies*, vol. iv. p. 453.

‡ See *Considérations générales sur l'Océan Indien*, pp. 51 to 55.

The only indication of the white squalls is given by the rippling and boiling up of the sea at the horizon.

These squalls are at times excessively heavy, and are most common between the tropics. Near the land, and particularly close to mountainous and elevated regions, they resemble very much whirlwinds, and electricity seems to play an important part in their formation, as in that of the water-spouts frequently encountered in the Pacific Ocean, especially in the archipelagos, and on the coasts of China and Japan.

In concluding this chapter, we must observe that the general laws for the currents of air, which we have deduced from a great number of observations, must not for all that be taken in too positive a sense.

If we have often presented them in a manner that might appear too decided and too absolute for the number of observations we have collected, it is in order to strike more strongly the attention of navigators, and to induce them to bring together and to multiply their observations, whether they confirm or contradict the laws we have deduced. It is the only means of drawing up well-defined and general laws which shall be true, if indeed it is possible to find laws in all cases.

CHAPTER II.

GENERAL CURRENTS.

CAPTAIN DUPERREY is the first who has collected the scattered observations of navigators on the currents of the Pacific Ocean. This labor, published in the physical part of the voyage of the *Coquille*, only extends to the Sandwich or Hawaiian Islands, and contains merely the currents of the South Pacific.*

Since this period, numerous observations have been collected and published separately. M. Dortet de Tessan has given, in the voyage of the *Venus*, a general chart of the currents encountered by that frigate; and Johnston has published the physical chart of the Pacific Ocean by Berghaus, to which he has made some additions, principally of the cold current of the coast of Peru, of which the distinguished *savant*, M. de Humboldt, first announced the existence, and to which his name has been given.

Without entering upon a scientific discussion of the different systems which still divide philosophers, on the causes and origin of some of these currents,—without seeking to solve the numerous objections that have been made to each one of them,—discussions which would undoubtedly be very interesting for science, but without real utility for navigation,—we shall limit ourselves to the statement of observed facts, profiting as much as possible by the latest observations made on the currents of the Pacific, and uniting all the information scattered through different works.

The important fact to sailors is to know the extent of sea

* *Chart of the Motion of the Waters in the Great Southern Ocean*, Paris, 1831.

which these currents occupy, their general direction, and their velocity, so that they may make use of or avoid them in their passages, according to circumstances.

In this chapter we shall not adopt the same course as in the preceding, and we shall commence with the currents of the South Pacific, dividing this ocean into two parts by the Equator.

According to the comparison of several routes followed by navigators already named,* the cross current of the Pacific begins near the southern point of Van Diemen's Land, or Tasmania, and would seem to be the result of two combined currents: 1st, the warm current of the east coast of Australia, the existence of which is proved; 2d, the cold current of the southern coast of Australia, indicated by observations which, however, are not so conclusive as for the former.

Cross current
of the Pacific
Ocean.

This current moves from west to east, crossing the whole breadth of the Pacific, and spreading more and more as it approaches the west coast of America.

Near this coast, and nearly on the meridian of 98° west longitude, it divides into two principal branches. The north branch continues to run E. N. E. and E. as far as 78° west longitude, and turns afterwards rather abruptly to the N., to the N. W., and to the W. N. W., taking the name of *Current of Mentor*, to lose itself in the equatorial current of the south.

Northern
branch of the
cross current,
or Current of
Mentor.

The other branch, that of the south, made up for the most part of the waters of the cross current and of those of which the temperature is lowest, advances on one side towards the north along the west coast of America, where it forms the cold current of the coast of Peru, or Humboldt's Current; on the other, towards the south, along the same coast of America,

South branch
of the cross
current.

Humboldt's
Current.

* Cook, La Pérouse, Marchand, D'Entrecasteaux, Krusenstern, Freycinet, Duperrey, Bongainville, 1825; Beechey, Vaillant, Du Petit-Thouars, etc.

Cape Horn Current. where it forms the cold current of Cape Horn which, turning round this Cape, penetrates into the Atlantic Ocean.

Cross Current of the Pacific Ocean. The current that we have named the "Cross Current of the Pacific Ocean" appears to us probable.

We must say, however, that the observations in the latitudes it occupies are not sufficient to prove its existence in a positive manner; up to this time, those that have been collected only indicate it. For ourselves, following only facts and leaving aside theories, while calling the attention and investigations of navigators to this current, we shall limit ourselves to announcing its probable existence, which is also founded on theory. We shall add, that according to this the rapidity of this cross current ought to be less than that of the equatorial current by all the influence proceeding from the diurnal motion of the earth, and that it is augmented at its surface by the action of prevailing winds from the west which blow in this region.

The southern limit of the cross current would be, even according to theory, difficult to appreciate; for the tendency of glacial waters to advance towards the Equator is admitted. Consequently, from the combined motion of waters going from south to north with those going from west to east there must result a mean variable direction, according to the meeting of these general currents.

Temperature of this current. There is little information upon the temperature of the waters of the cross current; according to the few observations that we possess, it would appear that, in the parallel of 60° south latitude, the medium temperature has been found to be 33° of Fahrenheit; in that of 50° latitude, 36°; in that of 45° latitude, 43°; in that of 35° south latitude, 66°.

Velocity of this current. The velocity of this current at its origin, between Van Diemen's Land and Campbell's Island, has been found to be forty miles a day, at the mean, by Captain Freycinet, who has crossed this whole belt, its direction being east;

twenty-nine miles, between Campbell's Island and the meridian of 138° west longitude, its direction being N. E. and N. N. E.; seventeen miles, between the meridians of 138° and 98° west longitude, its direction being N. E. The rapidity of this current must be very variable, and greatly influenced by the winds from the N. W., the W., and the S. W., which blow constantly in this zone of the Pacific Ocean, and often with much force.

The north branch of the cross current, designated, as we have said, "Current of Mentor," loses itself in the equatorial current. This current always inclines towards the east as far as the meridian of 78° west longitude, where it turns rather rapidly towards the N. E., the N., the N. W., and the W. N. W., to take finally a west direction. This current is mentioned by La Pérouse, Kotzebue, Duperrey, Lutké, M. de Tesson,* and by the Prussian navigators on board the ship *Mentor*.†

North branch
of the cross
current, or
Current of
Mentor.

The breadth of the bed of this current varies from three hundred and sixty to seven hundred and eighty miles. It is, in its east limit, very near the current of Humboldt.

Extent and
velocity of
this current.

About the parallel of 26° south latitude, where it flows towards the N. E., the N., and the N. W., its velocity in the month of May has been found by M. Tesson to vary from eighteen to twenty-one miles a day. In its south part, at the same period, it varied from ten to twenty-two miles.

The Current of Mentor is a warm current. The following are the temperatures found by M. Tesson in crossing it from west to east: at the west limit, 72° ; 68° .9 at its centre; $66^{\circ}.7$ at its east limit, on the parallel of 33° south latitude.

Temperature
of this current.

In May, the temperature has been found to be $67^{\circ}.6$ at this same east limit of the current of Mentor,‡ in 26° south latitude.

* *Voyage of the Venus*, Physical Part, by M. de Tesson, vol. iv.; and *Chart of the Currents observed during the Voyage of this Frigate*.

† *Geographical Almanac for the Year 1837*, p. 515

‡ *Voyage of the Venus*, Physical Part, vol. iv. p. 346.

We point out this current to the attention and research of navigators; the islands of Saint Felix and Saint Ambrose lie nearly in its central part.

Second, or south branch of cross current The second branch of the cross current, that of the south, after continuing to run for a certain extent towards the east, divides itself into two parts, which form two great currents, one going towards the S. E. and the S., the other rising towards the N. E. and the N. This division takes place nearly on the parallel of Chiloe Island and in 79° of west longitude.

The branch which runs to the southeast forms the Current of Cape Horn, of which we have already spoken in the *General Examination of the Atlantic Ocean*; that which runs to the northeast forms the cold current of the coast of Chili and Peru, which has received the name of Humboldt's Current. We shall proceed to speak of these two currents.

Current of Cape Horn. The Current of Cape Horn, as we have said, arises in the parallel of Chiloe Island; that is to say, 43° south latitude, and about sixty leagues from the coast of America. Its principal direction in this place is E. S. E. and S. E. It turns afterwards to S. S. E., and near the coast its direction is S., as high as the archipelago of Chonos.

It directs itself towards Cape Horn, preserving a breadth of about sixty leagues after leaving the coast. In the neighborhood of the land, it follows the outline of it; but at the exterior limit of the current it takes a direction which approaches more and more to the east, as it advances to the south, towards the extremity of South America.

It passes thus the lands of Magellan and Cape Horn, and on the meridian of this cape it extends to the parallel of 60° of south latitude, or thereabout. Its limit appears sometimes to pass near the islands of Diego-Ramirez.

When the current has passed to the east of the meridian of Cape Horn, it takes the direction of E. N. E. and enters the Atlantic Ocean, changing to N. E.

At its rise, the velocity of the Current of Cape Horn

varies from 10 to 20 miles a day. It augments as it advances towards the south. In the neighborhood of Terra del Fuego and to the west, its velocity has Velocity of this current. been found to vary from 12 to 25 miles a day.* It is greater with west winds, weaker and sometimes even imperceptible with S. E. winds.

To the east of Terra del Fuego, near and a little to the north of Staten Land, the velocity of this current has been found to be as much as 33 miles.*

On the parallel of Chiloe Island, $57^{\circ}.7$ Fahr. has been obtained as the temperature of the current of Temperature of the Current of Cape Horn. Cape Horn in the month of April; on the parallel of the entrance of the Strait of Magellan, $48^{\circ}.4$; a little to the east of the meridian of Cape Horn, $43^{\circ}.7$; in the south, and near Staten Land, $47^{\circ}.4$.

The cold current which runs up along the coast Current of the coast of Peru, or Humboldt Current. of Chili and Peru, under the name of Humboldt Current, is in contact at its origin with the Current of Cape Horn. It divides itself from that current on the parallel of 43° south latitude, nearly opposite the island of Chiloe, running E. N. E. and N. E. at the parallel of Valdivia.

Off Valparaiso, its principal direction is N. N. E. and N., and it continues thus to set along the coast of America as far as the parallel of Arica.

Beyond the indentation, which is pretty deep, where this city lies, the coast of Peru runs in its general direction north 50° west as far as Cape Blanco, lying in 5° south latitude.

The Humboldt Current, after having turned round the indentation where Arica lies, continues to follow the trend of the coast, directing itself towards the N. E.

When it arrives opposite Payta, near Cape Blanco, it leaves the coast, turning rather abruptly towards W. N. W., surrounding the Galapagos Islands; its north limit passes nearly thirty leagues north of these islands. It penetrates thus into the

* *Chart of the Currents observed on board the Venus, in 1837, prepared by M. de Tesson, Hydrographical Engineer, Physical Part, vol. iv. p. 359.*

north hemisphere of the Pacific Ocean, ascending to the parallel of 2° north latitude.

It turns then towards the west, enlarging more and more, and loses itself in the Equatorial Current.

Breadth of Humboldt Current. The breadth of this current, or the distance to which it extends from the coast, is variable. It is 120 miles at the parallel of Valparaiso; it augments little by little as it rises towards the north; and when, at the height of Payta, it runs from the land towards W. N. W., its distance from the coast is about 180 miles. On the meridian of the Galapagos Islands, its breadth is 480 miles; it is 840 miles on the meridian of 103° west longitude.

Irregularities in the Humboldt Current. In the Humboldt Current irregularities are observed; thus, sometimes the current, instead of inclining to the north, inclines to the south with a velocity of half a mile, of one mile, and even of more.

The periods at which these irregularities occur cannot be foreseen with any certainty. No apparent cause appears to determine the motion of the waters towards the south, and all that can be done is to take advantage of it when it occurs. It is often met with immediately before or after north winds. But this fact is far from always occurring, and no general rule can be deduced from it.*

Counter-current of Humboldt. Very near the coast of Chili or Peru, a counter-current is met with at many points, directed principally towards the south, which follows the sinuosities of the land, with a velocity that varies from three to twelve miles a day. This counter-current is necessarily produced by the Humboldt Current, and we have given it this name.

Temperature of Humboldt Current. The temperature of the waters of the Humboldt Current increases as it gets north, and this increase is considerable, as may be judged from the following observations.

* Fitz-Roy, *Directions for the Coasts of Chili and Peru*. These same irregularities also take place in the polar current of the south of Africa, which, from the Cape of Good Hope, runs along the whole coast of Africa, inclining towards the north.

Off Valparaiso, 52°.5 Fahrenheit has been obtained as the temperature of the waters of the current; 57° on the parallel of Coquimbo; 64° on that of Cobija; 65° on that of Arica. As far up as Pisco, 77° has been found; on the parallel of Lima, 66°; on that of Truxillo, 78°; finally, on that of Cape Blanco, 73° at the east limit, and 66° at the west limit of the current.

On leaving the current a little to the north of Cape Blanco, the temperature of the waters of the ocean has been found to be 11° greater than that of the waters of the current, and that, too, in the lapse of some hours.*

The velocity of the Humboldt Current, in common with all currents, is very variable. Moreover, its velocity is greater near the land than at sea; and this, as M. de Humboldt has remarked, is the case with most currents that run along the shores of continents.

Velocity of
Humboldt
Current.

The minimum velocity that we find in a passage made by the *Bonite*, † from Valparaiso to Payta, is three miles; the maximum, twenty-six miles a day. The first velocity was obtained between Cobija and Callao; the second, between Callao and Payta.

In a passage made by the *Venus*, ‡ from Valparaiso to Payta and to the Galapagos Islands, the minimum velocity of the current was found to be six miles, and the maximum twenty-six miles a day. The first velocity was obtained on the parallel of Arica; the second between Valparaiso and Cobija.

M. de Humboldt says that, according to his observations, from Valparaiso to Coquimbo, and principally from Arica to Lima, the velocity of this current has been found to be twelve, fourteen, and even eighteen miles a day.

* The greater part of these observations are borrowed from M. de Humboldt in the description he gives of this current. The *Observations on Currents* of Messrs. de Tesson and Darondeau, in the *Voyages of the Venus and the Bonite*, may likewise be seen. These vessels navigated in the Humboldt Current, from Chiloe to the Galapagos Islands. The observations of temperature we have selected are the averages.

† *Voyage of the Bonite*, in 1836, Physical Part, by M. Darondeau, Hydrographical Engineer.

‡ *Voyage of the Venus*, in 1837, Physical Part, by M. de Tesson.

Where the Humboldt Current turns to the northwest, suddenly leaving the coast at the height of Cape Blanco, its mean velocity is about eight miles a day.

The mean velocity of the current is, according to these observations, fifteen miles a day, or thereabouts.

It may be easily understood of what importance this current is to the navigation of ships going from south to north; thus, one can go from Valparaiso to Callao* in nine or ten days, and from Callao to Guayaquil in four or five days. On the contrary, weeks and months are required for the return voyages, especially navigating near the coast. This navigation is, in fact, for the most part impossible.

According to M. Duperrey, the southern limit of the equatorial current would be nearly on the parallel of 26° south latitude; its northern limit, with some exceptions, would be the parallel of 24° north latitude. Thus the waters of the Pacific Ocean in a zone of 50° of latitude—that is to say, nearly a third of the distance from one pole to the other—are carried towards the west by a regular motion. However, in the zone of which we are speaking, and a little to the north of the Equator, an expanse of sea exists where a general current is found directed from the west to the east, which appears to separate the equatorial current of the north from the equatorial current of the south. This counter-current, which appears to be produced in great part by these equatorial currents, probably traverses the whole Pacific Ocean from west to east. We shall speak of it again hereafter.

The velocity of the equatorial current is very variable. It has been found to be thirty, fifty, and even fifty-eight miles a day.† The mean may be estimated at from twenty-four to twenty-five miles a day.

* *Voyage of the Venus*, in 1837. This frigate took eleven days to go from Valparaiso to Callao. The distance between these two points is more than seven hundred miles.

† *Voyage of the Bonite*; passage from Guayaquil to the Sandwich Islands, in August, 1836; Physical Part, by M. Darondeau. *Voyage of the Venus*; *Chart of Currents*, by M. de Tesson; June, 1837. Passage from Callao to the Sandwich Islands. *Voyage of the Astrolabe*, in 1838, Physical Part, by M. Vincendon-Dunmonlin.

In order to study this current, we shall divide it into two parts, as it is divided by the equatorial counter-current; and we shall speak first of the equatorial current of the southern hemisphere.

The equatorial current of the south begins to make itself felt on the meridian of 90° west longitude. Its south limit passes to the north of the tropic of Capricorn, to the south of the island of Pitcairn, whence it follows nearly the parallel of 26° south latitude, as far as the meridian of the archipelago of Tonga.

Equatorial
current of
the south.

In the neighborhood of this archipelago, the equatorial current divides itself into several branches; one of them, of which we shall speak presently, has received the name of *Current of Rossel*, and makes its influence felt on the southern coast of New Guinea and in Torres Strait; this current is quite regular in the midst of all the archipelagos of this part of the Pacific Ocean, even at the period of the northwest monsoons.

Another branch descends along the coast of Australia, as far as Van Diemen's Land, or Tasmania. This branch forms the warm current of Australia, known under this name, and it is the origin of the cross current of the South Pacific Ocean.

Current of the
east coast of
Australia.

Between the parallel of 20° south latitude and the parallel of 10° south latitude it has been found that the mean temperature of the equatorial current of the southern hemisphere varied from 76° to 78° Fahr. between the meridians of 105° and 120° west longitude; it has been observed that it was from 79.5 to 80.5 between the meridians of 120° and 135° . In the neighborhood of Tahiti, 81.5 has been obtained.

Temperature
of the south
equatorial
current.

On the meridian of 178° longitude, and the parallel of 8° south latitude, it has been found to be 84.5 , its maximum in the southern hemisphere.

The temperature of the waters of the ocean outside the current has been found to be 67° ; that is to say, 9° and 18° lower than the temperature of the waters of the equatorial current of this hemisphere.

Current of
Rossel.

The current of Rossel is situated in the south part of the Páctic Ocean, and is in fact only a prolongation of the south equatorial current of which we have just spoken. It was pointed out for the first time by Admiral de Rossel, in his narrative of the voyage of d'Entrecasteaux, and it is for this reason that the name of that learned hydrographer has been given to it.

This current rises, or rather takes the name of the *Current of Rossel*, west of the archipelago of Tonga, and a little to the north of the island of Tongatabou. Its northern limit passes near and to the south of the archipelago of the Feejee Islands, ascends towards the N. W. and the N. N. W. fifty or sixty leagues to the east of the archipelago of the New Hebrides. It passes afterwards to the north of the island of Vanikoro, to the south of the island of Santa Cruz, where the current is directed to the west, and it is lost near and south of the island of San Christoval, one of the islands situated in the S. E. of the archipelago of Solomon.

The southern limit of this current, of which the bed enlarges as it advances towards the west, runs nearly along the parallel of 25° south latitude; then it rises, directing itself towards the W. N. W. to pass to the south of New Caledonia.

It is at this point that another branch of the equatorial current turns towards the S. E. to form the warm current of Australia directed to the S. S. W. along the east coast of this continent.

The principal direction of the current of Rossel is W. N. W. and N. W.; its temperature has been found to be 78° Fahr. It is felt as far as the Torres Strait. Its mean velocity is eight or ten miles a day. Its maximum has been found to be eighteen miles; the minimum four miles.*

Currents of the
east coast of
Australia.

Along the east coast of Australia, there is a general and a periodical current.

The general current of the east coast of Australia, a detached branch of the equatorial current, or rather a prolongation of this

* *Voyage of the Astrolabe*, in 1837, 1838, 1839, and 1840, Physical Part, by M Vincendon-Dumoulin.

current, only takes its name on the parallel of Cape Sandy and on the meridian of 167° east longitude.

Its direction is southwest about as far as the parallel of 30° south latitude, and it extends along this parallel at a distance of 480 miles from the coast.

To the south of the parallel of 30° south latitude, its direction is nearly S. S. E., and it changes more and more to the south as the current nears Tasmania.

Its distance from the coast is about three hundred miles, from the parallel of latitude of 30° to the south extremity of Tasmania, where it divides into two branches; one of insignificant size, which passes round Tasmania to the south and rises along the west coast of this island towards the N. N. W.; the other, directed towards the S. E., meets the cold waters which from the south pole set towards the north; it takes an intermediate direction, approaching the east, and contributes to form the cross current of the Pacific Ocean, of which we have already spoken.

The temperature of the general current of Australia Temperature of this current. has been found to be 64° Fahr. at its limit in the open sea or at the east; 71° in its central part; 68° near the coast. These observations were made in the month of December, by M. de Tesson, on the parallel of Port Jackson.

This temperature diminishes rapidly as one advances to the south. Thus on the parallel of Bass's Strait the temperature of the current was 60° Fahr. at the eastern limit, and the direction of the current in this part was southwest.

South of Van Diemen's Land or Tasmania, M. de Tesson found a temperature of 54° or 56° ; and the temperature of the waters of the adjacent sea was in this part 51° and 49° .*

The maximum velocity of the general current of Australia Velocity of the general current of Australia. has been found to be nineteen miles, the minimum six miles, a day.

Besides the general current which we have just described, there is found on the east coast of Australia, and near the land, a periodical current.† Periodical currents of the east coast of Australia.

* *Voyage of the Venus*, vol. iv. p. 350.

† Cook, Flinders.

Lieutenant Jeffries, who sailed a long time on this coast, points out that from the parallel of 28° south latitude, to the south part of Tasmania, during the summer,—that is to say, from the month of August or September to April or May,—the currents are directed south by west with a velocity of a quarter of a mile an hour, at a distance from the coast not exceeding twenty-one miles. At a greater distance from the coast, and even as far as sixty miles from land, they set north by east with a velocity of three fourths of a mile an hour. In the winter it is the reverse of what we have just described.*

We see, consequently, that the navigation along the east coast of Australia, according as we go north or south, must depend upon the season, and that we must, as the case may be, keep near or far from the coast.

When obliged to keep very near the coast to take advantage of the periodical current, this navigation requires much prudence and many precautions, and great attention must be paid to the oscillations of the mercury in the barometer, to avoid the land in time in case of a squall.

The barometer rises on this part of the coast with the south-east winds, and falls with the northwest, as we have previously said. The northeast and the southwest winds do not in any manner affect the barometer.†

North Pacific Ocean. We are now going to enter into the northern hemisphere of the Pacific Ocean, to study its general currents.

North equatorial current. The equatorial current of the northern hemisphere — or north equatorial current, to abbreviate — begins to make itself felt in 126° west longitude, and as far as the parallel of 24° north latitude.

Its northern limit follows nearly this parallel as far as the island of Loo Choo, situated on the meridian of 127° east longitude. To the west, however, of the Sandwich or Hawaiian Archipelago it bends considerably towards the south, and lies

* Krusenstern, *Essay on the Winds and Currents of the Pacific Ocean*.

† *Ibid.*, p. 33.

in this part very nearly on the parallel of 19° north latitude; sometimes even it is found still farther south.

The temperature of the waters of the north equatorial current is, on an average, 75° at the northern limit of the current; 77° on the parallel of 20° north latitude; 82° in 10° north latitude. Finally, on the Equator, 82° has been found in the eastern part of the Pacific Ocean; 83° in the middle; in the western part, and north of New Guinea, 88° ,—the maximum of the temperature of the waters in this sea.

Temperature
of north equa-
torial current.

In the zone occupied by the equatorial current of which we speak, very remarkable disturbances are sometimes met with. Thus, between the parallels of 10° and 5° north latitude, and particularly between the meridians of 115° and 150° west longitude, we find the eastern portion of a counter-current, named the counter equatorial current, directed towards the east.

Disturbances
in the north
equatorial
current.

This current sometimes extends farther towards the east than Johnston indicates. In fact, in the voyage of the *Bonite*, in 1836 and 1837, we see that from the 21st to the 30th of August, 1836, between the parallels of $4^\circ 55'$ and $11^\circ 8'$ north latitude, and between the meridians of $99^\circ 29'$ and $106^\circ 33'$ west longitude, currents were experienced varying from N. N. E. to E. N. E., with a velocity of which the minimum was three miles, and the maximum thirty-four miles, in twenty-four hours.*

Counter equa-
torial current.

We believe, however, that this current does not always make itself felt in the zone that we have just mentioned. Captain Hanet-Cléry, who has been so good as to communicate to us some of his observations on the Pacific Ocean, met on the 9th of April, 1846, in latitude $10^\circ 21'$ north, and longitude $150^\circ 24'$ west, a current directed S. 42° W., with 25.4 miles' velocity in twenty-four hours.

On the 11th of April, in $6^\circ 7'$ north latitude, and $147^\circ 23'$ west longitude, the current ran N. 61° W., with a velocity of 20.6 miles in forty-eight hours.

* *Voyage of the Bonite*, Physical Part, by M. Darondeau, vol. ii. p. 334.

Finally, on the 13th of April, in $1^{\circ} 17'$ north latitude, and $145^{\circ} 54'$ west longitude, the current ran in the direction of S. 58° W., with a velocity of 38 miles in forty-eight hours.

Captain Wilkes thinks that the origin of the equatorial counter-current is found in the Indian Ocean. It proceeds, according to him, from the current which runs along the west coast of Australia into the Indian Ocean, and it is a detached branch of this current. After it has turned round the west coast of Australia, its course lies between Celebes and New Guinea, to pass into the Pacific Ocean by the straits between this latter island and that of Mindanao.

The equatorial counter-current, of which, in fact, traces are found near the Marshall Islands* and the Gilbert archipelago, separates, according to Captain Wilkes, the equatorial current of the north from the equatorial current of the south, and traverses the Pacific Ocean through its whole extent.†

There are some facts in regard to this, which confirm the opinion of Wilkes, and which furnish important information for the navigation from west to east in the Pacific Ocean.‡

Captain Hunter points out the possibility of advancing towards the east in the Pacific Ocean without making a long circuit around Australia. Whalers, he says, follow this route habitually at the time when the S. E. monsoon prevails south of the Equator, — that is, from the end of March or the commencement of April into December and January. They keep to the north of the south equatorial current, and on the limit of the general winds or monsoons. We will let the captain speak for himself.

“ In October, 1835, being off the Asia islands, and wishing to make a passage to the eastward, winds light and variable, and current running strongly to the westward, against which we

* M. Duperrey, *Chart of the Motion of the Waters in the Pacific Ocean*, Physical Part of the voyage.

† Wilkes, *Narrative of the United States Exploring Expedition during the Years 1838 – 1842*, vol. v. p. 456, and Atlas. Beechey.

‡ Captain Hunter, of the ship *Marshall-Bennet*. (*Nautical Magazine and Naval Chronicle*, 1843.)

could make no progress, stood to the northward, and on the 19th of October were in lat. $2^{\circ} 6' N.$, and long. $134^{\circ} 11' E.$ Having lost the westerly current, pushed to the eastward between the parallels of $2^{\circ} 15'$ and $2^{\circ} 34' N.$ On the 27th were in long. $147^{\circ} E.$ From hence stood to the southeastward and made Matthias Island, (it being my object to cruise in this neighborhood,) on the 30th, passed through St. George's Channel quickly, current favorable, and to the Treasury Islands. Cruised here until 19th of December; started with a westerly wind which carried us to $169^{\circ} 36' E.$ on the 26th, having passed on the south side of Banks Islands, becalmed two or three days, then with variable winds, chiefly from E. S. E., proceeded to the southward, and anchored in the Bay of Islands 15th of January.

“These passages were made at a season deemed impracticable, before the west monsoon had set in steadily, by a southseaman of moderate sailing qualities, without using studding-sails. The passage to the eastward may, I am convinced, be made at all seasons, by pursuing the same plan, which is, as before stated, to keep to the northward of the equatorial current, and between the trades or monsoons. Here you will have a variable wind, chiefly from the westward, with a drain of favorable current at times. Further to corroborate this opinion, June 23d in $1^{\circ} S.$ and $149^{\circ} E.$ having been drifted from Matthias Island and New Hanover by a westerly current of two and a half or three knots an hour, stood to the northward, got westerly winds on the Equator. With these made easting, and on the 27th reached $155^{\circ} E.$ and $0^{\circ} 45' S.$; made Bouka Point soon afterwards; then found a current equal in strength to that at Matthias Island. At this time the westerly current did not extend quite to the Equator.

“Again, in September, 1840, being unable to hold on near the Admiralty Islands, in consequence of strong westerly currents, stood to the northward, and when in $0^{\circ} 24' N.$ and in $146^{\circ} E.$, proceeded to $2^{\circ} N.$ before losing the current; then worked to the eastward, and stood to the southward on the east side of the Green Islands, which are in about $156^{\circ} E.$ The passage from

Morty to Bouka has also been made in August by adopting the same plan. Although all these passages terminated in the longitude of the Solomon Islands, it was not through inability to proceed farther to the eastward, but merely in consequence of this being the destination. More might be quoted tending to show that these line currents seldom extend northward of 2° N."

These facts fully confirm the opinion expressed above, concerning the existence of a counter-current of greater or less breadth, separating the north equatorial from the south equatorial current.

The equatorial counter-current has been mentioned, through almost the whole breadth of the Pacific Ocean, by different navigators. The following extracts will give a sufficiently complete idea of it.

Lutké, in the east part of the Pacific Ocean, found currents setting E., N. E., and S. E., principally in this last direction, between the Equator and parallels of 8° and 10° north latitude. The mean direction of these currents was E. 6° S., and the velocity $12\frac{1}{4}$ miles in twenty-four hours.

In the west part of the Pacific Ocean, near the Caroline Islands, notwithstanding winds blowing strong from the N. E., the same captain experienced a current setting to the S. E. in latitude 8° north and longitude $163^{\circ} 20'$ east; west of this meridian the easterly current did not extend beyond the parallel of 7° north latitude, and its southern limit was on the parallel of $5^{\circ} 30'$ north. Between these two parallels, as far as the meridian of $152^{\circ} 20'$ east longitude, during a passage of twenty-one days (in January) he did not once meet with a current running to the west; on the contrary, he always had a current directed to the east and a little towards the south. During this interval the mean velocity of the current was 8.3 miles a day, and its mean direction E. by N.

North of the parallel of $6^{\circ} 30'$ north latitude, on the meridian of $152^{\circ} 20'$ east longitude, he found the current setting strongly to the west; west of this meridian, on that of $144^{\circ} 20'$ east

longitude, and south of the parallel of 7° north latitude, he found the currents again directed towards the east. South of the parallel of 5° north, and on the meridian of the island of Oualan, the current set strongly to the southwest; but on the parallel of 3° north they found again the current towards the east with a velocity of thirteen miles a day.

Other seamen have likewise spoken of the equatorial counter-current existing in the western as well as in the eastern part of the Pacific Ocean. Wilson found it in the archipelago of the Carolines, extending more to the south than Lutké places it. Captain Duperrey, between the parallels of 2° and 6° north, being from 7° to 10° to the eastward of the meridian of the island of Oualan, had currents setting to the S. E. and to the N. E. But, on approaching this island, he met very strong currents running to the S. W. Afterwards, between the Equator and the parallel of $8^{\circ} 30'$ north, and between the meridians of $148^{\circ} 20'$ and $137^{\circ} 20'$ east, he took again the easterly currents.

Admiral Krusenstern places the southern limit of this counter-current near the Equator, and its northern limit towards the parallel of 6° north.* Captain Freycinet met with strong currents to the east, between the parallels of $9^{\circ} 20'$ and 4° north and the meridians of $148^{\circ} 40'$ and $143^{\circ} 40'$ west longitude. Beechey has found between the Equator and the parallel of 4° north, going from the Society to the Sandwich Islands, a current setting to the N. N. E. with a daily mean velocity of 18 miles.

Captain Wendt, in the *Princesse-Louise*, experienced between the parallels of $6^{\circ} 30'$ and $10^{\circ} 30'$ north, and the meridians of $124^{\circ} 40'$ and $130^{\circ} 40'$ west, a current setting to the northeast with a variable velocity of from 17 to 25 miles. All these currents towards the east bear necessarily some relation to each other, and consequently, after all the facts we have adduced, we have thought ourselves entitled to trace the equatorial counter-current on the chart.

Admiral Krusenstern says, speaking of this current setting from west to east, that it extends over the west part of the

* Krusenstern, *Memoirs on the Pacific Ocean*, Part I. p. 15.

Pacific Ocean in a belt comprised between the Equator and the parallel of 6° north, and that its velocity amounts sometimes to as much as sixty miles in twenty-four hours. Vessels returning from China during the S. W. monsoon, and entering into the Pacific Ocean by the Strait of Gamen, do not generally go farther east than the Pelew Islands; but if they do not pay great attention to this current running east, they are frequently carried several degrees in that direction; * it must then be rapidly crossed from north to south to reach the S. E. trade-winds as soon as possible and pass to the southward of the Equator, where, near New Guinea, a W. and W. N. W. current is met with, having a velocity of from 15 to 40 miles a day.

We point out to seamen this counter-current, so important to navigation, in order to induce them to verify the facts we have just mentioned by frequent observations. The limits within which it is met can then be accurately traced, besides establishing its existence across the whole Pacific Ocean, which is not yet positively known.

Easterly currents west of the Hawaiian archipelago. West of the Sandwich Islands, and nearly on their parallel, a current has also been found setting towards the east; it is what Johnston calls *the entanglement of the easterly current*.

The existence of this fact is shown in a positive manner by the observations of Prussian navigators. Moreover, Freycinet has spoken of it, Beechey mentions it, and, finally, Lutké has collected numerous observations which prove the existence of certain currents setting towards the east, in the belt where the trade-winds blow with most strength.

Scientific men have endeavored to determine the cause of this perturbation in the north equatorial current. We hope to show directly, by the observations on temperature made by M. de Tesson, that what has been regarded up to this time as a disturbance of the equatorial current is in reality only the Japan Current (analogous to the Gulf-Stream of the Atlantic Ocean), of which

* It is not a counter-current of which we are now speaking, but a current caused, in part at least, by the S. W. monsoon.

we are about to speak. Not to leave the region of the Pacific Ocean on which we are now employed, we shall first mention the monsoon currents of the Caroline Islands. We will cite, in passing, one important fact, which is that the *Bonite*, going in 1836 from the Hawaiian Islands to Manilla, kept between the parallels of 18° and 19° north latitude, and that in this passage, as far as Luzon, she did not experience any current setting to the east.* We are consequently authorized to think that in this region — that is, west of the Sandwich Islands — the north limit of the equatorial current is found nearly on the parallel of 19° north latitude, and we are the more inclined to believe so because it is north of this parallel that currents are found setting to the east.

In the belt of the north equatorial current, and towards the western limit of the Pacific Ocean, there is found a remarkable disturbance known under the name of the *monsoon current of the Caroline Islands*.

Monsoon current of the Caroline Islands.

The monsoons of the China Sea, as we have said, exert their influence as far as the meridian of the Ladrone Islands and that of the Caroline Islands. In this part of the ocean we have alternately the N. E. trade-winds and the S. W. monsoon.

The necessary result is an alternating current, which often must have, especially in the western region of the Caroline archipelago, a very considerable velocity.†

The monsoon currents of the Caroline Islands would appear to occupy a zone comprised between the meridian of the island of Ponynipete or Bonnebey to the east, and that of Gilolo Island to the west; it

Extent of the monsoon currents of the Caroline Islands.

* *Voyage of the Bonite*, Physical Part, by M. Darondeau, vol. ii. p. 340, and following.

† Duperrey, *Voyage of the Coquille*. The monsoon currents of the Carolines do not appear to us a perfectly well established fact. Thus Lntké, as we said in speaking of the equatorial counter-current, has found near these islands currents setting towards the east, although the winds blew strong from the northeast; other navigators mention likewise easterly currents with the same winds. We should be disposed to believe that the equatorial counter-current may have been taken for a current produced by the S. W. monsoon.

must extend north and south from between the parallel of 10° or 8° north latitude, as far as the Equator.

From the month of June to the month of October, the current must set N. E., varying to E. N. E. From the month of October to the month of May, it must set S. W. and W. S. W.

Velocity of
these currents. The mean velocity of these currents must be two or
three miles a day. The temperature of the waters
Temperature
of these cur- that form them varies from 85° to $88\frac{1}{2}^{\circ}$ Fahr. This
rents. last temperature is found very near the Equator in
 135° east longitude. It is the maximum temperature of the
waters of the Pacific Ocean.

Notwithstanding the monsoon currents of which we have just spoken, the equatorial current makes itself regularly felt to the west of the Ladrone Islands, a little to the south of the southern parallel of this archipelago, and it does not appear to be influenced by the monsoons.

In this part its southern limit, which runs towards W. N. W., passes 120 miles, or thereabouts, south of Guam Island (one of the Ladrone Islands), and at the same distance north of Ouluthy Island (one of the Caroline archipelago); thence the equatorial current, of which the north limit follows the parallel of 26° north latitude, becomes more contracted in its limits as we approach the Strait of Formosa.

Off this island, and 120 leagues to the eastward, it turns rather abruptly towards the N., then towards the N. E., and forms the great current of the coast of Japan, of which we are now going to speak.

Current of the
east coast of
Japan, or Tes-
san Current. From the island of Loo-Choo, situated opposite the
east coast of China, and distant from it 140 leagues, a
constant warm current is found along the east coast
of Japan, setting from E. N. E. to N. E. This current, named
current of the east coast of Japan, or *Japan Current*, often
acquires a great velocity.

It is occasioned by the waters of the equatorial current which turn towards the east, and it makes its influence felt as far as the northwest coast of America; that is, it nearly crosses the

Pacific Ocean from west to east, bearing a resemblance to the Gulf-Stream.*

The southern limit of the Japan Current turns round the west coast of the island of Loo-Choo, and passes to the south and very near the island of Kakir-Ouma. From there it appears to travel E. N. E. to the north of Moor Island (marked doubtful on the charts), and, running about S. E., cuts the meridian of 180° at 21° north latitude,—the point where it comes in contact, on the parallel of the Hawaiian Islands, with the northern limit of the north equatorial current.

From the meridian of 180° it runs nearly E. N. E., cuts the parallel of 30° north latitude on the meridian of the archipelago of Hawaii, and, running to the N. E., it cuts the meridian of 148° west longitude in 40° north latitude.

From thence it makes a curve, taking a S. E. direction, then a S. S. E., a S., and a S. W. direction on the parallel of 32° north latitude, and on the meridian of 133° west longitude, nearly 600 miles W. S. W. of Monterey.

Such, at least, is as far as we can go, with the information we have at present, in determining the probable southern limit of the Japan Current.

We will now speak of the northern limit.

The Japan Current, after having skirted the east coast of this empire in one single stream, gradually widening, divides at the parallel of the middle of the island of Nippon, and on the meridian of 152° east longitude, into two branches; one, running N. E. and N. N. E. towards Behring's Straits, forms the current of the coast of Kamtschatka, of which we shall speak hereafter; the other, directed towards the east, preserves the original name of *Japan Current*.

The northern limit of this current appears to run at first

* M. de Tesson, by the temperatures of the water observed during the voyage of the *Venus*, in 1837, has perfected the first ideas of the Japan Current furnished by Krusenstern, and has thrown an entirely new light upon it. It is upon the information published by this learned hydrographic engineer, in the Physical Part of this voyage, (vol. iv. p. 348, and following,) that we base the following description of the Japan Current, which was traversed twice through its whole extent by the frigate *Venus*.

towards the east, and cuts the meridian of 162° east longitude at 41° north latitude; the meridian of 167° west longitude at 44° north latitude; and thence, turning to the N. E., it expands and loses itself in the neighborhood of the N. W. coast of America, on the meridian of 143° west longitude.

The velocity of the Japan Current is very variable. On the parallel of $36^\circ 30'$ north latitude, its direction has been found to be N. E. by E., its mean velocity 10 miles a day. From the parallel of 36° to that of 35° north latitude, at 70 leagues from land, its direction was found to be E. N. E. and its velocity 48 miles. At 25 leagues from the coast, in the same latitude, it was 72 miles. King mentions even having found in these latitudes a velocity of 5 miles an hour in the Japan Current.*

However, according to these observations and those of Broughton, it may be said that the average velocity of the Japan Current, in the neighborhood of the coasts of this empire, is one and a half or two miles an hour during the months of July, August, and September, and that its strength depends on the distance from land. It must also necessarily be influenced by the monsoons that prevail in these latitudes.

It has also been remarked that, in this region, the current sets more to the north in November, and more to the east in July.

The frigate *Venus* crossed the Japan Current, going to Kamtschatka, between the parallels of 21° and 42° north latitude and the meridians of 178° and 163° east longitude. Here, its principal direction was E. and E. N. E., its velocity varying from 10 to 17 miles.

On her return voyage from Kamtschatka to Monterey, the *Venus* crossed again the Japan Current, between the parallels of $40^\circ 30'$ and 37° north latitude, and the meridians of 162° and 133° west longitude. Its general direction, in this part, was

* King: Krusenstern, *Essay on the Currents and the Winds, &c.*, p. 20. Examples of a similar velocity are found in the Gulf-Stream and in the current of Mozambique in the latitude of Cape Corrientes.

N. 50° E., and its velocity varied from 16 to 18 miles in 24 hours.

Concerning the temperature of the waters of the Japan Current, we have only the observations made by M. de Tessan in the zones crossed by the *Venus*, and it is to be presumed that the temperature of the current must be very variable, depending on the place.

Temperature
of the waters
of the Japan
Current.

In $21^{\circ} 20'$ north latitude, and $163^{\circ} 20'$ west longitude, at its southern limit, nearly in contact with the north equatorial current, M. de Tessan found the temperature of the waters of the Japan Current to be $77\frac{1}{2}^{\circ}$ and $78^{\circ}.8$ Fahr.; that is to say, $4^{\circ}.30$ above the temperature of the waters of the equatorial current at its northern limit in this same part of the Pacific Ocean.

In $27^{\circ} 15'$ north latitude, $177^{\circ} 20'$ east longitude, he obtained, as the temperature of the current, $81^{\circ}.5$. It afterwards diminished gradually up to the northern limit of the current, and there, in 43° north latitude and $162^{\circ} 50'$ east longitude, the temperature was found to be 55° Fahr.

On leaving the current, the temperature fell to $53^{\circ}.2$; and from this to Kamtschatka it continued between $51^{\circ}.8$ and $48^{\circ}.6$ Fahr.

This fact proves that the waters that wash the coast of Asia are comparatively warm; and what confirms this assertion is, that the sea never freezes in these latitudes, notwithstanding the intensity of cold.

On his return voyage to Monterey, crossing the current again, the following observations were made upon the temperature: in 45° north latitude and 164° west longitude, outside of the current at its northern limit, $52^{\circ}.4$ and $53^{\circ}.8$ were found to be the temperature of the sea; and at the northern limit of the current $58^{\circ}.8$, in $43^{\circ} 30'$ north latitude and $161^{\circ} 10'$ west longitude. In the central part, $64^{\circ}.2$ and $64^{\circ}.4$ Fahr. were found in 41° north latitude and $158^{\circ} 40'$ west longitude.

The temperature of the current fell gradually as the frigate made easting. In 36° north latitude, or on the parallel of Monterey, and in $127^{\circ} 40'$ west longitude, $61^{\circ}.3$ Fahr. was found to

be the temperature of the waters of the Japan Current, almost in contact with the current of California. Thus, in a space of 55° of longitude, from the meridian of 177° east to 128° west, the fall of the temperature of the waters of the current was about $20^{\circ}.2$ Fahr., on its progress towards the coast of America, between the parallels of 27° and 36° north latitude.

We have thought ourselves justified by the preceding statement in tracing on the chart of the Pacific Ocean the current we speak of, adding to its original name of Japan Current that of the learned hydrographic engineer, De Tesson, whose observations we have made use of to determine its course.

It is evident, from the foregoing observations, that the warm Japan Current, or Current of Tesson, crosses all the northern part of the Pacific Ocean, and makes itself felt in the neighborhood of the N. W. coast of America. This fact is noticed by all the navigators who have crossed this zone of the Pacific Ocean; they point out a current running towards the E. and E. N. E., the existence of which they attributed to the prevailing winds from the W. (varying from the N. W. to S. W.) which exist in this zone. These winds, without doubt, contribute in part to make the current; but the temperature of its waters, higher than that of the surrounding sea, prevents our regarding it as a drift current.

Moreover, this current explains an undisputed fact,—that of the easterly currents which many navigators have noticed west of the Hawaiian archipelago, and on its parallel,—a fact not before explained. Finally, it furnishes us also the origin of the whirlpool of Fleurieu, of which we shall speak hereafter (page 88).

We think it desirable to give an abridged table of some of the observations made by M. de Tesson, with the accompanying remarks.*

* *Voyage of the Venus*, vol. iv. p. 348, et seq. *Irregularities of the Temperature of the Sea.*

Dates.	Latitude North.	Longitude.	Mean Temperature.	Observations.
1837.				
July 26	21° 20'	162° 37' W.	77.4	The temperatures from the 7th to the 14th of August show the existence of a very warm current. The temperatures of the 14th, 16th, 17th, and 20th of August show a rapid fall in the temperature of this current in the direction given. This current is analogous to the Gulf-Stream of the Atlantic Ocean, and, like it, causes thick fogs. It makes its influence felt as far as the northwest coast of America, more than 1,000 leagues from this point. This current, from its importance, deserves to be laid down on physical charts.
Aug. 7	27 15	177 26 E.	81.5	
12	32 58	168 30 E.	77	
14	33 51	165 52	79.7	
16	37 45	164 49	74.8	
17	40 17	163 57	66.7	
20	42 55	162 50	54.9	
21	44 30	161 50	54	

The current of the coast of Kamtschatka is, as we have said, a branch of the Japan Current, running towards the N. E. and the N. N. E. along the coast of Asia as far as Behring's Straits.

Current of the coast of Kamtschatka.

It separates from the Japan Current on the meridian of 152° east longitude, and on the parallel of 38° north latitude. Its eastern limit passes to the west of the Aleutian Islands, of St. Matthew's Island, and of St. Lawrence Island. Thence it passes through Behring's Straits and spreads over the Northern Ocean, running northwest on the coast of Asia, northeast on the coast of America, and north in the middle of the Strait.

There are but few observations on the temperature of the current of Kamtschatka. In the months of August and of September, M. de Tesson found, off Petropawlowski, that 52°.2 Fahr. was the mean temperature of this current. On the parallel of 60° north latitude, Wilkes obtained 50°; in Behring's Straits, 51°.2.

Temperature of this current.

Kotzebue, in Behring's Straits, found a velocity of from one and a half to two miles an hour in the current of Kamtschatka. M. de Tesson gives to it, in the latitude of Petropawlowski, a varying velocity of from 7 to 10 miles a day, in an E. N. E. and N. E. direction.

Velocity of this current.

Behring's Current appears to be formed by the excess of the waters carried to the strait of this name by the current of Kamtschatka, which do not find a sufficient discharge through this strait. It perhaps owes its origin to some entirely different cause; but we have not observations enough to show whether this current is cold or warm.

Behring's Current.

Behring's Current descends from the strait of this name, generally in a S. S. W. direction. As it goes south it spreads considerably, in such a manner that at its southern part it runs through the whole chain of the Aleutian Islands, and is very strong in the channels formed by these islands.

Its eastern limit runs along the northwest coast of America; its western limit, after leaving Behring's Straits, passes east of St. Lawrence Island, then east of St. Matthew's Island, and south a little westerly of the westernmost of the Aleutian Islands.

South of Behring's Straits, 47° Fahr. was found to be the temperature of this current; north and east of the Aleutian Islands, 47°; southeast of the same islands, 51°.1. Near the Aleutian Islands, and southwest of them, the temperature of the waters of Behring's Current was found to be 48°.6 Fahr. Its maximum velocity here was 19 miles, and its minimum 5 miles; its mean velocity was about 14 miles a day.

Fleurieu's
Whirlpool.

"I have named," says Johnston, "the current in the eastern division of the North Pacific Ocean *Fleurieu's Whirlpool*, after the learned hydrographer of that name, who has described Marchand's voyage, in a work which ranks in the highest class of modern nautical literature. The whirlpool is laid down from the observations of Marchand; and since it is not contradicted by the animadversions of Lütke, who sailed directly through its course, I have considered myself justified in laying it down provisionally."

If we cast a glance on the current chart accompanying this chapter, we shall perceive that what appeared to be a revolving current is the result of the southern limit of the Japan Current at its eastern extremity, and the northern limit of the equatorial current at its eastern origin.

Cold current
of the N. W.
coast of America,
and of the
coast of California.

Along the northwest coast of America, south of Cape Tshirikoff, and along the coast of California, we meet with a cold current, having chiefly a south direction, a little easterly, or westerly, according to the indentations of the land. This current follows the coast

at a varying distance, that may be estimated at an average of 300 miles. On reaching the coast of Lower California, it takes a more marked direction towards the west as it descends towards the south.

At Cape San Lucas its direction is nearly W. S. W., and it loses itself in the north equatorial current of the Pacific Ocean.

The temperature of the current of the northwest coast of America appears to rise rapidly as it descends towards the Equator. On the parallel of Monterey it has been found to be $56^{\circ}.3$ Fahr.; on the parallel of 30° north latitude, $59^{\circ}.5$ was the mean; on that of Cape San Lucas, $72^{\circ}.1$.*

Temperature
of the current
of the N. W.
coast of Amer-
ica.

The mean velocity of the current of the northwest coast of America has been found to be 14 or 15 miles a day. The maximum was 22 miles. Its velocity is greater near the coast than off shore, and is particularly great at the entrance of the Gulf of California.

Velocity of the
current of the
N. W. coast of
America.

To conclude the study of the general currents of the Pacific Ocean, it remains for us to speak of the periodical current of the west coast of Mexico.

Periodical
current of the
west coast of
Mexico.

It is an alternating current, occasioned by the monsoons which prevail on this coast. M. de Humboldt was the first who made it known. Since then, Basil Hall and Beechey have furnished information concerning it.

The current of the west coast of Mexico extends from Cape Corrientes, north of Acapulco, to the Cocos Islands. Its exterior, or western limit, passes east of these islands, at a distance of about twenty leagues, and the islands themselves lie in the counter-current which exists near this limit.

The current skirts the coast of Mexico, preserving a breadth of about 360 miles. It gives rise also to a counter-current at its interior limit, and very near the coast.

From December to April its direction varies from S. E. to E. S. E.; from May to December it is reversed, and takes a

* *Voyage of the Venus, &c.*

N. W. and W. N. W. direction. Its velocity depends upon the strength of the monsoon that occasions it.

The importance of this current for the navigation of the coast of Mexico may be readily understood.

We will recapitulate, in the following table, the currents of the Pacific Ocean, giving the mean velocity of each one, as far as we are able to derive them from the numerous comparisons extracted from the different voyages in this ocean.

COMPARATIVE TABLE OF THE MEAN VELOCITIES OF THE CURRENTS IN 24 HOURS.

<i>South Pacific Ocean.</i>	
South Equatorial Current,	24 miles.
Cross "	20
Cape Horn "	18
Humboldt "	15
Mentor "	16
General Current of Australia,	12
Periodical Currents of Australia,	} 6 miles near the land. 16 miles at sea.
<i>North Pacific Ocean.</i>	
North Equatorial Current,	30 miles.
Counter Equatorial "	15
Monsoon Currents of the Carolines,	3
Japan Current,	31
Current of N. W. Coast of America,	16
Kamtschatka Current,	8
Behring's "	14

After having made known the general facts in relation to the winds and currents of the Pacific Ocean, it remains for us to treat the practical part; that is, to speak of the general navigation of this great ocean. This will form the subject of Chapter III.

NOTE BY THE EDITOR.

JAPAN CURRENT. — Lieut. Silas Bent, U. S. N., on January 24th, 1856, read before the American Geographical and Statistical Society of New York a learned and original paper on the Japan Current (the Kuro-Siwo, or Black Stream, as it is termed by the natives, in consequence of the deep-blue color of its waters), from which we make the following valuable extracts.

“ One of the most remarkable of the offshoots of the great equatorial current of the Pacific Ocean is the Kuro-Siwo, or Japan Stream, which, separated from the parent current by the Bashee Islands and south end of Formosa, in lat. 22° north, long. 122° east, is deflected to the northward along the east coast of Formosa, where its strength and character are as decidedly marked as those of the Gulf-Stream on the coast of Florida. This northwardly course continues to the parallel of 26° north, when it bears off to the northward and eastward, washing the whole southeast coast of Japan as far as the Straits of Sangar, and increasing in strength as it advances, until reaching that chain of islands to the southward of the Gulf of Yedo, where its maximum velocity, as shown by our observations, is eighty miles per day.

“ Its average strength from the south end of Formosa to the Straits of Sangar is found to be from 35 to 40 miles per twenty-four hours at all seasons that we traversed it.

“ Near its origin the Kuro-Siwo, like the Gulf-Stream, is contracted, and is usually confined between Formosa and the Majico-Sima Islands, with a width of one hundred miles. But to the northward of this group it rapidly expands on its southern limit, and reaches the Loo-Choo and Bonin Islands, giving it a width to the northward of the latter of about five hundred miles.

“ To the eastward of the meridian of 143° east in latitude 40° north the stream takes a more easterly direction, allowing a cold current to intervene between it and the southern coast of Yesso, where the thermal change in the water is from 16° to 20° ; but from the harassing prevalence of fogs during our limited stay in that vicinity, it was impossible to make such observations or experiments as to prove conclusively the predominant direction of this cold current through the Straits of Sangar, particularly as the tide ebbs and flows through them with great rapidity.

Yet, from what we have, I am inclined to believe that it is a current from the Arctic Ocean running counter to the Kuro-Siwo, and which passes to the westward through the Straits of Sangar, down through the Japan Sea, between Corea and the Japanese islands, and feeds the hyperborean current on the east coast of China, which flows to the southward through the Formosa Channel into the China Sea. For to the westward of a line connecting the north end of Formosa and the southwestern extremity of Japan there is no flow of tropical waters to the northward, but, on the contrary, a cold counter-current filling the space between the Kuro-Siwo and the coast of China, as is distinctly shown by our observations. As far as this cold water extends off the coast, the soundings are regular, and increase gradually in depth; but simultaneously with the increase of temperature in the water the plummet falls into a trough similar to the bed of the Gulf-Stream, as ascertained by the United States Coast Survey.

“The surface of this counter-current is no doubt influenced in some measure by the southwest monsoon, and during that season of the year a portion of it is forced to mingle its waters with the Kuro-Siwo, between Formosa and Japan. But so well is its existence known to vessels trading on the coast of China, that they rarely, if ever, attempt to beat to the northward through the Formosa Channel, but almost invariably make the passage to the eastward of Formosa during the prevalence of adverse winds, though those winds may be stronger there than in the Formosa Channel.

“Of the power of these two currents I can speak from personal experience, in addition to the facts disclosed by the observations made by the Japan expedition; for in the winter of 1848, when attached to the sloop-of-war *Preble*, and bound from Hong Kong to Japan, we struggled for three days after leaving port against this southwesterly current, without making a single mile on our course to the eastward, and were compelled to resort to the expedient of working along close in shore, and anchoring whenever the tide was combined with the current against us. After reaching the mouth of the channel in this way we stretched across, doubling the south end of Formosa, and fell immediately into the Kuro-Siwo, when, encountering a severe gale of wind from the northward and eastward, we were drifted, under storm sails, ninety-two miles dead to windward in less than three days.

“Another resemblance between the Gulf-Stream and the Kuro-Siwo is to be found in the strata of cold water lying in the longitudinal direction of these streams. Those of the former were determined by observations

made by the Coast Survey, and are traced upon the diagram accompanying the annual report of Prof. Bache for 1854, from which the present delineation has been copied. I have represented those of the latter, as determined by the thermometric observations taken by the Japan Expedition, from which also, in fact, I have traced the whole outline of the Kuro-Siwo, from its origin about the south end of Formosa to the Straits of Sangar.

“There is a floating sea-weed found in the Kuro-Siwo similar in appearance to the *fucus natans* of the Gulf-Stream; but the specimens collected by the expedition were unfortunately lost before being submitted to botanists for examination, and it is therefore yet undetermined whether they are identical or not.

“The influence of the Kuro-Siwo upon the climates of Japan and the west coast of North America is, as might be expected, as striking as that of the Gulf-Stream on the coasts bordering the North Atlantic. From the insular position of Japan, with the intervening sea between it and the continent of Asia, it has a more equable climate than we enjoy in the United States; and since the counter-current of the Kuro-Siwo does not make its appearance on the eastern shores of the islands, south of the Straits of Sangar, and as these islands, in their geographical position, have a more eastwardly direction than our coast, the Kuro-Siwo, unlike the Gulf-Stream, sweeps close along this shore, giving a milder climate to that portion of the empire than is enjoyed in corresponding latitudes in the United States.

“The softening influence of the Kuro-Siwo is felt on the coasts of Oregon and California, but in a less degree, perhaps, than that of the Gulf-Stream on the coasts of Europe, owing to the greater width of the Pacific Ocean over the Atlantic.

“Still, the winters are so mild in Puget’s Sound, in latitude 48° north, that snow rarely falls there, and the inhabitants are never enabled to fill their ice-houses for the summer; and vessels trading to Petropawlowski and the coast of Kamtschatka, when becoming unwieldy from accumulation of ice on their hulls and rigging, run over to a higher latitude on the American coast and thaw out, in the same manner that vessels frozen up on our own coast retreat again into the Gulf-Stream until favored by an easterly wind.”

CHAPTER III.

NAVIGATION OF THE PACIFIC OCEAN.

THERE are two routes from Europe into the Pacific Ocean. One by the west, doubling Cape Horn; the other by the east, doubling the Cape of Good Hope. In the latter case, the Indian Ocean must be traversed in order to enter the Pacific Ocean by passing through one of the numerous straits by which these seas communicate in their central part, or by going round the south of Australia, or rather Van Diemen's Land.

By connecting what we have said upon the routes to be taken to cross the Atlantic Ocean, and on those to be followed in the Indian Ocean, the necessary directions will be had for reaching the Pacific Ocean by the east or by the west, whether the destination of the ship is the east coast of Asia, Australia, or any other point situated in the west of the Pacific Ocean, or whether it is the west coast of America.

We shall consequently limit ourselves to speaking of the routes to be taken to cross the Pacific Ocean; and among the great number of those that may be followed in this sea, we shall choose such as are the most important, and from which it will be easy to deduce all the others.

In order to facilitate our investigations, we will separate this chapter into three divisions. The first will comprehend the routes from the ports of America to China and Australia, with the return voyages; and the routes from India or China to the ports of the east coast of Australia, and back.

The second will give the routes from India or China to Australia passing through Torres Strait; directions for navigating

in this strait and along the east coast of Australia; and the return routes from the ports of Australia to India or China, passing through Torres Strait or Pitt's Strait.

The third division will embrace the navigation on the west coast of America.

DIVISION I.

There are two great routes to go from the west coast of America to Manila, to Macao, or to any other point of the south coast of Asia; one or the other may be taken, according to the circumstances or the object of the voyage.

Routes from the west coast of America to Manila, or to Macao

The first route is called "Great Southern Route"; the second, "Northern Route."*

The great southern route is taken only by vessels leaving places situated on the south coast of America; even these often prefer to take the northern route.

Great southern route.

Vessels going from Chiloe, from Lima, or from Guayaquil, directly to China or Manila, when they leave the coast of America make generally a direct course for the archipelago of Nouka-Hiva. They are, in this part of their voyage, favored by the southeast trade-winds; they afterwards pass to the south of the archipelago of the Gilbert Islands, and to the north of the Pelew Islands.

Beyond these islands, the route to be followed will depend on the direction in which the monsoons of the China Sea blow.

With the southwest monsoon the Strait of San-Bernardino is generally taken; with the northeast monsoon the course is north of the Philippine Islands, and through the Bashee Islands, between Formosa and Luzon.

An important observation for one going to Macao is, that the coast of China must be made in a suitable latitude, according to the monsoon. If, on making the coast, you are but one degree too far north or too far south, or, in other words, if you are but one degree of latitude to leeward of the point to be reached, the voyage may from that cause alone be prolonged several weeks.

* *Modern Navigation of the Pacific Ocean*

Another observation upon this route is, that it will be especially advantageous from March to October, the period when the southeast trade-winds blow over the whole extent of the ocean; whilst from October to February variable winds will be found blowing often from the west and the southwest, accompanied with bad weather. Hence the most favorable time for leaving the coast of America, when desiring to take this route, is from February to July. The route that we have just indicated leads likewise to the ports of Australia. Only after having passed to the west of the archipelago of Nouka-Hiva, steer so as to pass to the east or to the west of the Samoa and Tonga groups and the Feejee Islands, or between these different groups. Thence you can run for your port in Australia.

The preceding route to China may be modified, and the following may be pursued.*

Keep to the southward of the Equator as far as the meridian of 164° west longitude; thence run to the northwest to pass north of the Gilbert Islands, then between the Mulgrave and the Ralick Islands, turning to the north of the latter; keep on to the west, running up to 13° or 14° north latitude; pass to the south of Guam Island, to go in a straight line towards the Strait of San-Bernardino.

This strait must be entered with caution, and by daylight Violent currents and whirlpools, occasioned by the tides, are met with at its entrance, which is very narrow and winding. After having cleared this strait, enter the China Sea by the strait between the island of Mindoro and that of Luzon. You will then have a favorable monsoon for your port of destination.

If, in this route, you pass between the Ladrone Islands, all the channels which separate them may be traversed without fear; no one of them offers any danger.*

Northern
route from
America to
China. The northern route from America to China is that which consists in navigating in the northeast trade-winds; this route is adopted by vessels sailing from places in America situated north of the Equator, and even very often by those leaving ports situated to the south of it.

* Benjamin Stroule, *Nautical Magazine*, 1848.

By this route we avoid the frequent calms occasioned in the southern hemisphere by the neighborhood of the numerous islands scattered about, — calms which add much to the length of the voyage. We escape likewise the difficulties of navigation occasioned by these islands, the positions of all of which are not perfectly determined even at this time.

This route is especially advantageous to vessels leaving ports situated north of the Equator, and to those which sail between July and February.

On leaving the coast of America a course should be taken to reach as soon as possible the northeast trade-winds. In coming from the south, the zone of the variable winds of the Equator will have to be crossed. We shall say, in regard to this, that it appears advantageous to cross the line between Distance at which to cross the line. 113° and 128° west longitude. This opinion is based upon the tracks made by a great number of navigators. Besides, by the table found in Chapter I. it may be seen that the zone of the variable winds of the Equator is most probably narrower in the winter and spring of the northern hemisphere, than in the summer and autumn. Consequently, in order to profit by all these observations, the voyage should be so arranged as to reach the northeast trade-winds at the earliest moment; these are, when they have well set in, stronger than the southeast trades.

In the passage of which we are speaking, from the southern to the northern hemisphere, it will be necessary to cross also the equatorial counter-current which we have already described, and which sets strongly to the E. and to the E. S. E. It will be found nearly on the latitude of 4° or 5° north. It must be crossed as rapidly as possible, and the northeast trade-winds will generally be taken between the parallels of 5° and 6° north latitude in the months when the sun has a south declination, and between 9° and 10° north latitude when it has a north declination.

Once in the northeast trade-winds, if going to the Hawaiian archipelago, sail directly towards those islands, making them from the east, on account of the equatorial current. From the

Hawaiian Islands run to the west, keeping between the parallels of 13° and 15° north latitude, — the zone where the winds are certain to be found fresher than in a higher latitude.' This course is to be followed until the meridian of the Ladrone Islands is reached.

If not bound to the Hawaiian Islands, you may keep on the parallels of 12° and 13° north latitude, taking advantage of the wind and current. If the former falls off, a little northing must be made immediately, and the latitude increased 30 or 40 minutes, to take fresher winds. This will be necessary every time that the same fact occurs.

In going to the Ladrone Islands, the old sails may be kept bent; but from the meridian of these islands to the coast of Asia it will be prudent to change them, for in this part of the route there is a chance of strong breezes from the north, varying to the northeast, and occasioning a heavy sea.

From the Ladrone Islands, according to the monsoon that prevails in the China Sea, a more or less northerly route must be taken, so as to reach the place of destination.

At the period when the northeast monsoon blows in the China Sea, from the vicinity of the Ladrone Islands strong winds from the north are encountered; the currents take a direction towards the south, which makes it necessary to keep more to the northward than is required by the direct course to the Straits of Formosa, — the usual passage for entering the China Sea. Thus, in this case, it is better to take, in crossing the Ladrone Islands, the channel between Assumption and Grigan, and even to pass to the northward of this archipelago, in order to reach more easily the Straits of Formosa, and to double the Bashee Islands by the north, avoiding the currents which, in the straits, set often to the S. S. W. with winds from the N. and the N. N. E. There is also, as we have said, very bad weather in the Straits of Formosa.

During the southwest monsoon the Strait of San-Bernardino is to be taken, and the route must be planned so as to reach this strait easily.

The route that we have just pointed out is nearly that which the Spanish galleons formerly took in the voyage from Acapulco to Manilla.

These vessels left Acapulco at a time that allowed them to reach the Philippine Islands before the month of May, — the period when the southwest monsoon begins in these islands. They returned from Manilla in the month of July. Going, they generally touched at the Hawaiian Islands, and thence steered for the Ladrone Islands. They anchored at Guam Island. Thence the galleons sailed to Samar Island.

To return from India or China to the north coast of America, it is very important to leave at the period when the southwest monsoon prevails, which extends into the Pacific Ocean as far as the neighborhood of the Ladrone Islands, and which makes it easy to run rapidly to the north, crossing the zone of the trade-winds.

Return route from India or China to the north coast of America, with the S. W. monsoon.

Consequently, Manilla or the ports of China should be left towards the month of July. When the parallel of 34° of north latitude is reached, an east course must be made nearly on this parallel, taking advantage of the current of Tessian, or Japan Current, and the general west winds of this region, which appear to be nearly as constant as the trade-winds, and to which has been given the name of *west trade-winds*. These winds extend to the coast of California.

In going to a more southerly point than the coast of California, the route must be according to the destination, being careful to cut the zone of the northeast trade-winds in an oblique direction.

Vessels which sail for Peru or Chili adopt the preceding route. They afterwards cross the belt of the northeast trade-winds by an oblique course, until they reach the southeast trade-winds. They should cross the latter belt, making as much southing as possible, in order to pass soon to the southward of the parallels of 28° and 30° south latitude, into the temperate zone of this hemisphere, where the west winds prevail, with which they will finally reach their port of destination.

Return route from China or Manilla to a port of the south coast of America, with a S. W. monsoon.

Return route
from China
or Manilla to
North or South
America, with
the N. E. mon-
soon.

With the northeast monsoon prevailing in the China Sea, vessels will have very great difficulties to overcome in taking the preceding route. They will have a great deal of trouble in running to the north of the belt of the northeast trade-winds to reach that of the prevailing winds from the west, which will render their voyage much longer than when they set out at the time of the southwest monsoon.

Vessels bound to ports of South America, when they leave at the time during which the northeast monsoon blows in China, go by the route of the southern hemisphere, where the voyage is very dangerous on account of the numerous islands and coral banks that are met with in this part of the Pacific Ocean.

We have already, in speaking of the equatorial counter-current, pointed out the route followed by Captain Hunter,* in running from west to east in the western part of the Pacific Ocean, at the time when the southeast monsoon is blowing. These remarks are applicable to the return routes from China and from Manilla to ports situated in the eastern part of the Pacific Ocean, and consequently useful for those of which we have just spoken.

We have in fact shown, according to the observations of Captain Hunter, that the south equatorial current very rarely extends beyond the parallel of 2° north latitude. Consequently, at the time when the east monsoon prevails in this part of the Pacific Ocean, it is possible to make easting without difficulty by keeping near the Equator, and by seeking in the neighborhood of this line the belt where the current ceases, and that which is occupied by the equatorial counter-current setting towards the east. Besides this, even under the Equator, at the period of the southeast monsoon in the southern hemisphere (from March to December), there are variable winds which blow from the west.

Thus vessels from the Philippines, Timor, or the islands west of the latter, bound to ports in the Pacific Ocean, if they leave these islands in the beginning of December or January, will

* See page 76, and following.

generally have an easy and short voyage, provided they reach the passages to the north of the Moluccas, that of Gilolo, or that of Dampier, between the 15th of December and the 15th of March, the period when the southwest monsoon prevails in these latitudes.

At every other season, the direct route to the east will be possible, provided the vessel is kept, as we have said, to the north of the limit of the south equatorial current and of the zone occupied by the monsoon; that is to say, by keeping near the Equator.

During the monsoon from the west, the winds are generally from the north and the northwest, in the latitudes of the Cape of Good Hope and of New Guinea; east of this point, the winds from the west will be found fresh and regular, in addition to a current setting towards the east with a velocity of from two to two and a half miles an hour. This current extends between the coast of New Guinea and the Equator, and beyond into the archipelago of the Carolines. One may, without fear of losing the wind and currents, pass near Saint David Islands to the north of Providence Islands, and afterwards take the preferable passage for traversing the archipelagos, and run south in search of the west winds of the temperate zone.

Dampier's Straits, although the most direct route for a vessel bound to Sydney, is not the safest. The best route to enter Saint George's Channel would be to keep under the line until reaching the meridian of the Admiralty Islands, and then to steer southeast, passing between this group and Matthias Island. This route avoids the low islands and reefs, and on it sail can be carried during the night without fear.

The other route, north of the Solomon Islands, seems to be the best for those vessels to follow which are bound to New Zealand, to the Feejee Islands, or elsewhere to the east.

In going to New Zealand it is better not to cross the parallel of 10° of south latitude before reaching the meridian of 170° or 172° of east longitude. Afterwards the course is south along the western coasts of the Feejee Islands, which may be passed

very near; for the east winds extend very far to the southward during the months of January, February, and March. Keeping to windward of the reefs which surround the southern point of New Caledonia, the same course may be held until reaching the southern belt of variable winds.

On arriving at New Caledonia, or New Zealand, the voyage is short to the ports of the west coast of America, on account of the west winds that are met with south of the parallels of 28° and 29° of south latitude, which are in a measure constant winds, on account of their prevalence in this region.

Probably this route will in the end be the one most generally taken by vessels which, at all periods of the year, go from China or Manilla to the south coast of America, especially if they have very accurate charts of the western part of the Pacific Ocean.

Route from
Port Jackson
or Van Diemen's Land
to the coast
of America,
or of Europe.

The last part of the route pointed out above, for returning from China to the coast of America during the northeast monsoon, can be taken either to go from Port Jackson or Van Diemen's Land to ports in America, or to Europe, by doubling Cape Horn.

Several vessels have made the voyage from Port Jackson to Staten Island in 46 days. Captain Freycinet made the voyage from Van Diemen's Land to Terra del Fuego in 38 days. Leaving on the 29th of December, 1819, he was in sight of Terra del Fuego on the 4th of February, 1820. In this remarkable voyage, the corvette *Urania* kept between the parallels of 48° and 58° of south latitude, and, with the exception of a single day, when they blew from the southeast, the winds varied during the entire voyage from N. N. W. to S. S. W. passing through the west. The currents set constantly to the east and to the northeast, with a velocity of which the maximum was 70 miles in 24 hours, and the minimum 4 miles. The mean velocity of the current may be estimated, according to the observations, at 22 miles a day.*

When this route is taken to double Cape Horn, it must be remembered that summer is the most favorable season for leav-

* Freycinet, *Voyage of the Uranie and of the Physicienne*, from 1817 to 1820.

ing the Pacific Ocean, principally during the months of January and February, although this passage is generally so easy and so short that it may be undertaken at any period of the year.

We shall observe, while on this subject, that small vessels have a great advantage in passing through the Straits of Magellan from the Pacific into the Atlantic Ocean, especially now that there are accurate charts of this strait, and minute sailing directions.*

There must be, says Captain King, an undoubted advantage to be gained, to induce the navigator to involve himself in these channels, when he finds before him an open sea, with favorable winds.

On leaving the Straits of Magellan, the winds, being from the west, and more frequently north than south of west, are favorable for running along the coast; and in case they should not be so, there is no fear, as at a distance from the land, of meeting a very heavy sea, which might endanger a small vessel. It is comparatively smooth near the east coast of America.

On the other hand, the vessel which has doubled Cape Horn must, if the wind is northwest, run to the eastward of the Falkland Islands. She is then exposed to violent winds, which raise a terrible sea abeam. To make nothing, she must keep on a wind which again exposes her to a heavy sea.*

There is something gained, then, by small vessels, in giving the preference to the Straits of Magellan.

The great routes we have pointed out are sufficient to give a general idea of the navigation of the Pacific Ocean from west to east, and *vice versa*.

The changes necessary to adapt these routes to any particular port are easily made.

From the routes that we have given in the "General Examination of the Indian Ocean," while speaking of the navigation of that sea, it will be easy to determine which should be taken in going from the

Routes from India to the ports of the east coast of Australia.

* King, *Sailing Directions for the Coasts of Patagonia*, translated (into French) by M. Darondeau, Hydrographical Engineer.

different ports of India to Port Jackson, situated on the east coast of Australia. There are two routes to which we shall

Northern route. confine ourselves: one, the northern route, which leads into Torres Strait, ought to be taken from the beginning of September to the end of March, the period when the northwest monsoon blows in these latitudes; the other, the

Southern route. southern route, which goes round Australia to enter Bass's Strait, is taken from March to September, the

period when the southeast monsoon prevails in Torres Strait.

We shall give hereafter (page 113) directions for the navigation of Torres Strait, and for the east coast of Australia, or New South Wales.

In the southern route the object should be, when sailing from ports situated in the north of the Indian Ocean, to reach as soon as may be the zone of the trade-winds; to cross this zone rapidly in an oblique direction, inclining as much as possible to the west coast of Australia, and follow the south coast as far as Bass's Strait.

Coming from the Cape of Good Hope, the same route must be taken to cross the Indian Ocean from west to east, as to go to China by the great eastern passage.*

In this great eastern passage the Pacific Ocean may be entered, 1st. by passing to the south of Tasmania or Van Diemen's Land; 2d. by traversing Bass's Strait. We will give some information respecting these two passages.†

Route to the southward of Tasmania. If a vessel takes the southern route by Van Diemen's Land to enter the Pacific Ocean, a route often laborious and difficult, and longer than that by Bass's Strait, she should cross the parallel of 39° of south latitude well to the westward; when up to the meridian of 130° of east longitude, she should double the southern extremity of Van Diemen's Land, in such a manner as to reach the meridian of

* *General Examination of the Indian Ocean*, pp. 175, 176.

† *The Australia Directory*, published by the Admiralty, 3d edition, London, 1833. This work has since been translated (into French) by Captain A. Le Gras. See, for the winds in Bass's Strait, the *General Examination of the Indian Ocean*, 2d edition, p. 54.

144° east before making the land, in order to avoid falling in during the night with this dangerous and rocky coast. Care should be taken to avoid being carried on the coast by an error in the reckoning, or by a sudden gust of wind from the southwest blowing on shore.

After having rounded South Cape, if not bound to River Derwent, a berth of at least 24 or 30 miles should be given to Cape Pillar and to the east coast of Tasmania,—a distance sufficient to avoid the variable winds and calms which often render the situation of a ship very embarrassing near the land, while there is, at the same time, a good breeze in the offing. This is to be particularly observed during the summer, when the easterly winds prevail, and when, it is said, a current is found on the east coast of Tasmania and Australia, running north by east with a velocity of from three fourths of a mile to one mile an hour, between 7 and 20 leagues from land. On the other hand, inside of 7 leagues from the coast, it runs in a contrary direction, with a velocity about half as great as that we have just mentioned.

To enter the Pacific Ocean by Bass's Strait,* when nearly up to the meridian of 135° 40' east longitude, it will be best to keep on the parallel of King's Island. Thus the vessel will avoid being carried by a southeast wind, of which there is always danger, into the bay west of Cape Northumberland, or of being carried to the southward by strong winds from the N. N. E., often experienced west of Tasmania between the parallels of 40° and 44° south latitude.

Route by
Bass's Strait
from west
to east.

Approaching Bass's Strait from the west, it is not advisable to stand in for the coast of Australia, which is dangerous with southerly winds, on account of its being nearly destitute of anchorages sheltered against them. Winds from the southwest or south are particularly to be feared, and during the period when they most prevail a vessel should not pass north of the parallel of 40° south at least before being 40 leagues from King's Island. †

* The easterly variation in Bass's Strait varies from 7° 30' to 9° (1833.)

† *Australia Directory* n. 93 at sea

If the wind has a tendency to the northward, and if circumstances appear favorable for sighting the coast before night, it would be well on entering the straits, not being perfectly sure on this point, to steer so as to make the land on the meridian of 143° east. On this meridian there are some high white cliffs projecting considerably beyond the line of the coast, and there appears to be no danger in their vicinity at one and a half or two miles from land.

The west entrance of Bass's Strait is between the islands lying near the northwest point of Tasmania and Cape Otway in Australia. It is 36 leagues wide. King's Island is nearly in the centre, and occupies about 12 leagues of this entrance. The passage north of this island is 47 miles wide, and that to the southward but 37 miles. The latter, in which there are several dangers, is only used in case of necessity.

Approaching this strait from the west, it is advisable to sight the land as nearly as possible in the neighborhood of Cape Otway, because the lighthouse on this cape is very conspicuous.* If, however, the weather is thick, a depth of 60 fathoms, gray sand, will mark the right channel for the strait. The same depth with a rocky bottom is too far to the southward, and off the west coast of King's Island, which is rocky and very dangerous.

When sure of the position of the vessel at the entrance of the strait, steer to Curtis Island, which, from the deck of a vessel and in fair weather, is visible at a distance of 10 or 11 leagues. The distance from the entrance of the strait to this island being 40 or 50 leagues, and there being no danger on this route, a part of it may be run during the night, keeping a good look-out. Kent Group may be afterwards passed to the southward, at a distance of six miles at the most from Deal Island, the largest of the group. From this steer E. N. E. (by compass), or the course nearest this point, according to the prevailing wind,

* *Australia Directory*, p. 100, et seq. Besides the lighthouse at Otway, a fixed light was to be established on the north point of King's Island (Point Wickam); a beacon has been placed on Curtis Island; finally, there is also the revolving light of Deal Island (Kent Group).

being careful not to go too far to the north towards Long Beach.

The preceding directions are those of Captain Flinders; since they were published, the channel to the south of the Kent Group has been found to be strewn with so many dangerous rocks difficult to be seen, even in clear weather, that the best route to follow is that passing between Kent Group and Wright Rock, or the channel between the former and Hogan Group, leaving Curtis Island on the north. Crocodile Rock, between Curtis and Redondo Island, will be avoided by this course.

Near Wilson's Promontory the tides are so strong that nothing is gained by approaching it, except with a good breeze; in the event of a blow from the southeast, the situation of a vessel in its neighborhood would be equally bad, whether she had doubled the chain of islands situated at the entrance of the strait, or whether she had cleared one of the more southerly channels.

The most suitable places to anchor in the strait when bound east, are:—

Anchorage in
the strait with
east winds.

1st. Franklin Roads, under the northwest point of King's Island, where the sea is broken by the New-Year Islands, and where there is an indifferent shelter against east winds.

2d. Port Philip (the anchorage is just inside the entrance, and on the south side of the port; having a favorable wind, a vessel should sail *with* the tide, which runs strong).

3d. Hunter Islands (where the anchorage is between Three Hummocks and Hunter Islands, being careful not to get too near the weather-shore, lest there should be a sudden shift of wind).

4th. The bay contained between Wilson's Promontory and Cape Liptrap, which should only be resorted to in case of necessity (this anchorage is far from safe, and would be very dangerous if the winds blew strong from the southwest).

5th. Kent Group (suitable for brigs or small vessels, which may anchor in one of the little sandy bays situated in the eastern part of these islands).

6th. Furneaux Islands, between Clarke and Preservation Isl

ands. A vessel leaving this anchorage, and not able to double Clarke Island, and obliged to pass southeast of it, should, as soon as the wind becomes favorable, cross Armstrong Channel, sending a boat ahead to look out for dangers.

The information that we have here given is sufficient, with charts, for crossing Bass's Strait from west to east. The entrance of the strait contained between King's Island and Hunter's Islands (the passage south of King's Island), concerning which we have said nothing, ought not in general to be used, on account of Reid's, Bell's, and Conway's Rocks, situated in this passage. If, however, obliged to follow this route in crossing the strait, a vessel should pass to the southward of Reid Rocks, keeping near the Black Pyramid, and bringing it to bear N. 53° E. by compass, to clear the Bell and Conway submerged rocks. With a favorable and steady breeze, a vessel can pass between King's Island and Reid Rocks. In this case she would give the preference to the coast of the island, observing the effect of the current, which sets across the channel with considerable force. Reid Rocks always break.

Leaving Canton during the southwest monsoon, bound to the east coast of Australia, the shortest route would generally be the eastern, which enters into the Pacific Ocean by the straits of Formosa; the course is next to the eastward, enough to cross obliquely the belts of the northeast and southeast trade-winds, in such a manner as to arrive off the port of destination in Australia when on its parallel. This route offers no other difficulties than those of the navigation among the islands and archipelagos of the Pacific Ocean.

The same route will be, on the contrary, very difficult and very tedious in the northeast monsoon; for it will be necessary to pass out of the straits of Formosa to enter the Pacific Ocean, and to work to the northward and eastward until clear of the northeast trade-winds, and in the variable winds north of the parallel of 30° of

Passage to
the south of
King's Island.

Route from
the ports of
China to the
east coast of
Australia.

S. W. monsoon.

Route from
the ports of
China to the
east coast of
Australia.

N. E. monsoon.

north latitude, with which easting can be made; in all cases the object will be, on leaving the straits of Formosa, to make the shortest possible track through the trade-winds. Generally, the meridian of 165° of east longitude should be reached before turning south.

During the northeast monsoon, — that is, from September to February, — instead of taking this route, it will be better to keep in the China Sea, and thus avoid a great deal of bad weather, and make also a shorter voyage. The course is east of the great Natunas, then through the Carimata Passage; afterwards it runs for the east point of Madura, to pass between the islands of Pandy and Galion, and Bally's Straits, if preferred. It is better, however, to take Lombock's Strait, and better still to take the Strait of Allas.*

When clear of the straits, take advantage of the changes of wind in the Indian Ocean to work to the southward; since, at this season, the winds blow generally from S. S. W. to S. S. E. in the space which extends from the northern limit of the trade-winds to the eastern straits, it will be necessary to make a long circuit to the west to cross the belt of the trade-winds and reach the variable winds of the southern hemisphere; when in the variable winds, the progress eastward is easy. In the months of March and April a vessel can pass through Bass's Strait, or, if preferred, south of Van Diemen's Land, on account of the east winds which are frequent in the strait during these two months. In all the other months Bass's Strait must be taken as the most direct and shortest route.

On leaving Port Jackson, or the ports of the east coast of Australia, bound to India or to Europe, a vessel can pass through Bass's Strait or double the southern extremity of Van Diemen's Land, provided she sails between the beginning of September and the 1st of March. In January, February, and March, she will meet southeast winds in the neighborhood of Van

Return from the ports of the east coast of Australia to India.

Southern route.

From September to March.

* A vessel could also at the same period leave the sea of Java by Ombay Strait, and cross Torres Strait to reach Port Jackson.

Diemen's Land more frequently than in all the other months. These winds can be turned to account for running to the westward; it is necessary, however, to keep at a good distance from the south coast of Australia to profit by all the changes of wind, and to escape being wrecked by squalls from the southwest, which are frequent at this time.

Ships bound to Europe have also taken this route during the winter months of this hemisphere (June, July, August); bad weather rendered it very difficult, it is true, but not impossible, even at this season.

Vessels should get as soon as possible into the belt of the trade-winds of the Indian Ocean, and when there, take the most direct route for the port of destination; under favorable circumstances, the voyage from Port Jackson to Bengal is two months long; ships have taken 50 days to go from Bass's Strait to False Bay. The best passages have been made during the summer months (October, November, December).

We will now give directions for crossing Bass's Strait from east to west.

Passage of
Bass's Strait
from the east.

The entrance of Bass's Strait is comprised between Wilson's Promontory and the northeast cape of Tasmania or Van Diemen's Land. Between these two capes there are a great number of islands, of which the primitive formation is granite, making a chain of about forty leagues in extent.

The winds are generally favorable for crossing the strait from east to west, and for following along the coast, in the months of January, February, and March. The east winds are rarely felt at any other time; they come in gusts, and generally terminate with a breeze from the opposite direction, having much the character of a rotary tempest. The squalls which blow most particularly in the strait begin at N. N. W.,* turning gradually from west to southwest, where they cease. If the wind, before reaching the southwest, veers back to the north of west, the squall will con-

Favorable
season for
crossing the
strait from
east to west.

* See *Considerations on the Indian Ocean* for the winds on the Australian coasts Chap. I.

tinue. The barometer indicates perfectly these squalls ; it is seldom fine weather when the barometer falls to 29.88 inches, and bad weather is certain when it stands as low as 29.65.

We shall first observe, that during the three months of which we have just spoken, and during which the passage of Bass's Strait from east to west is the easiest, it is dangerous, if not impossible, for sailing vessels to cross Torres Strait from east to west. And we will next remark, that a vessel gains but little by being in Bass's Strait before the middle of December, and that it will be better not to arrive there before the middle of January.

On leaving Port Jackson, or any other port of the east coast of Australia, make Cape Howe the point of departure.* The course then must not be farther to the W. than S. S. W., by compass, until reaching $39^{\circ} 33'$ south latitude, on account of danger near Long Beach with southeast winds. When on the parallel of $39^{\circ} 30'$ south latitude, the course is nearly west by south, by compass, leaving the Sisters' Rocks, Craggy Rock, and Wright Rock on the port hand ; then run to make Deal Island, the most easterly of the Kent Group, which, in clear weather, can be seen from the deck of the vessel at 10 and even 12 leagues' distance. In the day-time steer for this island, and at night for the revolving light which marks it, and may be seen nearly at a distance of 26 miles. The ship will pass 3 or 4 miles to the southward of this island, and as she goes westward she will sight in succession the other islands of the group to the southward, and will pass them at the same distance. Do the same with regard to Curtis Island and Sugar-Loaf Rock, which will then be in sight. From Curtis Island to the northern extremity of King's Island, the course is about west by south, by compass, and the distance is 42 leagues ; no danger exists here ; it is, however, better to steer, if the wind permits, so as to pass 5 or 6 leagues north of King's Island. If the wind is west of north, a ship may run in safety for Three-Hummocks Island, and pass either to the north or south of King's Island, accord

* On this cape there is a fixed light, visible at a distance of 24 miles.

ing to the wind. A good look-out must be kept for three small islands, reported by the French corvette *Géographe*, in $39^{\circ} 53'$ south latitude, about 13 leagues to the west of Sea-Elephant Bay. (These islands appear to be doubtful.)

Anchorage in the strait with west winds. In case of contrary winds, if the weather be dark or rainy, and there is a fear of the winds becoming steady at southwest and blowing strong, there are some anchorages where a ship may wait for a change of weather. The following are the best: —

1st. The west bight of Erith Island, one of the islands of the Kent Group.

2d. Hamilton Roads, at the eastern extremity of Preservation Island.

3d. On the south side of the largest of the Swan Islands (only suitable for small vessels), and under Waterhouse Island.

4th. Port Dalrymple.

5th. Port Sorrel, accessible only to small vessels.

6th. Some bays of the Hunter group.

7th. Sea-Elephant Bay, on the east coast of King's Island, where a ship can water; the anchorage is under the northeast point of this island, when the wind is from the southwest.

8th. Western Port, sheltered by Grant Island, in which the vessel must drop anchor as soon as inside; the wind that is fair for passing through the strait is favorable also for leaving the port.

9th. Port Philip.

As the ports of which we have spoken are only sheltered by certain winds, and those very variable in Bass's Strait, the ship must always be ready to make sail if necessary.

Finally, the navigation of Bass's Strait requires care and a good look-out.

Northern route by Torres Strait. From March to September the voyage from Port Jackson to Bengal, or to the way-ports, may be made through Torres Strait. In this route the ship should From March to September. run to the north along the coast of Australia as far as Sandy Cape; then she will take the inside route. If she takes the outside route, she must, on leaving Port Jackson, run for

the meridian of 155°, and pass to the west of Howe Island and Middleton Island; she should then steer to the northward, carefully avoiding Wreck Reefs, and Bampton, Minerva, Bellona, Ball, Kenn, Frederic, etc. Banks, among which are passed Lamb Island and Bass Island. These banks and islands are situated between the parallels of 24° and 20° south latitude. Allowance must also be made for a northwest current of at least one mile an hour. After doubling round Wreck Reefs, steer to pass 60 miles to the east of Diana Bank; then enter Torres Strait, for the navigation of which we will give particular directions.*

DIVISION II.

The navigation of Torres Strait, one of those that connect the Indian with the Pacific Ocean, has for many years possessed great importance; and as the number of vessels taking this route increases every day, we think it will be useful to collect and combine all the information scattered through the *Nautical Magazine*, in such a manner as to give to seamen as complete an idea as possible of the navigation of this strait. The following translation is drawn up from the directions of Captains P. King, Blackwood, and Yule,† who made the surveys and charts of this dangerous region. We have confined ourselves to copying them verbatim, while mixing them together.

Navigation in Torres Strait, and routes by this strait from India to ports on the east coast of Australia, and back.

As we have said (pages 104, 112), Torres Strait may often be taken with advantage in the routes for going from the ports of

* To follow these directions it is necessary to consult the following English charts:—

1st. Chart of Australia, No. 1042 of Hydrographic Office.

2d. Endeavor Strait, No. 1748, Hydrographic Office.

3d. Torres Strait, Bligh Channel, No. 1792, Hydrographic Office.

4th. Barrier Reefs from Raine Island to Cape York, No. 1749, Hydrographic Office.

5th. Charts Nos. 1068, 1075, 1076, and 1077, of Flinders and King.

6th. Chart No. 1091, French Hydrography.

† King's *Directions* had not then been translated; those of Blackwood and Yule had been, in the *Mélanges Hydrographiques*, vols. ii. and iii. pp. 7 and 216, by M. Daron dean, Hydrographical Engineer.

India to those of the east coast of Australia and back. It was long believed that it was impossible to get through this strait during the northwest monsoon; the examination of it made by Captain Blackwood has demonstrated that this is a mistake.

On coming from the Indian Ocean into the Pacific Ocean, through Torres Strait, there are two routes that may be taken from Cape York to the ports of the east coast of Australia; the

Inner route. first, the inner route, follows the east coast of this continent from Cape York as far as the reef of Break-

Sea-Spit, which makes out from Sandy Cape to the northward;

Outer route. the second, the outer route, leads out of the Barrier

Reefs to the northward of Darnley Island, through Bligh Passage, or through the passages north and south of Raine Island. When outside of the Barrier Reefs, the vessel takes, in reverse, the route that we have already laid down (page 112); that is, she passes east of Diana Shoal, between Albert's Reef* on the west and Mellish's Keys to the east, and shapes a course to pass to the eastward of Kenn's Reef, Wreck Reef, and Cato's Reef, up to the parallel of Sandy Cape, south of which she finds an open sea.

Sailing from the ports of the east coast of Australia for India, the inner route may be followed up to Cape York, or the outer route, taking Bligh Channel or the passages of Raine Island.

“Opinions are divided † on the subject of the respective advantages of the two routes we have just described; for a quick passage the outer route is certainly preferable, but, all circumstances considered, the inner route is generally regarded as the safest.

“It appears to me that the inshore track of Captain King should be followed if in a steam-vessel, at all times, as the small delay occasioned by anchoring for the first five or six nights would be amply compensated by the rapid runs she would make during the day-time in the smooth water of that sheltered track, and the distance from Cape York to Sydney being not two thou-

* On chart No. 1092 of the French Hydrographic Bureau, this bank is called *Alert's Reef*; it is north of Farquhar Group and Vine's Bank.

† *Directions of Captain Blackwood, Nautical Magazine for 1845, p. 688.*

sand miles, she ought certainly to perform that distance in a fortnight, taking also into consideration any adverse gales that she might meet with when in the vicinity of Sydney during the winter season.

“ If in a sailing vessel I would recommend steering out of Torres Straits by the passage (lately surveyed by H. M. ships *Fly* and *Bramble**) north of Darnley Island, which has the peculiar advantage of clear ground in every part for the purpose of anchoring, and of being quite devoid of sunken coral patches.

“ If furnished with the charts executed by H. M. surveying vessels in 1844, I cannot conceive that, with common caution, a vessel should meet with accident in sailing out by ‘Raines Island Beacon’; but this latter passage has the disadvantage of foul ground to anchor in, in the space between the Bird Isles and Raines Island, although the route is the shorter of the two in point of distance.

“ Opinions are divided as to which is the most preferable track to follow when passing through Torres Straits from east to west, or the return passage from Sydney to India; but there can be no question, (if speed be an object,) that in the height of the southeast trade, or from May to September, the passage entering either by Raines Island Beacon or by Bligh’s Entrance, north of Darnley Island, may be performed in half the space of time that it takes to follow the inshore route, along the coast; and such being the fact, it will be the passage most generally used by the merchant-shipping, to whom a speedy market is of the last importance.

“ A steam-vessel will have the great advantage also of being able to perform this return route through Torres Straits in the westerly monsoon, or from November to March, at a time when impracticable for sailing-vessels, and I think that in all cases her best track will be the inshore passage of Captain King, especially as she may supply herself with wood fuel at any part of the east coast. I can see no reason why her return passage from Sydney

* Ships belonging to the expedition under Captain Blackwood’s command.

should occupy more than five weeks to Singapore, as she will certainly carry up the southeast trade to the latitude of 14° or 15° S., when she may meet with the westerly wind."

We have thought that these views of Captain Blackwood would be useful in giving seamen a general idea of the navigation of Torres Strait.

General remarks.—
Winds.

"Hitherto Torres Strait has only been navigated generally by ships passing from east to west, but on three or four occasions vessels have sailed through in the opposite direction. This passage, however, has always been attended with great delay, as it was found that the westerly monsoon, which prevails from November to March, inclusive, in the seas of the Indian Archipelago, does not blow steadily within Torres Straits, where it only appears in spurts of eight or ten days' duration about the change of the moon. Occasionally these westerly winds blow with considerable strength, but they are usually unsteady,—in fact, mere interruptions of the southeast trade-wind. These spurts may be expected in November and in the following months until March. Sometimes, but rarely, they are encountered as late as April. The question of winds is, however, of little importance when steam routes are under consideration, especially on the present occasion, as parties interested will be satisfied on learning that no winds have ever yet been experienced in Torres Strait which are calculated to interfere materially with the progress of steamers in either direction.

"The easterly trade-wind prevails throughout the year in the sea contiguous to the northeast coast of Australia. From May to September, inclusive, it blows generally from E. S. E. to S. S. E., strong and steady. During the remaining months of the year, the trade-wind becomes light, and draws more to the northward, sometimes blowing for several days from E. N. E. and N. E. In January, February, and March, spurts of short duration from the northwest may be expected about the change of the moon, sometimes in strong gusts, but generally moderate with clear weather. The writer has already alluded to a spurt

of northwest wind which he met with in the end of April, 1844, in lat. 19°, but they rarely occur so late in the season.

“ On the east coast of Australia, between Moreton Bay and Sydney, westerly winds prevail from May to September, the winter months of the southern hemisphere. Gales are of common occurrence at this season ; but, as the wind blows from the land, the water is smooth, and they offer little obstruction to steam navigation. During the summer months the wind is generally from the eastern quarter, assuming in a great degree the character of a trade-wind.

“ The currents on this coast are chiefly influenced by the trade-wind. The stream from the eastward ^{Currents.} divides at Break-Sea Spit, when one portion runs to the north-west towards Torres Strait, and the other curves to the south along the east coast until it reaches Cape Howe, when it unites with the body of water forced through Bass Strait by the westerly winds, and runs eastward again towards the south end of New Zealand.” *

“ If a ship be proceeding from Madras or Calcutta through Torres Straits, she will doubtless go down the Bay of Bengal, round the west coast of Sumatra ; but if from Singapore or China, she would probably find Allas Straits the best passage to go through, as good anchorage is to be obtained all along the western or Lombock side of the strait, at a distance of two miles from the shore. †

Routes for
Torres Strait
during the
N.W. monsoon,
coming from
the Indian
Ocean.

“ Having cleared the straits of Allas, a course may be shaped to pass to the southward of Sandal-wood Island and Rottee, (both of which points are very accurately placed in the charts,) at a reasonable distance from the latter, so as to avoid the Sahul Shoal, parts of which are dangerous to approach. The strait of Rottee is safe to sail through, although Captain Laws reports a danger in it, the position of which should of course be avoided by keeping on the north side of the strait.

* G. W. Earle. (See what we have said of the winds and currents on the coasts of Australia, p. 57 et seq. and p. 71 et seq.)

† Blackwood.

“ Coupang Bay is a good anchorage during the east monsoon ; but in the west it is unsafe, and I believe but few ships lay there during the latter period.

“ From the south end of Rottee a direct course may be shaped for Wallis Islands, at the western extreme of Endeavor Straits, avoiding one or two coral banks, on which both Captain Flinders and ourselves got soundings ; they are small in extent, but less water might possibly exist in parts which were not tried by the lead.” *

Captain Mackenzie says, on the contrary, that ships sailing from India or China for Torres Strait would do well to keep on in Java Sea, shaping their course to the north of the Sunda Islands, until they leave it by the passage between Ombay and Pulo Kaming. During the two monsoons, Captain Mackenzie says, the water is smooth in Java Sea and the Moluccas, compared with what is found south of the Sunda Islands and in the Sea of Timor, on account of the heavy swell from the southwest usually encountered there. Sailing vessels will have, moreover, in keeping in Java Sea, the advantage of meeting with land-breezes near the north coast of the Sunda Islands. On leaving Ombay they will take a direct course for Torres Strait.

According to this, vessels leaving India ought to pass through the straits of Malacca for Singapore and the Java Sea ; cross this sea, leaving it by Ombay Strait, or by passing between Timor and Wetta, and keep in Timor Sea as far as Torres Strait. This route appears particularly advantageous for steamers.

This opinion of Captain Mackenzie is confirmed by the following information : † it will complete what we have already said of the navigation of Java Sea. ‡

* Flinders' Bank (15 fms. coral bottom), $9^{\circ} 56'$ south latitude, $129^{\circ} 35' 8''$ east longitude ; Fly Bank (12 fms. coral bottom), $9^{\circ} 52'$ south latitude, $128^{\circ} 39'$ east longitude.

† We borrow this information from the *Nautical Magazine* of 1853, p. 113. We sum up whatever will be really useful of the very long directions given in this publication by Captain G. W. Earle. We shall put into notes the descriptive part of the English directions, so as to separate the routes from all accompanying details.

‡ *Considérations générales sur l'Océan Indien*, p. 199 et seq.

To go from Singapore to Port Jackson, through Java Sea and Torres Strait, two routes may be taken, known under the names of southern and northern routes.

Routes for a steamer from Singapore to Port Jackson through Java Sea and Torres Strait.

“With the exception of the strait between Celebes and Salayer, on the northern track through the Java Sea, and the passages through the islands east of Madura on the southern track, there are no channels throughout the route so contracted as to render the navigation difficult either during night or day; and by properly timing the departure of a steamer from either terminus, (a process with which steam navigators in the Indian Seas are familiar,) it can be so arranged that the former may be passed during daylight. It should be observed that no weather is likely to be experienced throughout the route sufficiently boisterous to retard the speed of steamers of a large class, and thereby interfere materially with calculations made previous to starting.

“About eight o’clock in the evening is the time best suited for the sailing of the vessel from Singapore, and as the steamers with the outward mails from Europe so time their departure from Penang as to arrive at Singapore almost invariably at ten or eleven o’clock in the forenoon, this arrangement will afford ample time for transferring the mails and embarking passengers. From the outer roads the course is E. by N. to

“Pedra Branca, (32 miles,) a detached rock, twenty-four feet in height above the level of the sea, situated nearly in the centre of the eastern entrance of the Strait of Malacca, which has been the leading mark for vessels entering or leaving the strait for ages past. The main channel, which lies immediately to the north of the rock, is four miles wide in the narrowest part. A lighthouse of dressed granite, seventy-five feet in height, has recently been erected on the summit of the rock, which is probably the most perfect of the kind that has ever been constructed to the eastward of the Cape of Good Hope. The light, which has been regularly illuminated since the 15th of October, 1851, is on the revolving principle, attaining its greatest brilliance once a minute. It is visible from the deck

of a ship at a distance of fifteen miles, when it disappears below the horizon; but it may be seen much farther from the mast-head, as its brilliancy is so great that the horizon is the only limit to its range. The reefs and dangers which beset the eastern entrance of the Strait of Malacca are all within the influence of the light as visible from a ship's deck. It has been named the 'Horsburgh Lighthouse,' as an appropriate tribute to the memory of one who labored so indefatigably in facilitating the navigation of the neighboring seas.

"From Pedra Branca, the course is about S. E. by E. 315 miles, with soundings of twenty-five to thirty fathoms mud, to

Carimata Passage. "The Carimata Group, (347 miles,) a cluster of islands lying at the northern entrance of the strait between Borneo and Billiton, commonly called the Carimata Passage.*

"The most frequented track through the Carimata Passage lies to the south of Souroutou, the channel between it and Ontario Reef being somewhat less than twenty miles in breadth. When the peak on Carimata comes to bear N. N. W., a S. S. E. course, which will bring the peak right astern, leads clear through the strait, about mid-channel between the Mancap Shoals, which extend from the southwest point of Borneo, and the reefs on the eastern side of the strait. The east island of the Montaran Group may be seen in clear weather from the masthead while passing; but as the Peak of Carimata will be still visible, no other leading mark is necessary. The depth of water throughout the passage varies from fifteen to twenty fathoms mud.

* "Carimata, the principal island of the group, is fifteen miles in circumference, and consists of high land, with a peak near the centre, upwards of 2,000 feet in elevation, which is visible in clear weather at a distance of fifty miles. Souroutou is also high, but more level, with a hummock near the western extreme, which is visible at a distance of twenty-five to thirty miles. The strait which separates it from the southwest end of Carimata is two miles and a half wide. I passed through this strait in 1834, and had regular soundings in eight or nine fathoms; but it has never been fully surveyed, and as a steamer has the advantage over sailing vessels in being able to pursue a straight course, without having to make short cuts through the islands to avoid detention by contrary winds, there will never be any occasion to go out of the beaten track."

“After passing through the Carimata Passage, the navigator has the choice of two beaten tracks to the eastward, which unite at Pulo Kambing on the north coast of Timor, each of which has its peculiar advantages at certain seasons. During the prevalence of the easterly monsoon, from April to September inclusive, the southern track, along the north side of the islands east of Java, is to be preferred by steamers bound to the eastward, as during this season the current generally runs in that direction, after passing Bali, at the rate of between one and one and a half knots an hour. The northern track, by the Strait of Salayer, has the advantage in point of distance by about thirty miles; and as the westerly monsoon, which prevails from October to March, is often attended by squalls and heavy rain among the islands east of Java, while the northern track enjoys comparatively fine weather, the latter is likely to be preferred by steamers passing in either direction during that season.”

The southern route to be taken during the easterly monsoon.

The northern route to be taken during the westerly monsoon.

On leaving the Carimata Passage, if the southern route is taken, steer directly for the island of Bawian.*

Southern route in Java Sea.

“If the steamer does not arrive abreast of Bawian until after dark, it will be best to steer for Pondy, off the east end of Madura, so as to pass through the channel between it and Gilion † soon after daybreak. If, on the other hand, Bawian is passed before dark, the better course will be to steer for the northwest end of Kangelang, which will afford a clear run during the night, and the channel between that island and Urk may be adopted. Both these passages are thoroughly well known, and are much frequented by shipping. ‡

Island of Bawian.

* “Bawian, 705 miles. Lubek of the old charts, an island about thirty miles in circumference, consisting of a central mass of hilly land about 2,000 feet in elevation, with plains of small extent at its base.”

† Gilion, or Gili-Yang. The word *gili*, in the language of Madura, means island.

‡ Pondy (807 miles from Singapore) is about nine miles in circumference. It is a table land varying in height between 80 and 150 feet, bounded on the sea-coast by steep cliffs.

The Island of Galion (so called on the French charts) is more than double the size

“The passage between Pandy and Galion, or Gili-Yang, is generally adopted by ships from Bali Strait bound to Singapore and China, and by the Dutch Company’s ships bound to Banyu-Wangi, to fill up with coffee previous to their homeward voyage.”

“Soon after passing through the islands east of Madura, the depth of the sea becomes unfathomable, and the route during the ensuing four days will lie across the volcanic gorge which separates the continent of Asia from that of Australia. A course should now be steered to reach the parallel of 8° S. when abreast of the northwest extreme of Sumbawa, from which point a due east course along the same parallel will lead clear to the Ombay passage, where the track joins the northern route by the Strait of Salayer.* The landmarks on this part of the route are highly

of Pandy, and differs in appearance, as the hills slope gradually down to the sea-shore.

Kangelang, or Kangeang, is visible from a ship’s deck at a distance of 30 miles. The channel between this island and Urk is 10 miles wide, and perfectly safe, with 40 to 53 fathoms in mid-channel; care must be taken to avoid the Takat Shoal (Four Brothers of the Charts), a coral reef with three low sand-banks upon it; but as it is distant nearly 20 miles from Kangeang, only ordinary precautions are necessary. — G. W. EARLE.

* Flat Island (1,018 miles from Singapore), lying to the north of Sumbawa, in 8° 8' south latitude and 117° 23' east longitude, is visible from the deck of a ship at the distance of 16 miles. As its summit is nearly level, it is not always easily distinguished at night.

The Shoal of Maria-Reygersbergen (a Dutch shoal, doubtful on the chart No. 926 of the French Hydrographic Bureau), which lies northwest of Flat Island, in 7° 56' south latitude, was examined in 1825 by a Dutch cruiser, who placed it in 7° 51' 30" south latitude, so that the passage between Flat Island and this shoal would be about 16 miles wide.

The great mountain of Timboro, on the north coast of Sumbawa, is 35 miles to the east of Flat Island. It is an excellent landmark. (On the chart No. 926, this mountain, called Tombara, is only 24 miles east of Flat Island.)

Bima (1,108 miles from Singapore) is a Dutch settlement, situated in the southeast part of a deep bay on the north coast of Sumbawa. It may be considered as the capital of the island.

The double-peaked volcanic island which lies close to the northeast extreme of Sumbawa, is a noted landmark. (It is probably the Island of Goonong-Apee that Earle speaks of.) The northern peak is an active volcano.

Rusa-Lingit (1,300 miles from Singapore) is also an excellent mark, being high and steep-to. A reef, called Bangalore Shoal, had been placed on the charts about 20

conspicuous. The peak on the east end of Lombok is visible at an immense distance, and it is a useful mark for vessels passing along the islands east of Java. The northern shores of these islands are generally bold, and steep-to, with no soundings a mile off shore. The shoals laid down in some of the charts off the north coast of Lombok, marked *doubtful*, have been repeatedly sought for without success by Dutch cruisers, so that it may be safely said that they do not exist.”

When clear of Carimata Passage, having taken the northern route to go east in Java Sea, steer for the Group of Solombo, or Nuso-Lombo (782 miles from Singapore). The principal island, Great Solombo, is about twenty miles in circumference, consisting in a hill of singular form, with a broad, level summit. Passing to the south of Great Solombo, at a distance of ten miles, an east course leads up to Point Layken, the southwestern extremity of Celebes.*

miles to the northwest of this island. It is now pretty well ascertained that the *Bangalore* must have been wrecked on Angelica Shoal, which lies 30 miles to the northeast of Rusa-Lingit (Rusa-Linguette of chart No. 926 of the French Hydrographic Bureau. The Angelica Shoal is not laid down on that chart). H. M. sloop *Haai* ran aground on this bank in December, 1846, but she succeeded in getting off. When aground, Iron-head (the northeast extremity of Flores) bore S. 63° 30' E.; Llimandiri Peak, S. 52° E.; Lobetobie Peak, S. 32° E.; Rusa-Linguette Peak, S. 30° W. (by compass), and latitude observed 7° 48' 30" S. Earle gives several other bearings taken by the sloop. Some of these bearings appear to be wrong; but three of them intersect 24 miles from Rusa-Linguette. Angelica Reef seems about four miles in extent, and is divided by two channels running north and south; in the centre are some rocks above water.

Iron Cape (Tanjong-Bunga, or Cape of Flowers) is a high, bold promontory, forming the northeast extremity of Flores. The chief settlement is at Larentuka, in the strait which separates Flores from Sodor and Adenara. This spot has been recommended as a coal depot. — G. W. EARLE.

* At a distance of 150 miles to the eastward of Solombo, the soundings increase to 60, 100, and 130 fathoms; but when to the southeast of the rocks called the Hen and Chicks, they decrease suddenly to 15 and 16 fathoms; after which they become variable; in some places there is no bottom until near the point of Celebes. These overfalls are startling to strangers, though there is no real danger in the route that crosses the banks, for it has been carefully explored.

In clear weather Lumpo-Batang, or Bonthain Hill, which is an immense mountain with a rounded summit, will be perceived before the low lands. It is usually enveloped in clouds.

Tanakeke, a little island off the southwest extreme of Celebes, is low and level,

“When abreast of Bonthain Hill, the centre of the channel between Middle and South Islands in Salayer Strait should be brought to bear due east before steering for it, in order to pass to the north of Mansfield Bank, which is said to have only $3\frac{1}{2}$ fathoms water upon it in some places.

“Salayer Strait (1,139 miles). The most frequent track through the strait lies between Middle and South Island, the channel being four miles wide, and clear of dangers. There are passages through the other channels, which, although sometimes used by the country vessels, have not been thoroughly explored. To the eastward of this strait, and throughout the Moluccas, the westerly monsoon is the fine season, this part of the archipelago being supplied with moisture by the rain-clouds brought from the Pacific by the easterly winds which prevail from April to September inclusive. Salayer is also the eastern boundary of the Great Asiatic Bank in this latitude, for after passing through the strait the sea becomes unfathomable, and continues so until the Great Australian Bank is reached.

“When clear through the strait, an east course may be continued until the high peak of Kambyna bears northwest, when S. E. by E. leads direct to the passage between Ombay and Pulo Kambing. The only land near this part of the track is Hagedis or Lizard Island (1,272 miles), which is low, but well wooded, and is visible from the deck at a distance of 20 to 25 miles.”

The passage from Salayer Strait to Pulo Kambing occupies ten days.

and may be seen at a distance of 15 or 20 miles. The channel between the island and the mainland affords all the year round excellent anchorage in eight or nine fathoms.

Near the south coast of Celebes the soundings increase gradually from the shore, which may be approached with safety, as the water is sufficiently clear to show any danger that may exist. Bonthain is a Dutch settlement; there is anchorage in $6\frac{1}{2}$ fathoms, with the flag-staff northeast, and the extremes of Celebes E. by S. $\frac{1}{4}$ S. and S. by W. $\frac{1}{2}$ W.

Bulu-Kamba, also a Dutch port, lies 15 miles east of Bonthain. The anchorage is preferable to that of Bonthain, during the strength of the easterly monsoon, as it is more sheltered; but the latter has the advantage during the westerly monsoon. — G. W. EARLE.

“Pulo Kambing, or Passage Island, (1,520 miles southern track, 1,490 miles northern track,) is one of the most noted landmarks in this part of the world, being ^{Pulo Kambing.} situated at a point where two frequented tracks cross each other. The island is about 25 miles in circumference, with steep wall-like sides, crowned by a peak about 2,500 feet high. There is no anchorage near the island, owing to the depth of the sea, which is sometimes unfathomable at a distance of only two ships' length from the shore.

“The channel between Kambing and Ombay is eighteen miles, and that between Kambing and Babi, eight miles wide. Both are clear of danger, and may be adopted according to the convenience of the navigator.*

“The channel between Wetta and Timor is wide, and perfectly clear of danger. There are small fringing reefs on the shores of both islands, but generally the sea is unfathomable at a distance of a quarter of a mile from the coast. The land on both sides is exceedingly high, and as there is generally a dense haze near the surface of the sea during the heat of the day, its outline is often more clearly distinguishable during the night.

“Pulo Jaki (1,513 miles southern track, 1,553 miles northern track) is low and level, with a fringing reef. The strait between the island and the East Point of Timor is narrow, but safe, with anchorage under the Timor shore.”

Kissa, and the east end of Timor, form a channel 18 miles wide, which is safe, as is also the channel between Jaki and Jeti.

To come out of Java Sea any of these channels may be taken that is most convenient.

“After leaving Timor, no land will be seen until Torres Strait is reached, unless it be deemed advisable to make Cape Wessel, a precaution by no means necessary, as the soundings decrease gradually as the strait is approached, thus affording sufficient

* “Dilli, the capital of the Portuguese possessions in Timor and Solor, lies fifteen miles south of Kambing. It is a reef harbor, easy of access, perfectly sheltered, and exceedingly well adapted for a coal depot, should such be required.” — G. W. EARI.

warning to the navigator ; while the latitude can always be obtained at least once in the twenty-four hours, for it has been generally remarked that during the westerly monsoon, (the only season in which the sun is likely to be obscured,) when the day has been overcast, the night has invariably been clear, or *vice versa*. For the first 200 miles after leaving Timor, the sea continues unfathomable, but soon after attaining this distance, soundings will be struck in 130 to 150 fathoms on the Great Australian Bank, which decrease gradually to nine fathoms near the entrance of Endeavor Strait. There are several coral patches to the south of the track, about the parallel of 10° , but none of these have less than seven fathoms water upon them, with the exception of the Money Bank, which was discovered by the ship *William Money* in 1841, and was afterwards passed over by several of the ships employed in conveying H. M. 80th regiment to India in 1844. The least depth on the bank is four and a half fathoms. Victoria Rock, the only danger north of the track until Torres Strait is approached, was discovered by a steamer of that name while on her voyage from Sydney to Singapore in 1843. The boat was sent to examine it, and only six feet water was found on the shallowest part. On approaching Torres Strait, it will be well to get at once into the parallel of the western entrance of Endeavor Strait ($10^{\circ} 45'$ to $10^{\circ} 50'$ S.), in order to avoid some dangers said to exist to the eastward of Booby Island, called the Aurora and Proudfoot Shoals. These are laid down respectively in long. $141^{\circ} 7'$ and $141^{\circ} 33'$ E. in the parallel of $10^{\circ} 33'$ S., but on what authority is not distinctly known."

Navigators differ on the question of which should be preferred to enter Torres Strait by, — Endeavor Strait or the channel to the north of the Prince of Wales Group. The latter, of which we will speak hereafter, seems to be especially adapted to sailing-vessels of great burden ; for steamers Endeavor Strait seems most suitable, particularly if a coal depot should be established, as is proposed, at Albany Island.

We will now return to Blackwood's directions.

“ In steering in for Endeavor Strait from the westward, in the parallel of $10^{\circ} 50'$ S. the high land of Prince of Wales Islands will first be seen at a distance of 20 ^{Endeavor Strait.} to 25 miles, extending from N. E. to E. N. E., and when at a distance of 11 or 12 miles, the northern Wallis Isle* should be seen from the masthead, bearing S. 75° E., and Booby Island bearing N. 5° E.

“ The northern Wallis Isle first makes as two detached islets, separated about a ship's length from each other, the southern being the larger of the two.

“ The southern Wallis Isle is low, flat, and woody; the highest trees being on its northern extreme.

“ The northern and southern Wallis Isles are separated by a channel of five miles in extent, which is not safe to pass through, nor should it be attempted south of the Wallis Islands, between them and the mainland, that channel being full of shoals.

“ The soundings will be very regular in approaching the strait, gradually decreasing to five and a half fathoms (sand), which will be the depth at the extreme of the sandy spit, which runs out due west, six miles from the north Wallis Isle.

“ To avoid this danger, bring the northern Wallis Isle to bear E. by S. $\frac{1}{2}$ S.; when at a distance of eight or nine miles from the isle, steer in a due east course; this will lead clear of the sandy spit running out from the north Wallis Isle, on the extreme of which there are only two fathoms, and when two or three miles are run on this course, and north Wallis Island brought to bear southeast, six and seven fathoms will be ob-

* “ Red Wallis (2,493 miles southern track, 2,463 miles northern track), one of the landmarks for the western entrance of Endeavor Strait, is a rocky island, about a mile in circumference, and very scantily clothed with vegetation, the red stone and earth of which it consists giving it the appearance from which it derives its name. Woody Wallis, which lies about a mile and a half to the south, is somewhat larger, and is covered with stunted trees. These islands are visible from a ship's deck at a distance of fifteen miles. From Red Wallis to the site of the proposed depot for fuel at Port Albany, the distance is thirty-seven miles, which will make the entire distance from Singapore to Cape York 2,500 miles by the northern track through the Strait of Salayer, and 2,530 miles by the southern track along the islands east of Java.” — G. W. EARLE.

tained, and the narrow part of the channel passed through Cape Cornwall should now be seen bearing E. N. E.

“ A careful eye will clearly make out the discolored water in the vicinity of the spit, and if there be much sea on, it will show itself by a heavy break: should it be necessary to tack when near the western extreme of this spit, keep the lead actively going, as the channel is there only two miles across and bounded by a sandy ledge on the northern side similar in features to the spit above named, only that it is not so shoal, having three fathoms in one spot only.* After entering a mile or two, the channel widens out to three or four miles.

“ Having brought the northern Wallis Isle to bear south, steer a N. E. by E. course to pass a mile or two south of Cape Cornwall.

“ Endeavor Strait is perfectly clear of sunken dangers † or foul ground, having an average depth of from seven to eight fathoms, coral sand, all over the strait.

Entrance
Island. “ The course from north Wallis Isle to Entrance
Isle is E. N. E., and the distance seventeen miles. Entrance Isle is the northernmost of the Possession Isles, and the passage south of this island is perhaps the best for sailing out of Endeavor Straits by; it is full two miles wide on an average depth of nine fathoms, sandy bottom, and clear of sunken dangers. † The two other channels between the southern islands

* This bank, on which the soundings vary from 2½ fathoms to 2 fathoms, projects from the west coast of Prince of Wales Island, and runs out west in a point as far as the extremity of the bank of north Wallis Island, and forms with the northern edge of the latter the west entrance to Endeavor Strait. It is called Rothsay Bank. Endeavor Strait may also be entered by bringing Cape Cornwall, known by the peaked hill on its extremity, to bear N. 78° E. (English Chart, No. 1748.) — *Added by the Author.*

† Captain Mackenzie shows that there are four sunken rocks in this strait, as well as a rock under water situated between Entrance Island and the little island called Woody Island, one of those that form the east coast of the channel of Entrance Island. These rocks were seen by the ship-of-war *Rattlesnake*, subsequently to Blackwood's survey.

It will be well to point out their position nearly as laid down in Blackwood's Chart, No. 1748, corrected in 1854. Southeast of Cape Cornwall there are three spurs of rock, covered with five fathoms of water. The most distant is 2½ miles

of the Possession Group are equally safe and clear of shoals, although not quite so broad.

“Entrance Island may be known by having a high rounded hill on its northeastern extremity.

“The tides sometimes set through these channels with considerable strength, as much as five knots at ^{Currents.} the springs; the ebb tide setting to the N. E. and N. N. E., the flood to the S. W. and S. S. W., it being high water at full, and change at one o'clock, the rise of tide being nine feet six inches.

“Having passed out of Endeavor Strait by any of the passages above named, it is optional to sail through Torres Straits either by Raines islet beacon or by the route through the northern part of the strait going out by Darnley Island (lately surveyed by H. M. ships *Fly* and *Bramble*), which is in every respect a safe and practicable passage in both monsoons, and has the great advantage of the ground being perfectly clear of sunken dangers.”

We will now give the directions of Lieutenant Yule* for crossing Endeavor Strait from east to west, after reaching Cape York, if this strait is preferred to Prince of Wales Channel, concerning which last we give (page 130) some information.

“Coming from the southeast with a ship drawing more than fifteen feet of water, it is necessary after passing the channel between the Brothers and Albany Islands, to keep a good lookout for a rock situated nearly in mid-channel between Mount Adolphus and Cape York. (This rock, which was examined by an officer of the *Fly*, has four fathoms on it. Blackwood's Chart, No. 1748, gives only three fathoms.)

“When this danger is passed, stand on direct for Endeavor Strait, which can be entered by either of the three channels we

from the Cape. Northeast of these rocks, and nearer the shore, is Eagle Rock, on which there is only one fathom of water. Near this there is a second spur, with $2\frac{1}{2}$ fathoms of water. Heroine Rock, on which there is one fathom, is about $2\frac{1}{2}$ miles S. S. E. of Entrance Island. Finally, a rock bearing the name of Gibson is one mile from this same island in the same direction; it has one fathom on it, and its position is marked as doubtful. It is apparent from this that it is necessary to navigate carefully in Endeavor Strait.

* *Mélanges Hydrographiques.*

have just mentioned (page 128). In these channels the least depth has been found to be $4\frac{1}{2}$ fathoms. Of these three channels I consider the most westerly the best, because it is the broadest, and because the depth varies from $8\frac{3}{4}$ to $9\frac{3}{4}$ fathoms, sandy bottom.

“To enter this channel the ship must steer west of the group of Possession Islands, of which the two most westerly are very near each other and thickly wooded. Having passed between these islands and a high, steep island to the west (Entrance Island), a course S. 70° W. will fetch Wallis Islands; pass about two miles north of the most northerly of these islands, the one called Red Wallis, and when abreast of it the course will be W. $\frac{1}{2}$ S. for eight miles, or till Booby Island bears N. by E.

“To keep clear of the great sand-bank of which we have spoken (page 128), which makes out from Red Wallis Island to the west, nothing south of this course must be made. When Booby Island bears N. by E. the vessel is clear of Endeavor Strait.”

Another less direct channel, which Blackwood does not mention, is that of Prince of Wales, north of the islands of this name. This channel, which is particularly suitable for large ships, also leads to Cape York; to take it coming from the west, the vessel should pass north of little Booby Island, and, avoiding the reefs east of it, should make for the channel, bounded on one side by Reef *d* and Northwest Reef, and on the other by Goode, Hammond, and Wednesday Islands, north of Prince of Wales Islands. Having doubled the last of these islands, the course is about S. E. by E. till on the meridian of West Double Island; then southeast for Cape York, after which Torres Strait may be left, either by Bligh or Raine Island Channel.*

“From Entrance Island † steer N. 45° E. for thirty miles; this course will lead to a position four or five miles south of a small patch of black rocks, over an average

*-See hereafter (page 145) King's directions for crossing Prince of Wales Channel, coming from the east.

†: Blackwood's Directions.

depth of nine to ten fathoms coral sand and shells. These rocks (named Harvey's Rocks in the chart) are fifteen or sixteen feet above water, and are bold to approach within a mile either way. Having brought these rocks to bear N. W., distant two miles, the course must be altered to N. N. E. for twelve miles, to steer between a cluster of low woody isles called 'The Sisters.'

"It may here be observed, that the space of sea comprised by 'Harvey's Rocks,' 'Mount Adolphus,' 'The Sisters,' and the northern coast of Australia, is, for nearly thirty miles each way, quite clear of dangers, and if the night be coming on and it be an object to avoid anchoring, a ship may safely heave to for the night after having passed through Endeavor Straits nine or ten miles, or make tacks every three or four hours in the space above described, which has been closely sounded and surveyed.

"These low woody isles, called 'The Sisters,' are The Sisters. separated by safe channels of from three to four miles in width, any of which may be passed through. The widest is the channel between the 'Northern Sister' and 'Long Island,' which may be distinguished by its having a low small 'sandy islet,' lat. $10^{\circ} 6' 30''$ S., in the centre of the channel, having a few small bushes on it. Pass in either north or south of this islet, avoiding a sunken patch which lies due east, nearly two miles from it, and is the only sunken danger we discovered in the strait, and steer an E. N. E. course for a low island covered with cocoa-nut trees on its northern end. Pass to the northward of this island in a clear channel nearly four miles wide, between it and a low small island called Dove Island, and then shape a N. E. by N. course, which is now the direct channel, leading between the northern islands of the strait and the great reef which here surrounds the southern coast of New Guinea.

"In the absence of a chart it is difficult now to describe the track, as numerous low woody isles will appear. It may suffice to say that steering a N. E. by N. course from Dove Island for thirty-five miles all sail may be carried, and the channels between the islands sailed through with perfect confidence, recol-

lecting in all cases that the northwest sides of the islands are bold to approach within half a mile, the reefs which surround these coral islets always extending from their E. S. E. and S. E. extremes.

“Having run thirty-three miles in this course over an average depth of nine to ten fathoms sand, varying the course a little either way according to the tide, Stephens Island, lat. $9^{\circ} 31' S.$, will be approached, and the mouth of the strait will open, the depth of water being now seventeen fathoms. Stephens Island may be known by its being rather higher than the rest of these low woody islets, and being separated from another small islet, called Cambles Island, by a channel of two miles in width, which is not to be attempted. If the weather be at all clear, Darnley Island, which is 580 feet high, will now be seen. It bears E. S. E. from Stephens Islands, distant thirteen miles, and should water be wanted, or it be an object to obtain anchorage, good shelter during the southeast trade will be procured in Treacherous Bay on the northwest side of the island, the depth of water being eleven fathoms, coarse sand, half a mile from the shore.

Route when coming from the east to cross Torres Strait by Bligh Channel.

“A ship intending to sail through by this passage should (after having passed Cape Rodney and the southeast part of New Guinea) place herself in the parallel of $9^{\circ} 15' S.$ lat., on which latitude a west course will take her well to the northward of the Eastern Fields and Portlock Reefs, and into the best channel for entering the strait.

Eastern Fields and Portlock Reefs.

“The Eastern Fields, discovered and laid down by Captain Flinders, are a detached mass of reefs, the northern part of them lying in $10^{\circ} 2' S.$ lat., and $145^{\circ} 45' E.$ long.; and Portlock Reefs are a similar group, the northern extreme of them lying in $9^{\circ} 26' S.$ lat., and $144^{\circ} 58' E.$ long., leaving a clear passage of thirty-four miles between Portlock Reef and the Great Barrier Reef, which may be said to terminate in the same parallel, — viz. $9^{\circ} 26' S.$

“In the neighborhood of Portlock Reefs, soundings of fifty-

eight to sixty fathoms will be obtained on a coarse, corally bottom, and the soundings gradually decrease to forty-five and forty fathoms as Anchor Cay is approached.

“Anchor Cay is a small sand-bank on the north-west extreme of a detached reef; it is in $9^{\circ} 22' S.$ Anchor Cay. lat., and bears N. E. by E. twenty-four miles from Darnley Island, which is distinctly visible from it in clear weather: Conjointly with another sand cay of the same description (bearing from Anchor Cay E. S. E. three miles), it forms the southern boundary of Bligh Entrance. Each of these sand-banks is surrounded by a reef running a good mile to the southeast from them; they are safe to sail between, and are separated from the north extreme of the Barrier by a clear passage seven miles in width.

“Bramble Cay, which forms the best guide for Bligh Entrance, bears N. W. $\frac{1}{2}$ N., nineteen miles Bramble Cay. from Anchor Cay. It is a sand-bank twelve or fifteen feet above low-water mark, visible seven or eight miles from the mast-head, having a reef extending a mile from its E. S. E. extreme; this sand-bank is covered with coarse, scurvy grass, and is the resort of numberless sea birds. A detached patch of black rocks, twelve or fifteen feet above water, bears S. W. by W., three miles from the sand-bank, leaving a clear passage between them and Bramble Cay. These rocks are bold to approach within a mile.

“From a position six or seven miles to the southward of this sand-bank (if the weather be at all clear) Darnley Island should be seen bearing S. by W., distant twenty- Darnley Island. eight miles from Bramble Cay; it is 580 feet high, and makes as a rounded knob from the above position. The hill of Darnley Island is in $9^{\circ} 35' 20'' S.$ lat., and $143^{\circ} 50' E.$ long. A long reef, having a sand-bank at its extremity, runs out northeast nine miles from the island. To the northward of and detached from this reef are three separate coral patches, the two southern of which have sand-banks on them showing at half tide, and with clear passages between them. These detached patches should be carefully looked out for, as they here narrow in the channel;

they always break, but at high water the northern patch is covered; it lies seven miles north of the sand-bank on the extreme end of the reef that runs out from Darnley Island, or distant nearly sixteen miles, bearing N. N. E. from the island itself, leaving a clear channel of fourteen miles between it and Bramble Cay, from which it bears S. by W.

“The southern part of the entrance between Bramble Cay and this northern patch should be carefully avoided at night, there being ample room for a ship to heave to or anchor in twenty-two fathoms, coral sand, in any part of the channel north of Bramble Cay, between it and the coast of New Guinea, which is distant from Bramble Cay thirty miles at its nearest point.

“Care should be taken not to come under six fathoms when standing in towards the New Guinea coast, which will lead clear at a distance of seven or eight miles from the land.

“This coast is low and just visible from a ship’s deck in parts, when in five fathoms. The flood tide sets in near
Tides. Bramble Cay from the N. E. and E. N. E., running at the springs at the rate of nearly two knots per hour, the ebb in the opposite direction running with greater strength; but as the coast of New Guinea is approached the flood tide assumes a more northerly direction, setting along the land to the N. W. and N. W. by W.

“It may be considered that a westerly set of at least one mile per hour may be allowed for when steering in for the mouth of Torres Straits, and after a gale it may exceed that rate

“The ebb tide did not appear to exert any influence when fifteen or twenty miles from the mouth of the strait, the ship being solely affected by the prevailing westerly current. Having passed Bramble Cay, the flood tide will be found to set to the W. and W. S. W., being diverted to a more southerly direction by the great reef off the southern coast of New Guinea.

“About the centre of the strait, in the neighborhood of Dove Island and the Sisters, the flowing tide sets to the northwest and ebb to the southeast, — the average rise and fall all over the strait not exceeding ten feet at the highest springs.

“It is high water at Darnley Island at the full and change of the moon at 9h. 30m., the tide rising nearly ten feet. On the south coast of New Guinea it is high water at 10h. 30m., the rise being fourteen feet. At the Sisters, in the centre of the strait, at 11h. At Cape York at 12h.; and at Wallis Island, the west extreme of Endeavor Straits, at one o'clock, the tide running full two hours longer in the stream than by the shore.”*

We shall confine ourselves here to pointing out the routes that may be pursued, when, having reached Cape York by Endeavor Strait or by Prince of Wales Channel, it is preferred, instead of taking Bligh Channel, to leave the Great Barrier by the Raine Island passage. The first part of this route, as far as Cape Grenville, is the last part of the one given in King's directions for going from Sydney to Cape York by the inner route (see page 143), and we shall describe it fully hereafter, giving Captain King's directions; the other part of this route will be described by Captain Blackwood, who gives the directions for sailing from Raine Island to Cape York (see page 146). Neither of these officers having specially described the route from Cape York to Sydney or Raine Island, we must limit ourselves here to some information concerning these routes, to be completed hereafter by the directions given for pursuing these same routes in the reverse way.

Route from
Cape York,
leaving the
Great Barrier
by the Raine
Island Chan-
nels.

When three fourths of a mile north of York Island, the course is E. S. E. to pass south of Mount Adolphus Islands and north of the Albany Islands, keeping a good look-out for the rock with three fathoms on it between these islands (page 129), and leaving to the east the Brothers' Islands. Having brought the most northerly of these islands to bear east, or the northwest point of Albany Island west, the course is S. S. E. $\frac{1}{2}$ E. to pass to the eastward of Turtle Island and Shadwell Point, leaving on the east the Reefs Z and X, continuing on the same course (S. S. E. $\frac{1}{2}$ E.), and leaving on the west Gilmore Bank and on the east Cairncross Island. The passage is between this latter

* *Mélanges Hydrographiques.*

and Bushy Island. Thence steer to pass eastward of and near the Hannibal Islands, leaving to the east some sandy islets, the Boydong Cays and the Reefs W and V, and passing north or south of Bird Islands; then take, as may be convenient, the North Channel, north of the Reef and Cockburn Islands, or the Pollard Channel, which is south of them. These two channels meet again south of the Middle Banks, from whence shape a course for Raine Island. The Great Barrier may be left by passing either north or south of this island. As we have said, we do no more than point out these routes, because we do not wish to fill up the blanks left in the directions of King and Blackwood by taking their reverse routes, to be given hereafter.

On leaving Cape York, when between the Brothers and Albany Islands, the Middle Passage may be taken to reach the Raine Island passages, for which purpose follow in the reverse order the directions (page 150) given by Blackwood for crossing this channel coming from the east. The Middle Passage falls into the North Channel and Pollard's Channel near the Middle Banks.

Such are the routes to be pursued, when coming from the west, for passing through Torres Strait. They allow the choice of the inner or outer route in going to the ports of the east coast of Australia.

Routes from
Sydney to
India. Vessels leaving Sydney or the ports of the east coast of Australia for the ports of India, during the southeast monsoon (from April to October), will gain more by going through Torres Strait than Bass Strait, because at this period of the year strong west winds prevail on the south coast of Australia, which make the voyages very long, and render the doubling Cape Leeuwin very difficult.

Passing through Torres Strait, there are two routes that may be taken; the inner route, coasting inside the reefs of the Great Barrier, the east coast, and the northeast coast of Australia; and the outer route, which is outside the Great Barrier.

Inner route.

In taking the inner route, says Captain Blackwood, the directions of Captain King must be strictly followed, for, con-

sidering the physical condition of these seas, it is not impossible that there are steep coral banks at no great distance from the tracks that have been sounded out. We will now give these directions.*

From Sydney to Cape Sandy, where King's description commences, the navigation is attended with no difficulties beyond those usually encountered in an open sea without dangers. The following is quoted from Captain King: —

“ Having hauled round Breaksea Spit (see Flinder's chart, sheet III.) in the evening, it would perhaps be dangerous to steer on through the night; after running, therefore, to the W. N. W. for five or six leagues, bring to until daylight; but, if the day be before you, the course from the extremity of the spit is W. N. W. $\frac{1}{4}$ W. for about a hundred miles. You will then be about twenty miles from Cape Capricorn; on your way to which you should pass about three miles within Lady Elliot Island (1), and also within the southernmost islet of Bunker Group (2), by which you will see how the current has affected your course, and you can act accordingly: if it has set you to the northward, you may pass on either side of, or through the islands, without danger. After making Cape Capricorn, you may leave it at a convenient distance, and, directing your course about N. W. by N., pass either within or without the Peaked and Flat Islands off Port Bowen (4); then, steering for the Percy Group (6), pass between the 2d and 3d Northumberland Islands (5).†

“ After passing the latter, avoid a low dangerous rock that bears from it N. 8° E. five miles and three quarters, and from 1st Peak S. 85° W. To avoid this in the night, pass close round No. 3, which is high, and of bold approach.

“ The channel is safe on either side of the Percy Isles, but

* *Nautical Magazine* (1834), p. 68. These directions are only for the inner route, and the descriptions of the ports given by Captain King are omitted. — *Remarks by the Editor of the Nautical Magazine.*

† On King's Chart these islands are numbered 1, 2, 3, 4, 5, 6, 7, 8, &c.; he has made use of the same system for the numerous groups of islands lying hereabouts; and he also designates many islands or reefs by letters.

that to the westward of them, being better known, is recommended as the safest. Following either the Mermaid's or Bathurst's track* will carry a ship round the projections of the coast as far as Cape Grafton (35); as far as which, if the weather be fine, there can be no danger of proceeding through the night; but it must be recollected, that at Cape Grafton the coral keys of the Great Barrier Reef approach the coast, and consequently the channel becomes contracted.

"On reaching Fitz-Roy Island (36), round it at a mile off shore: and when its north end bears west, steer N. W. $\frac{1}{2}$ N. for thirty-five miles; you will then be a league to the southeast of a group of low isles: should it be night when you pass them, come no nearer to them than fourteen fathoms. In steering this course, great care should be taken not to go too much to the eastward, to avoid the reef which the Tamar saw.

"If the moon be up, and the weather fine, the islets will be readily distinguished, but it would be more prudent to wait for daylight. This course will carry a ship over two of my tracks,† and the soundings will be in 17, 18, and 19 fathoms. From the

* These two tracks are laid down on King's Charts, 1075 and 1076; they are as follows. The two tracks start from Percy Islands. From these islands, one passes east of the Beverley Group and Double Island; then west of the island *k* 2, marked by a small peak; from this island it passes east of the Three Rocks, then east of the islands *l*, *l* 2 of Cumberland Group, round which it passes on the east, leaving to the eastward, however, the little islets lying opposite to the largest of these islands, which rises to the height of 1,441 feet. The second route, starting from the Percy Islands, passes between Pinepeak Island No. 3, visible at 12 or 13 leagues, and the island No. 5 of the Percy Group; then east of the islands *k* 1, *k*, and *k* 2, leaving to the eastward the islands of *k* 4 $\frac{1}{2}$ and *k* 4 of Cumberland Group; it passes then some miles to the westward of the uncovered sand-bank seen by Flinders in 1802, and passes round to the east of the whole group of the Northwest Cumberland Islands. From the Cumberland Islands to Cape Bowling-Green the two tracks approach each other, and both pass to the south and the west of Holbourne Island, and then at a little distance from Cape Bowling-Green. From this cape to the Palm Islands, the two tracks are direct. They pass afterwards to the westward of the group of Palm Islands, then they approach each other north of this group; they both pass west of the Prince Regent Sand-bank and Reefs, and east of all the islands that line the coast as far as Frankland Islands. One of the tracks passes east, the other west of these islands, and afterwards they take a straight course to Fitz-Roy Island, situated south of Cape Grafton. The first passes east, the second west of this island.

† Captain King.

low isles, direct your course for the Hope Islands (37), which bear from the former N. 18° W. thirty-eight miles; but the course had better be within that line, to avoid some reefs in lat. 15° 51': pass, therefore, within five miles of Cape Tribulation, whence a direct course may be steered on either side of the Hope Isles. The better route will be within the western Hope, and along its reef, at the distance of three quarters of a mile, by which you will avoid reef *a*. When you are abreast of its north end, a N. by W. westerly course, for twenty-eight miles, will carry you to Cape Bedford (40), which may be rounded at from one to three or four miles. You will see in your way, at 3½ miles from the north end of the Hope Reef, reef *b*; and at 15 miles from it you will be abreast of *e*; and five miles farther on you will pass Captain Cook's Turtle Reef (43), which has a dry sand at its north end. These three reefs will be to the eastward of your course.

“The current sets to the northwest, so that your course must be directed accordingly. In coasting along the shore, you will discern the summits which are marked on the chart. The high conical hill on the south side of the entrance of Endeavor River (38), is Mount Cook; bearings of which, crossed with the summit of Cape Bedford, or any of the particularized summits or points, will give the vessel's place; by which the effects of the current, which is generally very slight, will be ascertained. On one occasion we found a current in the space between the Endeavor Reef and Turtle Reef, of two miles an hour, to the northwest.

“Being off Cape Bedford, and steering to the N. ½ W., you will see the Three Isles (44) ahead; steer between them and the low wooded island, and direct your course round Cape Flattery (41), and Look-out Point (42), in order to anchor under the Turtle Group (49): unless you have time before dark to reach the islands 4, 5, or 6, of Howick's Group (52), under which anchorage may be found. In rounding Look-out Point, do not come within two miles and a half of it, to avoid a reef that is on Captain Cook's chart, which, however, we did not see; it lies a

mile and a half north from the peaked hill, at the extremity of the point.* You may pass on either side of the Turtle Group, or between Lizard Island (46) and Eagle Island (48), but the latter course is not to be recommended; first, because the wind is generally fresher as you increase your distance from the shore; and, secondly, because the run is ten or twelve miles longer. There is good anchorage under the northwest side of the Peak on Lizard Island.

“From the Turtle Group steer N. W. by W. $\frac{1}{2}$ W. until you see the hillock at the southeast end of No. 1 of Howick Group: pass inside it, and within a mile of 2 and 3, and between islet 4 and Cole’s Islands (50), also in shore of 6, and of the dry sands *s*, *t*, and *u*. The Mermaid’s track will direct the course to Cape Melville (56). If the day be advanced when abreast of 6, of Howick Group, anchorage had better be secured under it, as there is none to be recommended between it and Cape Flinders (59).

“Upon rounding Cape Melville, the Islands of Flinders Group (58) will be seen; and as soon as you have passed between the stony reef that projects off the Cape, (the extremity of which bears from it by compass N. W. by N., and from Pipon Island S. W. by W. $\frac{1}{4}$ W. nearly,) and the reef that surrounds Pipon Island (57), direct the course for the extremity of the islands to the westward, which is Cape Flinders; the course and distance to it is W. $\frac{3}{4}$ S. nearly thirteen miles, leaving a low woody island on the starboard hand.

“His Majesty’s sloop *Satellite*, in 1822, grounded upon a small reef, *a*, bearing N. by E. (easterly) from the extremity of the cape, distant about two miles; but, as a ship may pass within a stone’s throw of the cape, this danger may be easily avoided. The best anchorage to leeward of Cape Flinders is under the flat-topped hill, at a third of a mile from the shore, in ten fathoms, muddy bottom. In hauling round the cape, avoid a shoal

* On King’s chart there are also two sand-banks, bare at low water, between which the track passes. These two banks bear E. and N. E. $\frac{1}{2}$ E from Point Lookout, 2 miles and $2\frac{1}{2}$ miles distant.

which extends for two cables' length from the shore on its western side.

“ If daylight will allow of time to run fifteen miles further, the ship may proceed to the anchorage under reef *d*; but in this neighborhood anchorage may be obtained under any of the reefs or islets between this part and Cape Grenville, for the bottom is universally of mud; and, by anchoring with the body of a reef bearing southeast, the vessel is sufficiently sheltered from the sea, which is generally smooth.

“ On leaving Cape Flinders, steer W. $\frac{3}{4}$ N. for about 23 miles, leaving the reefs *c* and *g* to seaward, and *d*, *e*, and *f* to the southward of the course; then haul up about N. W. $\frac{3}{4}$ N., and steer within the reef 1 and Pelican Island (63), and to seaward of the Claremont Islands (64) 1 and 2, which are low and woody.

“ When abreast of island 2, the southwest end of the reef *m* will be seen, which should be passed at from one to two miles, and the course N. by W. $\frac{1}{4}$ W. will carry you to islands 4 and 5, which you may pass on either side of; the channel between them is also quite safe. If you take the latter course, steer north, within the reef *o*, and then close within 6, to avoid a low rock that covers with the tide. Having passed this rock, which is marked on the chart, steer for 7, and pass within one mile of it, to avoid the shoals that extend off Cape Sidmouth (66). Hence the course is N. N. W. towards Night Island (67); and, when abreast of it, steer N. $\frac{1}{2}$ W. until near the covered shoal *v*, when the course may be directed within Sherard's Islets (68) and reef 10 (on which there is a sandy islet covered with some bushes); and then steer round Cape Direction.

“ Hence a course N. N. W. $\frac{1}{4}$ W. will carry you within the reefs *y*, *z*, *a*, *b*, and *c*; and without the rocky islet that lies off Restoration Island (70): continuing this course for about five miles beyond Cape Restoration, you will see the long reef *e*; then steer northwest along its edge, which extends until you are abreast of Fair Cape (71), where it terminates with a very

narrow point. Thence steer N. W. $\frac{1}{2}$ N.,* and pass between the two easternmost Piper's Islands (74) and the reefs *h*, *i*, and *k*; then on either side of *l* and *m*, inshore of Haggerston Island (76), and round the outermost of Sir Everard Home Group (77).

“The anchorages between Cape Flinders and this are so numerous as not to require particular mention: the northwest end of every reef will afford shelter; but the anchor should not be dropped too near to them, because the tide sweeps round the edge with greater strength than it does at half a mile off, and the bottom is generally deeper. If the day is advanced and the breeze fresh, Night Island should not be passed; because the anchorages between it and Piper Islands are rather exposed, and a vessel getting under weigh from Night Island at daylight will easily reach Piper Islands, or Margaret Bay, before dark.

“Margaret Bay (77) is round Cape Grenville; the anchorage, being fronted by Sunday Island, is well sheltered: it is a safe place to stop at. Anchor in six fathoms, with the island bearing southeast.

“In passing round Sir Everard Home Islands (77), steer wide from them, to avoid the tide drifting you towards the group; for it sets to the northwest across the course. The course is then about N. W. $\frac{1}{4}$ W. to the Bird Isles (80), and thence, to the reef *v*, about N. W. by N.; the better and more direct plan is to pass within *v* and *w*, (there is, however, a safe channel between them,) and when abreast of the west end of the latter, the course and distance to Cairncross Island (82) is N. by W. $\frac{1}{2}$ W. about eighteen miles.”

“In taking these routes, leave on the port hand the Hannibal Islands, and on the starboard the Boydong Keys.”

* These routes are given by King in his directions. On the chart, the track passes two miles east of Restoration Island, and thence the course N. 30° W. leads straight to Piper Islands. This is the course of the track laid down on the chart. The track N. 40° W. leads much farther from reef *e*. According to the Chart No. 1076, it would be dangerous to make more than four miles on this course without returning to the north course to run along the western edge of reef *e*, on account of a bank which rises above water four miles to the westward of this reef.

“ There not being any very good anchorage between Cairncross Island and Cape York, it would be perhaps better to anchor under it for the night, in about fourteen or fifteen fathoms, mud, the island bearing southeast, but not nearer than half a mile, because within that distance the bottom is rocky.

“ Leaving Cairncross Island, steer N. N. W. $\frac{1}{4}$ W. until Escape River (84) is abreast of you, when look out for reef *x*: steer within it about N. W. by N., which will take you inside the covered reef *z*. Your course then must be round the Albany Islands (87), and hence N. W. by N. for *a*, which is a rocky islet that may be seen from abreast the Albany Isles.

“ The passage through the Possession Isles (90) and Endeavor Strait (91) is not to be recommended for a large ship, on account of the shoal water that extends from Wallis Isles towards Shoal Cape; the route round the north end of Wednesday (92) and Hammond Islands is preferable. Upon passing reef *a*, Wednesday Island will be seen: in steering towards ^{Prince of Wales Channel.} it, avoid standing too close to the rocky islet that is abreast of the strait between it and Horned Hill, as some sunken rocks stretch off it for about a quarter of a mile;* steer round the north point of Wednesday Island at half a mile, then W. by S. $\frac{1}{4}$ S., which will carry you to the northward of the rock off Hammond Island. From this rock steer S. W. by W.; and when abreast of the southwest end of Hammond Island, haul towards a reef, to the southward of the course, on which you will see some dry rocks, which you may pass within half a mile of: by so doing you will avoid reef *d*, which is generally, if not always, covered: the fair way of this channel is seven and eight fathoms deep.

* On the Charts Nos. 1076 and 1748, these dangers, which terminate at the east by Strait Rock, extend as far as two miles to the eastward of the meridian of Horned-Hill Point.

On the same chart No. 1748, the hidden rock to the east of Horned-Hill Point is called *Duym* Rock, and not *Strait* Rock, as we give it. To the eastward of Duym Rock there is a bank having two and a quarter fathoms on it in its shoalest part. The east part of this bank is more than three miles from Horned-Hill Point. Strait Rock, on the corrected chart No. 1748, is a visible islet, lying in the south part of Prince of Wales Channel at its eastern entrance.

“ When the summit of Good Island (93) bears S. W. by W., steer W. by S. southerly for Booby Island * (95), by which you will avoid Larpent Bank, and when you are past it, you are clear of the strait. Hence you may steer W. $\frac{3}{4}$ S. through the night, on which course you will very gradually deepen your water. To the northward of the two tracks to the westward of Booby Island are some coral reefs, the positions of which are not correctly ascertained.

“ Being fully convinced of the great advantage and superiority which the inner route possesses over the passage without the Barrier Reefs, which for many years has been generally adopted, I am anxious to prevail upon navigators bound through Torres Strait to give it a trial; the result of which I feel assured will be in favor of its being ever afterwards used.

“ The season in which the strait only can be passed commences with the month of April, and ends with October; that is, during the southeast monsoon. The westerly monsoon, besides being a foul wind, is accompanied by unsettled, gloomy weather and heavy rains, and frequently by strong gales, against which it is impossible to make a voyage without great delay and loss of time.

“ The passage up the northeast coast is not affected by the monsoons. The southeast trade blows up the coast during the whole year, with little variation; save that during the months of June, July, and August, it is occasionally, although rarely, suspended by northeasterly winds, with thick rainy weather. To the southward of Cape Grafton (lat. $16^{\circ} 51'$) this interruption is of more frequent occurrence. Still, however, the prevailing wind to the northward of Breaksea Spit is from southeast, and there will be no difficulty in making an expeditious passage.” †

Such are the directions of Captain King for the inner route. We will now give those of Captain Blackwood for the outer route, when making for the Raine Island passages.

* On this island there is a letter-box.

† *Nautical Magazine*.

“Vessels, after leaving Sydney, are recommended to make the most direct course to approach the tropic of Capricorn, — where the outlying dangers may be said to commence, — on the meridian of $156\frac{1}{2}^{\circ}$ E.; it being presumed that the vessel is navigated by chronometers, with well-known errors and rates, there can be no object in sighting either Cato Island, Bird Islet, or Wreck Reef.*

“The tropic of Capricorn having been crossed somewhere between the meridians of 156° and 157° E., the outer route through the Coral Sea will be divested of many of its terrors, if the vessel is rigorously kept where the tracks of other vessels appear most crowded on the chart, passing to the eastward of the supposed Australia and Kenn reefs, and to the northeastward of Alert Reef, Diana Bank, and Osprey Reef.

“Having crossed the tropic in about long. $156^{\circ} 30'$ E., run to the northward on that meridian, until in lat. $20^{\circ} 30'$ S., when the vessel will have passed 60 miles to the eastward of Wreck Reef, and from 20 to 30 miles to the eastward of the doubtful positions of the Australia and Kenn reefs.

“From lat. $20^{\circ} 30'$ S., long. $156^{\circ} 30'$ E. steer N. W. $\frac{1}{4}$ W., until in lat. 15° S., long. $151^{\circ} 30'$ E., when a direct course, W. by N. $\frac{1}{4}$ N., may be steered for the Great Barrier Reefs, at Raine Island. In making these courses some allowance must be made for the prevailing northwesterly current, especially when approaching the barrier, and a careful lookout must be kept for the Alert Reef when passing it, as its northern extremity is not clearly defined.”

“Raine Island, which may be easily known by the substantial tower built on it, is situated in the centre Raine Island. of the opening between the northern extreme of the Great Detached Reef, and the projecting point of the Great Barrier Reefs N. E. by N. $8\frac{1}{2}$ miles from it; there is a clear channel on either side of the island, the southern being $3\frac{1}{2}$ miles, and the northern nearly 2 miles broad. The island, which is of coral formation, is nearly three quarters of a mile in circumference, and 20 feet

* See Admiralty Charts of Australia.

above the low-water level; it is surrounded by a coral reef closely fringing the northwest end, but extending $1\frac{1}{4}$ miles from the southeast extreme of the island; this reef is in most parts dry at low water, and entirely so at springs.

“As no bottom could be reached with 125 fathoms of line in any part of the opening, nor close up to the lee of the Raine Island, it affords no anchorage.

Beacon. “Raine Island having become the most important point for entering Torres Strait from the outer route, it was considered by Captain F. P. Blackwood the most eligible site for a sea mark; a substantial beacon of stone was accordingly erected, in 1844, under his direction, on the southeast point of the island. The beacon is a circular tower, surmounted by a wooden dome with a ball on the top; the whole is 64 feet in height, or 74 feet above low-water mark, and the tower is 30 feet in diameter at the base. It was painted with alternate red and black vertical stripes, and in clear weather is visible 8 or 9 miles from the deck, and 10 or 12 miles from the masthead of a vessel. Its position is in lat. $11^{\circ} 35' 50''$ S., long. $144^{\circ} 2' 20''$ E.

Supplies. “An ample supply of provisions has from time to time been lodged in the chambers of the beacon, for the relief of shipwrecked or other distressed persons; and an iron tank capable of holding 5 tons was placed at its base for the reception of rain water from the roof.

“Raine Island produces a bushy sort of plant, coarse grass, and a kind of spinach. Sea-birds are incredibly numerous, and a great abundance of wholesome bird's eggs may be gathered at certain seasons of the year; turtle also frequent the island to deposit their eggs.”

Anchoring. “As a general rule vessels may anchor under the lee of most of the reefs and islands within the barrier, during the prevalence of the southeast trade-winds (from March to September); but it is not always safe to do so at the other seasons of the year, as heavy gales often come on to blow suddenly from the opposite quarter, when the northwest sides of those reefs and islands would naturally become dangerous lee shores.

“H. M. S. *Fly*, during the survey, seldom experienced the slightest difficulty in weighing her anchor; but her tender, the *Bramble*, and especially the boats, suffered much in this respect; this can only be accounted for from the ground tackle of the former being sufficiently ponderous to break off the projecting irregular masses of coral, which the gear of the smaller vessels failed to do.

“It being presumed that Raine Island Entrance, described in page 145, has been decided upon for passing through the Great Barrier Reefs from the outer route, and that the beacon on Raine Island has been plainly made out, steer for the southern passage, which is much wider and far preferable to the northern. Having entered the southern passage, and brought the beacon to bear north, distant about a mile, with the southern edge of Raine Island Reef at about half a mile off, steer S. W. by W. $\frac{1}{4}$ W., carefully allowing for the tidal stream, as well as the current to the northward, and a run of 9 miles from abreast of the beacon will bring the vessel into soundings, on the edge of the bank, passing at about half a mile to the northward of the northern extreme of the Great Detached Reef; the main body of the Great Barrier Reefs will then have been fairly entered.*

Directions for
Raine Island
Entrance and
Blackwood
Channel.

“Should a vessel be compelled to enter by the northern passage, she should haul up, so as to pass at about half a mile or two thirds of a mile from the north side of Raine Island, and steer S. W. $\frac{3}{4}$ S. for 6 or 7 miles, or until the beacon bears N. E. $\frac{1}{4}$ E.; then by steering S. W. by W. $\frac{1}{4}$ W. for about 3 miles, the vessel will be on the edge of the bank, in the position above mentioned, when entering by the southern passage. Great care is here necessary in making due allowance for the stream and northerly set; and the beacon must not be brought to bear to the southward of East, in order that the shoal patches, lying 4 miles to the westward of Raine Island, may be avoided.

Northern
passage.

“When the vessel has reached into soundings of 25 or 30

* See Admiralty Charts of Australia.

fathoms, in the entrance of Blackwood Channel, a good lookout from aloft must be kept for the small sunken patches which lie near the edge of the bank, on two of which was found as little as 12 and 14 feet at low-water springs, but as they appear white, they will be easily seen from aloft, in contrast with the adjacent deep water.

“The seaman must not be here alarmed by the cross and troubled sea, which just upon the edge of the bank of soundings is produced by a strong easterly wind acting against the ebb stream. The strength of the ebb stream in the vicinity of the Great Barrier Reefs is, however, generally much less than the flood stream, which combines with the additional set to the northward, along the edge of the barrier, this set being caused by a long-continued southeast trade-wind; and for this full allowance must be made, not only when trying to make Raine Island entrances, but when passing through them, in order to prevent being swept to the northward among coral patches that have not been examined.

“From the position indicated by the before-mentioned soundings of 25 to 30 fathoms, a run of 16 miles will lead a vessel to the Middle Banks; but the course should be decided on with great care, as it would be highly dangerous to fall to the northward of them. The course to make good is S. W. by W. $\frac{1}{4}$ W., which with a strong ebb stream may sometimes be adopted, but at all other times the northerly set must be kept in check by steering a point, or even a point and a half farther to the southward.

“If Raine Island Passage should have been entered late in the afternoon, it would be prudent to anchor abreast and well to the southward of the Middle Banks, in 12 or 15 fathoms, by which the eastern sun of the following morning would enable the mast-head man to clearly discover all the dangers lying in the track to the westward; to be prepared for which a prudent seaman will have his vessel under moderate, but commanding sail, with an anchor ready to drop, at a moment's notice, the whole way from the outer barrier to the main land.

“ Although, as before noticed, there is a passage to the northward of the Middle Banks, the patches which lie 2 or 3 miles to the northward, and Tynemouth Bank to the westward of them, render it unadvisable for a vessel to pass that way; if, therefore, the voyage be lengthened a few miles, it will be far better to make sure of passing to the southward of the Middle Banks, thereby escaping all danger, and having the advantage of seeing Ashmore Banks, which are always visible in clear weather at a distance of 3 or 4 miles, and Sir Charles Hardy Isles, at a distance of about 14 miles.

“ When the vessel has run the given 16 miles, from the entrance of Blackwood Channel, and is abreast of the Middle Banks, it becomes a matter of great importance to make out her position with respect to these banks, which, if not seen, may be done by bearings of Ashmore Banks and Sir Charles Hardy Isles; for a course must now be chosen for the North Channel, Pollard Channel, or Sir Charles Hardy Isles.

“ Should Raine Island have been passed early in the morning, and the Middle Banks reached by noon, the North Channel will afford the shortest run to the Bird Isles, under the lee of which she may anchor if necessary.”

“ North Channel, which runs between the eastern pitch and northwest extreme of Cockburn Reef, and the scattered sunken patches to the northward, is somewhat shorter and more frequented than Pollard Channel.

“ A vessel proceeding through the North Channel from the eastward, should pass at about three quarters of a mile to the northward of the easternmost pitch of Cockburn Reef, steering $W. \frac{1}{2} S.$, with Cockburn Isles on the port bow. When Sir Charles Hardy Isles are in line, $S. E. \frac{3}{4} S.$, steer $W. by N. \frac{1}{4} N.$, and round the spit of the northwest extreme of Cockburn Reef — which is clearly defined by the color of the water — at the distance of a quarter of a mile, then haul up more to the southwestward for about 2 or 3 miles, to avoid the rock awash, described as lying $2\frac{1}{2}$ miles to the westward of the pitch of the reef; the dangers of this channel being then passed,

Directions.

and the Bird Isles in sight to the westward, steer for them, and proceed as directed at page 149.

“It will not be necessary to follow to the letter these directions for the North Channel, as there is room enough for the navigator to proceed according to his own discretion when looking at the chart, taking especial care to keep a good lookout for the northern patches, and the dangers off the northwest extreme of Cockburn Reef.”

Pollard Channel. “Pollard Channel is a safe, though narrow passage, running 9 miles, nearly N. E. and S. W. between the southeast edge of Cockburn Reef and the long bank of foul ground to the northwestward of Sir Charles Hardy Isles; the average breadth of the channel is about a mile, and the depth varies from 16 to 30 fathoms, with sand and coral bottom. At springs, the streams run through with great velocity, and when opposed to strong breezes, create so confused a sea as would at times place a vessel in difficulties.

Directions. “In sailing through Pollard Channel from the eastward, the southern edge of Cockburn Reef being, as before observed, quite steep close to, should be skirted at a not greater distance than one third of a mile, to avoid a series of sandy shoals on the southern side, which, if the weather be fine, will be plainly indicated by the difference in the color of the water; these shoals contract the western end, and narrowest part of the channel, to three quarters of a mile in breadth.

“When the northwestern Sir Charles Hardy Isle bears E. by N. $\frac{1}{4}$ N., well open of the southeastern island, and the largest Cockburn Isle N. N. W., the dangers of Pollard Channel, in running to the westward, will be cleared; and taking care to avoid the shoal patch to the southward of Cockburn Reef, already mentioned, a N. W. by W. $\frac{1}{2}$ W. course, for 16 miles, will take a vessel to the Bird Isles, when she may proceed as directed at page 149.”

“Vessels, after entering the Great Barrier Reefs by Stead Passage, or either of the openings between it and the parallel of $12^{\circ} 30' S.$, are recommended to steer for Ashmore Banks, and

then proceed for North Channel or Pollard Channel, according to circumstances. It may perhaps be found convenient to proceed from these banks by the open channel to the southward of Sir Charles Hardy Isles; but as that channel has not been closely sounded, it must be adopted with caution.

“Although Raine Island Entrance is to be preferred on account of the beacon and the greater breadth of the opening, it by no means follows that Stead Passage and the other practicable channels between it and lat. $12^{\circ} 30' S.$ are to be condemned; on the contrary, in the event of a vessel making the Great Barrier Reefs, and either of these openings is distinctly recognized, it will be far better to take advantage of it than to attempt to beat out again for the sake of running through Raine Island Entrance, more especially if the vessel happens to find herself near an opening in Wreck Bay, or any other deep indentation of the barrier, out of which it is next to impossible for a sailing vessel to beat against the heavy sea, which generally rolls in upon the reefs.

“These channels being similar in breadth and character, directions for one will do for all; and although they do not generally average more than a third of a mile in breadth, the Great Barrier Reefs are here so narrow, that the run from the heavy sea outside to the smooth water within the reefs is, with a commanding breeze, accomplished in a few minutes.*

Openings between lat. $12^{\circ} 30' S.$ and Raine Island.

“When either of these openings is recognized beyond a doubt, steer boldly for it, conning the vessel from the mast-head, from whence, if the sun's glare be not ahead, all dangers lying in the channel will be easily distinguished by the color of the water. The vessel having fairly entered, may first steer for Ashmore Banks, and then proceed for North Channel, or Pollard Channel, as directed at pages 149, 150; or if late in the day anchor inside the reefs.”

“Sir Charles Hardy Isles, two in number, are fringed with narrow coral reefs, which are steep-to; Sir Charles Hardy Isles.

* See Admiralty Charts of Australia.

the southeastern island is $2\frac{1}{4}$ miles in circumference, and of moderate height. The northwestern isle is not quite so large as the other, but it is higher and more peaked, its summit, nearly E. N. E. 13 miles from Cape Grenville, being 320 feet in height; a shoal spits runs out half a mile from its northwest side. Both isles are covered with coarse grass and stunted bushes, growing on a stony soil, which, when seen from seaward, have a reddish appearance, and being distinctly visible from the Great Barrier Reefs, are good marks to steer for when running for the inner route. There is a deep channel a quarter of a mile wide between the islands.

Water. “The southeastern Sir Charles Hardy Isle has the advantage of possessing a very fair spring of fresh water, close to the shore on the southwest extreme of the island, at two thirds of a mile off which is a small rocky islet. The supply from March to July would be quite sufficient for a large ship; but afterwards the spring appeared to dry up, in which case it would be better to proceed to Cape York for water, where it can be procured at all seasons of the year.

“The best anchorage is near the northwest side of the southeastern isle; but a vessel may anchor in 6 and 7 fathoms, almost anywhere under the lee of Sir Charles Hardy Isles.

Tides. “It is high water, full and change, at Sir Charles Hardy Isles, at 9h. 15m.; springs rise 10 feet.”*

Pandora Entrance. “This opening is only recommended as a sort of refuge entrance for a vessel to run for, in the event of her having overrun Raine Island Entrance, and being unable to beat back in time to enter that opening before dark.

“Pandora Entrance may be easily known by the large sand-bank on its southern side; round this, at the distance of about half a mile, and then steer S. W. by S., running through the passage with the sand-bank bearing northeast, the depth will then be from 30 to 13 fathoms, when a vessel may anchor under the lee of the reefs; or if not late in the day, proceed to the northwestward.

* See Admiralty Charts of Australia.

“If, through thick weather or other unfavorable circumstances, a vessel should be so much out in her reckoning as to miss Pandora Entrance also, the Papuan or Great Northeast Channel is the only opening to leeward recommended, although a vessel may pass through Olinda, or Yule Entrance, if hard pressed, or even through one of the gaps farther to the northward. In running to the northward for the Great Northeast Channel, steer nearly parallel with the Great Barrier Reefs, and at such distance from them as circumstances may render necessary. As this route is little known, much is left to the discretion and vigilance of the navigator, especially when passing between the barrier and the outer chain of reefs which lie to the southeastward of Murray Island, and contract the channel to about 20 miles in breadth. Having passed these reefs and reached the parallel of $9^{\circ} 15' S.$, bear up to the westward for Bligh Entrance, and proceed as directed at page 130.*

“If the direct approach to this channel from the frequented part of the outer route were better known, it would be difficult to decide upon which to recommend, this, or Raine Island Entrance. At present the chart only shows the two tracks of Captain Flinders; but several merchant vessels are also known to have entered Torres Strait by the Eastern Fields and the Great Northeast Channel, without any reefs having been reported to exist between the outer route abreast of Alert Reef and the Eastern Fields.*

Papuan, or
Great North-
east Channel.

“The advantages of the Great Northeast Channel have already been alluded to at page 128, and, although the route round the Eastern Fields and through Bligh Entrance to Booby Island exceeds by about 50 miles that through Raine Island Entrance, the difference in distance is more than compensated for by the saving of time and relief from anxiety; for the Great Northeast Channel being broad and easy to make, with regular soundings and few hidden dangers, a vessel, properly managed, may run through Torres Strait, from Bligh Entrance to Booby Island, without being compelled to anchor more than once; but en-

* See Admiralty Charts of Australia.

tering the Great Barrier Reefs by Raine Island is necessarily attended with much more risk and anxiety; and the intricate nature of a great portion of the route through Torres Strait would render it necessary to anchor at least twice between the Great Barrier Reefs and Booby Island.

“A vessel by the outer route intending to proceed through Torres Strait by the Great Northeast Channel, having arrived at a position in about lat. 15° S., long. $151^{\circ} 30'$ E., may shape a course for the Eastern Fields by either of the tracks of Captain Flinders, carrying no more sail in the night than the vessel will conveniently bear when suddenly hauled to the wind, and taking every other precaution against unknown dangers which in this little known region may still exist. The northeastern extremes of the Eastern Fields and Portlock Reefs being well determined, those reefs should be passed on that side. From the northeast extremity of Portlock Reef, steer W. by N. 50 miles, which will lead the vessel abreast of Bligh Entrance, on the parallel of about $9^{\circ} 15'$ S., from whence proceed as before directed, at page 130.

“It is hardly necessary to repeat that a vigilant
Caution. lookout from the masthead in the daytime is absolutely necessary: at night, if the weather be not very boisterous, the ear may often detect the sound of breakers before they become visible. An anchor should always be kept ready to let go, and a vessel having entered the Great Barrier Reefs should be kept under easy, but commanding sail, with a boat in readiness to sound ahead on the appearance of discolored water, which will be often found to arise from the shadow of passing clouds, tide riplings in the vicinity of reefs, or from some cause not yet understood, in the spots of discolored water, which have been so frequently met with and sounded over, without indicating any difference in the depth of water from that surrounding them.

“Although the lead should be constantly kept going
Sounding. whilst in soundings, it must not always be depended upon as indicating approach to reefs, as they generally spring up precipitously from the bottom, the lead often not giving sufficient warning to avoid them.

“Steering directly with the sun in the vessel’s course must be particularly avoided in the vicinity of reefs, as, from Glare of the sun- the strong glare, it is then scarcely possible to discover dangers in time to steer clear of them.

“It must be recollected that there are few familiar objects on the vast extent of the Great Barrier Reefs to point out the position of a vessel, and however minutely the outline and geographical details of the reefs and shoals in these seas may be given to the navigator, they will avail him but little, unless vigilance and due caution be observed; for charts of coral waters, even on the highest authority, must not lull him into a fancied security, as until every foot of ground has been thoroughly examined, it would be wrong to suppose that numerous shoals and small heads of coral do not exist, which have hitherto escaped detection.”*

To complete what we have to say concerning the routes through Torres Strait, it remains for us to speak of that of the corvettes *Astrolabe* and *Zélée*, under the orders of Admiral Dumont d’Urville. We do not, however, advise its being taken; for Bligh Channel, and next Prince of Wales Channel, are far preferable in all respects.

Track of the
Astrolabe and
of the *Zélée*
through Torres
Strait.

The track pursued by the two corvettes carried them to the entrance of Bligh Channel; it passes north of Anchor Cay,† then between the reef extending northeast of Arroub (Darnley) Island, and the detached reefs of which we made mention, page 133. From Darnley Island it passes north of Atagor (Nepean) Island, to the northward of and near Hougar (Stephens) Island, then north of Dalrymple (one of the Sister Islands); that is, as far as this island the track keeps on the northern part of Bligh Channel. From Dalrymple Island the track passes west of

* These directions for the outer route are taken from the *Australia Directory*, published, under the authority of the Lords Commissioners of the Admiralty, by the Hydrographic Office. 1859. — *Editor*.

† See chart No. 1091 of French Hydrography, surveyed and drawn by Messrs. Vincendon-Dumoulin, Hydrographic Engineer, and Midshipman Coupevent-Desbois. Many names differ on this chart from those on the English charts 1077 and 1792. We will give those named on the latter in brackets.

Rennel Island, then, running along the southern margin of the great Warrior Reef, it crosses the reef east of Toud (Warrior) Island by Mauvais Channel, which is excessively narrow. The broad passage here between Warrior Island and Djeguei (Dungeness) Island is, in all cases, very much preferable to Mauvais Channel, which perfectly merits its name. At the outlet of this channel the track leads directly north of Gueborar (Brothers) Island, and south of the small Nicholl's Cay, which is north of the Brothers at the distance of about $4\frac{1}{2}$ miles. From the Brothers, which presents two high hills, it takes a course nearly S. W. by W. $\frac{1}{2}$ W. toward the north shore of Mulgrave Island, leaving to the north Orman Reef (which this navigator attempted unsuccessfully to pass through in 1816), Passage Island, Jervis Island, and several islets bordered with reefs marking the north shore of the channel, and of which the most westerly is Farewell Island; leaving to the south Matron Cays, Possession Island, Black Rock, and the reefs that border the north shore of Mulgrave Island. After having doubled this and Farewell Island, the ship is clear of the strait and enters the Indian Ocean.

We will now cite the opinion expressed by Captain Bannatyne on the outer route followed by him from Sydney to India, crossing Torres Strait by Bligh Channel.

Left Sydney the 1st of July; the 6th, passed between Wreck and Kenn Reefs; 12th, toward midnight, the ship was between Eastern Fields and New Guinea. At 10 A. M. made the breakers on Portlock Reef; at 4 P. M. doubled the northeast point of Portlock Reef, and toward 10 o'clock bore up for the entrance of Bligh Channel. The soundings at 4 A. M. was $49\frac{3}{4}$ fathoms, sand and coral; at 8 o'clock, 40 fathoms, black sand. At 8.30, saw Bramble Cay at the distance of 7 or 8 miles, bearing north-west. At noon, Stephens Island bore south 3 miles off, and at 4 P. M. anchored in $15\frac{1}{4}$ fathoms, sand and mud, under Rennel Island, a cable's length from shore. The next day, at 7 A. M., made sail; at 8 o'clock, off Arden Island; at 10 o'clock, passed to the northward of Village and Cocoa-nut Islands, and to the

southward of the Sisters Bet, Sue, and Poll. At 4 in the morning passed between Double and Wednesday Islands; at 6.30, the west point of Goode Island bore south one mile distant.

Thus, by this route, the passage of the strait was accomplished in 34 hours, of which 15 were passed at anchor under Rennel Island: and 13 days only from Sydney.

This channel, says Captain Bannatyne, one of the best I have seen, seems to me destined to become the one course for vessels from India to the east coast of Australia and back, especially for steamers. The New Guinea or Bligh Channel is, according to Captain Bannatyne, the best that can be taken, whether from the Indian or the Pacific Ocean, and that either with the N. W. or S. E. monsoon. We have shown how opinions differ with regard to the routes to be pursued in these parts, and we will leave it to captains to make their selection.

We give below the comparative advantages of each of these routes,* according to Robson, who has long studied this question.

“The advantages of the inner passage are,—it has been fully and ably surveyed; it is well delineated in excellent charts; sailing directions for its whole length are published; entrance to this passage is effected without difficulty or intricacy round Break-sea Spit; that extremity of the strait, under favorable circumstances, may be sailed for a considerable distance during the night, and anchorage is attainable at any spot where it may be requisite to bring up. Against these, it is common to balance the disadvantages of such protracted straits navigation, the increased distance of full seven hundred miles,† through which a ship is kept entangled amongst the reefs, while by the other route she would be sailing on an open sea; the labor of so frequently anchoring, and the loss of time.

“The advantages of the passage by the Barrier are said to be the shortness of the route and the consequent saving of time, an

* *Nautical Magazine*, 1837, p. 68.

† G. W. Earle says the opposite, and shows that the inner route is shorter by 200 miles than the outer route.

open sea as far as 12° south, the accuracy with which the openings in the reef are now known, and the shortness of the distance thence to Bird Islands, where the two routes unite, so that a ship may pass the straits with only twice anchoring, or at most four times.* All these points may be admitted as true.”

We now come to consider the Great Barrier itself. Commencing at the south, and running toward the north, we find the first and second Three-mile Pass, that which, in 1780, Bligh's boat entered, the one where the *Hibernia* passed in 1810, the one where Captain James Cook entered in 1770; further north still are Nimrod, Brown, Winter, † Stead, and Grove Passages, and some others without names, believed to be also safe. These passes are tolerably well known; finally, north of Raine Island, there are Yule, Fly, Cumberland, and Flinder's Passages, the two last situated near the Murray Islands.

“Now, from the above statement it would seem that the advantages lie greatly on the side of the outer passage, but notwithstanding all that appears so favorable, I must still consider the inner route the best, and this in regard of one circumstance of paramount importance, namely, the weather. It appears that throughout the period of the easterly monsoon the weather is unsettled, and fine clear weather with a steady monsoon breeze is interrupted by dark squally days with thick weather and rain. Approaching the Barrier under such circumstances would be peculiarly hazardous; for as there is no anchorage nor shelter to windward of it,—nothing but an open, unbounded ocean,—a ship so caught, and obliged to carry off a danger of such magnitude against a heavy sea and lee current, would be in imminent peril; and although a commander may have gone by that route many times, and may have invariably experienced fine weather, no man knows what is before him; and what others have found to be the case, he also may, to his cost.”

* It will be perceived that Robson does not speak of Bligh Entrance.

† Winter Pass, discovered in 1831 by Captain Richardson, is situated nearly in $11^{\circ} 58'$ south latitude and in $143^{\circ} 47' 36''$ east longitude. This pass is safe, deep, and about three quarters of a mile wide. (*Nautical Magazine*, Vol. I. p. 116.)

Robson mentions here, in support of this opinion, several examples which we need not repeat. He then compares the length of passage by the outer route with that by the inner route, of which he says the length and fatigue have been exaggerated. Thus the *Flora* took 22 days to go from Sydney to Torres Strait by the outer route, the *Bentinck* 28 days, the brig *Joseph Winter* 22 days; by the inner route a convoy of 8 ships, convoyed by the steamer *Crocodile* sailing from Port Jackson, arrived at Booby Island in 23 days; the brig *Helen* and the *George Hibbert*, sailing together from Sydney and forced to anchor several times, reached Booby Island in 29 days, of which 11 days were passed at anchor on account of a very unusual period of bad weather. Finally Robson, whose discussion we abridge considerably, concludes by some directions relating to Stead's Passage, which we give here, as they might in certain cases be useful.

“ In some directions which have been published for the Barrier, particularly Stead's Passage, it is recommended for a ship to make the detached reef lat. $12^{\circ} 0' S.$, and to run along its *northern* side as she advances towards the Barrier. With all deference to the sentiments of a clever practical navigator, who gives this advice, it nevertheless seems to be very questionable, the prevailing winds being from the southward of east, varying from about E. S. E. to S. S. E. Stead's Passage will be found situated towards the leeward angle, or bend of that deep indentation which is formed in the Barrier between the latitudes of about $11^{\circ} 51'$ and $12^{\circ} 7'$; consequently, if with the wind at southeast a ship passes along the *northern* side of the detached reef, and stands on from thence for Stead's Passage, she runs into a leeward bight, she has but one more known passage — i. e. Grove's — to leeward of her, and should the wind veer more southerly, she might find some difficulty in passing Stead's Passage,* which is tortuous, longer than some others,

* This objection appears to us unfounded, for there is a broad passage between the large detached reef situated north of Raine Island and the Great Barrier, and, besides, the ship will have to leeward the Raine Island passages, which appear to us, in all cases, much preferable to Stead's Passage, lying across the Ashmore Banks.

and has the objection of a shoal patch in the fair way, which, though believed to have plenty of water over it, is nevertheless a valid objection, while the actual depth of water remains uncertain.

“But if, on the contrary, a ship having made the detached reef passes to the *southward* of it, she will then approach the Great Barrier to windward; and in proportion, as the wind is southerly, she will get into perfectly smooth water under the lee of that bend of the reef, i. e. the main Barrier, which runs to the eastward in about $12^{\circ} 7'$ or $12^{\circ} 8'$. Hence, being on the weather side of this indentation, she will have the advantage of choosing her opening. She will see, as she approaches, the Nimrod's entrance nearly right ahead, and, supposing she does not take this, then bearing along the face of the Barrier, she will have each of those known and approved passages which are given in the chart, opening in succession as she advances, or runs to leeward, and may adopt that which she can most conveniently sail through, or may otherwise be induced to adopt.”

This opinion, Robson adds, is not only mine, it is also that of Captain T. Johnson, of the *Recovery*.

We give, also, concerning the outer route, the opinion of Captain Mackenzie, who has been a long time in this vicinity, and from whom we have already borrowed several directions in the *Considérations Générales*, etc. The *Gambia* made the passage from Sydney to Booby Island in 12 days, taking the outer route and Bligh Passage. We will not repeat this route, previously given at page 156, and described in detail in the *Nautical Magazine* of 1852, page 556. We will only quote some of the observations made by Captain Mackenzie.

“The Prince of Wales Channel seems at all times preferable to Endeavor Strait, it being well buoyed, marked, clear of sunken rocks, and with moderate depths to anchor in at any time or spot, whilst the four sunken rocks discovered in Endeavor Strait, as well as the one found between Entrance and Little Woody Islands* since the last careful examination by

* These dangers are laid down on the corrected chart of Blackwood, No. 1748.

H. M. S. *Rattlesnake*, renders it anything but a safe navigation, and for the above discoveries need not to be used during the night.

“The only risk I can perceive in the adoption of the passage we have made by Bligh Entrance, may be from natives, and all the sound arguments advanced by Captain King, in favor of the outer route as well. The Eastern Fields, coast of New Guinea, with Portlock and other reefs, prevent any sea from getting up, as prevails outside the barrier. In our case we had soundings to guide us, and no risk or cause for anxiety. The distance through the strait from east to west (East Key to Booby Island) is less entering than any other route. The sun never shines ahead to dazzle the eyes, — no higher course than S. S. W. is required, and even should the wind become scant, there is not only ample room to work, but in the event of very thick and squally weather occurring, plenty of anchorages at any time in moderate depths. Once N. N. E. of Darnley Island, there is no risk in keeping under sail in a clear night, or at any rate in a moonlight night, as far as Wednesday Island. One would suppose, after reading Captain Blackwood’s account of this passage in the *Nautical Magazine*, and a sight of his chart, that it would at once, during the easterly monsoon, supersede every other route for merchant ships, were it not that constantly each season we see the effect of old prejudices, which lead parties (risking, we conceive, thereby their insurance) to prefer Stead’s and other passages to that of Raine Island, *after* the erection of the beacon, and the publication of the charts and directions, from which period no one could be justified in adopting any other than Captain King’s inner route for it.* In the westerly monsoon, by the *Rattlesnake’s* late surveys, vessels would be enabled to take this passage and run down their easting to a position enabling them to enter and cross the southeast trade to advantage.”

* That is, the route by the Prince of Wales Channel as far as Cape York; then the one that we have described from King, from Cape York to Bird Islands; and that which we have given from Blackwood, from Bird Islands to Raine Island, taking these several routes in the inverse direction.

To resume: for the inner route we have the very influential opinion of Captain King, that of Robson, and even that of Captain Blackwood, who looks upon this route as the safest; for the outer route, we have indisputable facts, opposed to those cited by Robson; this route is evidently the shortest, as Captain Blackwood tells us. We have thought proper to point out to seamen these differences of opinion with regard to the advantages and disadvantages of the two routes; without entirely settling the question, they tend to throw light on it, and consequently will assist them in making a selection. If we were obliged to state our own opinion, we should say that it was best to take the inner route when not pushed for time; the outer route in the opposite case. It is probable that this last will be the route most generally chosen by merchantmen, to whom a quick passage is a prime consideration. In this case we should take Bligh Channel, and then Prince of Wales Channel, or *vice versa*, according as we came from the east or the west.

Route from
Port Jackson
to India
through Pitt
Passage.

From March
to September.

The best route that can be taken to India or China, sailing from Port Jackson, not wishing to take the southern route through Bass Strait or the northern through Torres Strait, appears to be the one passing eastward of New Guinea through Pitt Passage,* and crossing Java Sea from east to west, or leaving it by taking Ombay Strait. In this latter case, after having left Java Sea, the course is south of the Sunda Islands.

This route, as well as the northern one, must only be pursued from March to September; that is to say, when the southeast monsoon prevails south of the Equator.

Sailing from Port Jackson or Van Diemen's Land, run east,

* The so-called Pitt Passage is the space of sea bounded west by Boutong Island, east by Salawatty and Batenta Islands, which comprise Pitt Strait. Pitt Passage is bounded south by Bouro, Ceram, Mysole, and the adjacent islands; north by Xulla-Bessey, Oby-Major, and by the chain of small islands which extend from the latter to Pulo-Popo. Pitt Passage communicates with the Pacific Ocean through the strait of the same name; through Dampier's Strait, contained between the islands of Batenta and Waygiou; through Gilolo Strait, formed by Waygiou Island and Gilolo Island. This last is the widest.

a little north, up to the meridian of 160° east longitude ; then steer north, keeping nearly on this meridian, and passing east of Howe Island, Middleton Island, Wreck Reef, and Cato Bank.

Captain Bristow, however, thinks that it is preferable, sailing from Port Jackson, to follow the coast as far as Sandy Cape, and to pass west of the reefs we have just named.

In this way the ship passes west of New Caledonia, keeping a good lookout for the dangers in this vicinity, and runs for Cape Saint George, the southern point of New Ireland.

When making for Saint George's Channel and Pitt Passage, it is necessary to keep at no great distance from the coast of New Guinea, mistrusting the easterly currents and light northwest breezes, frequently met with north of the equator, which sometimes drive vessels very far out to sea ; the vessel should, therefore, on reaching the meridian of 134° , keep near the coast of New Guinea, when approaching Pitt Passage with the southeast monsoon (from March to September).

Instead of taking Saint George's Channel, the vessel may enter the one contained between New Britain and King William's Cape, leaving Rook Island on the east or west ; she will then steer to pass between Lottin Island and Long Island, or double the latter to the west, according to circumstances. She will then coast the shore of New Guinea, passing north of the neighboring islands, from the Gulf of the *Astrolabe* as far as the island of Dumont d'Urville, and follow the coast as far as the point of the same name ; from this point she will shape her course to pass north of Traitor's, Mysory, and Providence Islands, then follow the coast of New Guinea to Cape Mamori, and, keeping near shore as far as Cape Good Hope, she will reach Pitt Passage by Dampier's Strait. This route, followed by the *Astrolabe*, is shorter and more direct than that through Saint George's Channel, and is not so dangerous.

On reaching Pitt Passage by Dampier's Strait, or by whichever appears the most suitable, adhere to the different directions we have given for sailing in the Indian Ocean (page 189) on the return from China through Pitt Passage, passing east of the Philippine Islands.

When the northwest monsoon prevails south of the equator, a vessel bound to India must not, as in the route above described, coast along the shores of New Guinea. In November, December, and January, it is better to run north as far as the parallel of 5° north latitude, near which the northeast trade-winds will be met with. At this time of year pass south of Mindanao, through Basseelan Straits, cross Sooloo Sea, then enter China Sea through the Straits of Balabac, rounding the northern point of the islands of Benguey and Balambargan. Thence, crossing China Sea, make for the Straits of Malacca. This route is, undoubtedly, the best that can be taken bound to India during the northeast monsoon, sailing from the ports of the east coast of Australia or of Van Diemen's Land.

A vessel leaving the ports of the east coast of Australia or of Van Diemen's Land, bound to China or India, during the time when the northwest monsoon prevails south of the line (from September to March), and not wishing to take the southern route through Bass Strait, will meet with strong breezes by taking the eastern route; that is, a route still more easterly than the last mentioned. There are, in this case, two routes pretty generally used: one passes west of New Caledonia, New Hebrides, and Santa Cruz Islands, and east of the Solomon archipelago; the other passes east of New Caledonia, New Hebrides, and Santa Cruz Islands. These two routes coincide nearly with what we have described as the Great Eastern track, from the Cape of Good Hope to China.*

To follow the first of these routes, on leaving Port Jackson stand E. N. E. to take advantage of the regular breezes found at sea, and, on reaching the meridian of 160° east longitude, pass to the eastward of Howe and Middleton Islands, running north; as there are often southwest winds near New Caledonia, it must not be approached too closely. After having doubled this island, which must be passed to the west-

* *Considérations Générales sur l'Océan Indien*, p. 175.

ward, run north on the meridian of $164^{\circ} 20'$ for the channel lying between the Santa Cruz Islands and the archipelago of the Solomon Islands.

This archipelago being rounded, if, in the first months of the monsoon, the vessel is bound to China, she will cross the archipelago of the Caroline Islands, running north; when clear of this archipelago, she will steer to run near the point of Guam Island, where she will take one of the channels between the Ladrone Islands; she will then stand on next through the passage or Strait of Formosa, then between the Bashee Islands.

In case of not arriving at the Solomon Islands till after the month of January, the period at which the winds of the north-east monsoon slacken in the China Sea, the ship could pass between the islands of Gouap and Goulou, or between this latter and the Pelew Islands; thence, she should steer to round the northeast point of Luzon, then take the most convenient channel for crossing the Straits of Formosa and reaching China.

The second eastern route from the ports of the east coast of Australia or Van Diemen's Land to China is Second Eastern Route. longer than the preceding; but it has fewer dangers, and has also the advantage of more regular winds than those west of New Caledonia and New Hebrides; in keeping to windward of all these islands, it is only necessary to look out for the westerly currents met with in crossing the belt of the southeast trade-winds.

On leaving port steer to sight Norfolk Island, or to pass a little to the eastward of it; thence steer to make Matthew's Island (or volcano), visible 24 miles off. Pass to the eastward of New Caledonia, New Hebrides, and the neighboring islands, and leave the Feejee Islands on the east; round the New Hebrides at a convenient distance, keeping on the meridians of 171° or 172° . If not able to weather Erronan Island, the most easterly of the latter, pass into the channel that separates it from Tanna; then stand north as far as the parallel of 13° south latitude. If the New Hebrides have not been seen, endeavor to sight Tucopia, or Fataka Island; then continue to run north so as to cross the

line between 160° and 168° east longitude. As the westerly currents are in general strong, endeavor to reach the Carolines on the meridian of 163° , and, in case the line has been crossed in 160° or 162° east longitude, endeavor to pass through this archipelago between the meridians of 156° and 155° . When clear of the Carolines, pass south of the Ladrões or through one of the channels between these islands; then shape the course for the Straits of Formosa to enter the China Sea.

In the routes that we have just described, if any delays occurring during the voyage should prevent arriving in the China Sea till after the end of the northeast monsoon, the latter part of the route might be changed from north of the equator. In that case pass south of Mindanao to take Basseelan Strait; or passing through the Philippines, take the Strait of Panaon or Surigao, or still better that of San Bernardino. The first is north of Mindanao; the second, north of Samar. The first leads into Sooloo or Mindoro Sea; the second, into the China Sea, north of Mindoro. It would do equally well, passing south of this last island, to take Mindoro Strait. The Strait of San Bernardino is generally taken in preference to Surigao Strait for passing from the Pacific Ocean into the China Sea.

DIVISION III.

We have treated the general navigation of the Pacific Ocean and that of the coasts forming its western boundary. We will now pass to the navigation of the east coast of this great sea, and commence with the directions for passing from the Atlantic Ocean into the Pacific, doubling Cape Horn.

The seamen who have doubled Cape Horn have given different directions in some respects. Among the various opinions, we adopt those which appear to us best established, and, before pointing out the most approved routes, we will speak of the most favorable season for doubling Cape Horn from the east. This is still one of the points on which navigators are most divided. We give, on this subject, the opinion of Captain J. Weddell, Master, R. N.

Doubling Cape
Horn from the
Atlantic Ocean

This opinion is not the result of a single voyage, but that of an experience of five years' navigation in this vicinity. Captain Weddell considers the months of April and March the worst months for doubling Cape Horn.

“The difficulty, however, in making this passage is removed by choosing the proper season, which, when attended to, must at least save much time, and wear and tear of the ship. In the beginning of November the winds begin to draw from the northward, and continue to be frequent till about the middle of February, when they shift into the southwest quarter; during these months the westerly winds are not lasting, hence the passage may be easily effected. From about the 20th of February to the middle of May, the winds are generally between S. W. and N. W., and blow with great violence. During this interval, no ship need expect to make a passage round the cape, that is not well equipped in every respect. From the middle of May to the end of June, the winds prevail from the eastward with fine weather. During these six weeks, a vessel may round the Cape in sight of the Diego Ramirez. In July, August, September, and October the winds prevail again between S. W. and N. W.; but August and September are more particularly tempestuous. In regard to the route which ships should take round the cape, much depends on the season of the year, as relates to the force of the prevailing westerly winds. I prefer, at all times, passing to the westward of the Falkland Islands; and, in the summer season, to pass through Straits Le Maire, as it saves 50 or 60 miles of westing, and can be attended with no risk if you have sufficient daylight to see to run back through the straits, in the event of being caught with a southerly gale at the southern entrance.

Favorable
season for
doubling the
Cape, coming
from the east.

“Cape Horn lies from Cape Good Success S. S. W. $\frac{1}{2}$ W. distant 31 leagues. In this line lies Barnavelt's Island. If intending to touch at an anchorage about Cape Horn, a S. by W. $\frac{1}{4}$ W. course through the night will but well avoid the indraught which sometimes sets to the northwest among the islands, at the entrance of Nassaire Straits; if not intending to go into harbor,

a south course from Straits Le Maire to the south of Cape Horn, edging to the westward, and passing the Diego Ramirez on the south side, at the distance of a few miles, is the most advisable track. Ships working to the westward, off the cape, in the summer season, should stand towards the shore of Tierra del Fuego in the evening, when the wind will often be found to draw from the northward off the land, and western again in the morning.

“These observations refer to the seasons I have recommended for passing the cape; but during those months which are attended with the most violent gales, viz. March, August, and September, I have only to recommend the advice given by Commodore Anson, that of standing to the southward, in the latitude of 60° , where the sea is more regular and the winds more equal. If, however, a ship be making a coasting passage, and should require to anchor, the following instructions may be found useful. The prominent situation of Cape Horn at once points out the neighboring bay of Saint Francis, in which are two harbors perfectly safe for vessels of any draught of water. Their approach is so easy as to make it necessary only to remark, that Wigwam Cove is the second opening on the west side of the bay, and by steering along the western shore about N. by E. it will be easily found.

“On account of the violent gusts that blow out of the cove in westerly gales, a vessel had better anchor at the entrance, where is 21 fathoms water, and a bottom of sand and mud, and wait an opportunity of kedging into the cove, till South Head shuts in Cape Horn, when the anchorage will be perfectly safe.

“The second harbor in this bay is pointed out on the chart by the name of Maxwell’s Harbor. The entrance is on the north side, between Saddle Island and Jerdan’s Island; but is so narrow, that with a contrary wind a vessel must anchor at the entrance, and kedge to her berth, which may be chosen at pleasure, every part being perfectly secure. Here the water is so smooth that repairs upon a ship can be carried on with great convenience. Wood is abundant on the south side, and water may be obtained in several places.

“In proceeding westward, New Year’s Sound next presents itself. In this sound are several anchorages, but Indian Cove may be considered the most commodious. Indian Island stands at the mouth of the cove, and bears from Sanderson’s Island at the entrance of the sound W. N. W., 16 miles. The anchorage in this cove is at the upper end, in the south corner, in 14 or 15 fathoms water, within three cables’ lengths of the shore; in most other parts the ground is rocky, and the water deep. The entrance not being more than three fifths of a mile broad, a large vessel in working against a strong southwest wind, which blows out of the cove, would require to be worked quickly to take advantage of the flaws of wind that play about the entrance. The shoals and spots of foul ground are indicated by kelp about them, and should consequently be avoided. At the entrance of the cove on the south side of Mid-channel are two patches; in the inner one is a depth of three fathoms, and in the outer one eight. The tide flows on the full and change of the moon at fifty minutes past three, and rises about seven feet. Wood and water are abundant, and can be conveniently procured.

“Clear Bottom Bay is an anchorage which, by being close to the coast, is convenient for a vessel to touch at for wood and water; to sail into it from sea, bring the east Il Defonsos S. $\frac{1}{2}$ E., and steer N. $\frac{1}{2}$ W. for Turn Point. About a mile and a half to the E. N. E. of this Point is the anchorage, and at the distance of three cables’ lengths from the shore, in 22 fathoms water, in a bottom of sand and clay, is the most eligible berth.”*

Such are the directions of Captain Weddell. We will now describe the course to be pursued in doubling the cape.

As we have before said,† Captain King advises, when doubling Cape Horn from the Atlantic, to keep within 100 miles of the east coast of Patagonia. Captain Fitz-Roy is not of the same opinion. I do not think, he says, that it is important for a large, well-built ship to keep near the east coast of Patagonia. The sea, it is true, is smoother there; but the currents near the coast set north with

* This quotation from Weddell extends a little beyond that of the Author. — *Editor*

† *Considérations Générales sur l’Océan Atlantique.*

more strength than farther out at sea. However, in sight of this coast ice is never found, whilst farther east it has been met with, even north of the parallel of 40° south latitude. Instead of running south as far as the parallel of 60° S., as King advises, I should prefer to work to westward near Tierra del Fuego, toward Nassau Bay. In Orange Bay, a vessel may wait for the favorable moment to make a long stretch to the westward. If disappointed in this, she may return to anchorage under Black Island in Euston Bay, or anywhere else, and await there a more favorable opportunity. The principal object is to make as much westing as possible, until reaching the meridian of 82° west longitude.* There is no ice to be found near Tierra del Fuego, but it is often encountered at sea off this island. By the route here pointed out near Cape Horn and the land, many dangers and much straining and injury will be avoided, by remaining quietly at anchor during the bad weather, and taking advantage of the change to fair weather or favorable wind to work to westward. It appears from this that Fitz-Roy advises in all cases the course near the land. Weddell's opinion is different, for he advises this route during the summer, and the open route on the parallel of 60° or thereabouts, during the winter.

We ought to say that Fitz-Roy's opinion in this respect is supported by Cook, La Pérouse, and Krusenstern, and that Captain Beechey holds the same view. I do not see, says the latter, the necessity of running south to double Cape Horn; I only recommend one thing, that is to take the tack that will make most to the westward, without a particular regard to the latitude otherwise than to pass 20 leagues south of the cape. With northwest winds, I should run southwest; with southwest winds, northwest; and, in case the wind did not favor me on either tack, I would take the southern one, unless I was in too high a latitude. The strongest winds do not prevail near the coast, as is thought; it is quite the contrary, and, at 30 miles distance, the sea breaks, owing to the inequality of the bottom. There

* With a fast ship, it would be sufficient to work up to the west as far as long. 80° W.; with a dull sailer, it would be prudent to work up as far as 85° W.

is, however, a serious objection to approaching the land east of Cape Horn, in consequence of the velocity with which the current sets across Le Maire Strait, especially with the south winds. This does not take place westward of Diego Ramirez Islands, and I see no objections to approaching the land here, at least to within 40 or 60 miles. In the vicinity of Diego Ramirez I found little or no current.

When doubling Cape Horn from the eastward, pass inside of or west of the Falkland Islands, and keep east of and as near as possible to Staten Island, because southwest winds are most frequently met with as soon as the Pacific Ocean is opened. The northwest wind off the Falkland Islands usually hauls to the west and southwest near Staten Island. With a west or southwest wind off this island, there is nothing to be done but to run south. It is best, however, not to make this a long tack unless westing is made. If not, even if little or nothing is made on the other tack, the land should be kept aboard, for there is no advantage in running south, except to avoid losing in longitude. But the coast to the eastward of Cape Horn should not be approached too near.

Such are the most general rules for doubling this cape.

As to the passage through the Strait of Le Maire or outside of Staten Island, opinions are divided. Prudence dictates taking the latter course, although the passage through the strait makes to windward and shortens the route. In any case, with a south wind, it is best not to pass through the strait, for with a windward tide the sea in this strait becomes very heavy. In a calm, it would also be imprudent to attempt it, for fear of not reaching the west side of the strait (the part for anchoring), on account of the tides setting on the Staten Island side. Everywhere else the anchorage is in deep water, and very near the shore. With winds from the northward, however, this route appears very advantageous. Such is King's opinion. Captain Fitz-Roy, whose authority in this particular is supreme, thinks there is neither danger nor difficulty in passing through the Strait of Le Maire. The only danger that appears to exist, and that without good

grounds, would be a calm. Vessels from the south are little exposed to this danger with southwest winds, unless they are light, and, in that case, they will probably be found from the northwest in the northern part of the strait. Good Success Bay is admirably situated for giving shelter, if wind or tide fail.

In doubling Staten Island to the southward, the tide-rips, which extend some distance from Cape St. John on the northeast part of the island, must be avoided; beyond this there are no other dangers near this island.

These directions are sufficient to give seamen an idea of the manner in which they may double Cape Horn from the east.

It is said by most seamen who have navigated in this vicinity (King, Basil Hall, Beechey, La Pérouse, etc.), that the barometer gives no reliable indications near Cape Horn, and cannot be considered as sure a guide as it is in the middle latitudes. Thus, although the mercury often rises or falls before a change of weather, more frequently still its rise or fall follows this change. The mean height of the barometer is 29.5ⁱⁿ. In northwest winds the mercury is low; if it falls to 29 or 28.8, a southwest wind may be expected, which does not commence until the column of the mercury has ceased to fall. It often happens that this fall takes place without being followed by any change of weather.

Straits of
Magellan. We shall not speak here of the Straits of Magellan; the navigation in this strait is wholly local, and, consequently, we will refer to King's directions for the coasts of Patagonia, for passing from the Atlantic to the Pacific Ocean through this strait. With a steamer, especially if small, this passage may be very advantageous; with a sailing vessel, the passage is very long and often dangerous.

For a small vessel going from the Pacific to the Atlantic Ocean, the passage through the Straits of Magellan is, on the contrary, very advantageous. It is, in all cases, the most secure route; the passage will be nearly as quick and less dangerous than doubling Cape Horn. Proceed as follows. Enter the Gulf of Trinidad, pass through Conception Strait, Sarmiento or St. Esteban Strait, then Smyth Channel, and enter the strait at

Cape Tamar. In these channels north winds prevail, and good anchorages for the night can be found.

For passing through the Straits of Magellan from the east, the winter months are without doubt the best. Coming from the west, the summer months are preferable; the nights are short and the west winds steady.

In doubling Cape Horn to pass from the Pacific into the Atlantic Ocean, no other difficulties are encountered than those caused by bad weather, heavy seas, and floating ice. This passage is therefore very easy for a large ship, and the summer months (January and February) are considered the most favorable for making it. On doubling Cape Horn with a small vessel, it will be well, for the sake of smoother water, to pass inside of the Falkland Islands, and even to go through Le Maire Strait. With a large ship, Beechey thinks it is preferable to pass south of the Falkland Islands, especially in winter, because then the winds tend to haul to the east, and by keeping outside the ship can fetch River La Plata, or very near it, on the starboard tack.

Doubling Cape Horn from the west.

One of the greatest dangers incurred in doubling Cape Horn is undoubtedly the sudden encounter during the night with a low iceberg, when it blows fresh and there is a heavy sea. According to all navigators, it appears that it is in the winter and the spring months (July, August, and September) that they are most frequently met with; sometimes these floating masses are only a few yards above water, and are consequently very difficult to distinguish by night. In winter the risks in this respect are very great, and most so far south of the cape. It is with high winds and a heavy sea that most icebergs are seen. Consequently, as Captain Basil Hall advises, in bad weather it would be prudent during the night to lie to; with fair weather and a dark night, a little headway may be kept with the brightest lookout. Above all, set the sails so that the lookout can see clear all round. There occurred to me, says Captain Hall, a precaution worth mentioning: having reefed the topsails and courses, the yards were braced *nearly* up, the bowlines hauled and ²¹

kept ready to go about in the night, whatever direction the wind might come from. In this way, if ice was made ahead and near, the ship could either tack or bear up, as requisite. In any case, the yards being braced in a little, the ship was ready for any evolution.

The preceding directions contain the necessary information for doubling Cape Horn under the most favorable circumstances. We shall now give the navigation along the west coast of America.

Doubling Cape Horn bound to San Francisco. When doubling Cape Horn bound to San Francisco, the ship will not stand to the northward after reaching the meridian of 82° or 84° W., as directed on page 170, but will continue to the westward, so as to be between the 87th and 88th meridians of west longitude when abreast of Chiloe. She will then shape her course to cross the equator between the longitudes of 112° and 120° W., and stand to the northward, keeping the starboard tacks aboard until San Francisco bears E. N. E.; or until the ship, having run into the variables, is able to head for her port. The object of making westing near Cape Horn is that the ship, on entering the south-east trades, can steer her course with the wind free, and all sails drawing.*

Navigation of the west coast of America. The navigation of the west coast of America offers no difficulty in going from south to north, only care being taken to keep in Humboldt's Current going north; in sailing along the north coast during summer, the ship must keep in the Mexican Current. Thus the voyage is easy from the Straits of Magellan to Acapulco. The monsoons of the coast of Chili must be taken into account, and the voyage will be shorter or longer, according as the existing monsoon is favorable or contrary.

A ship bound to Acapulco, and arriving on the coast of Mexico in winter, — that is, at the period when the current sets south-east and the monsoon is blowing from northwest, — must keep

* These directions for vessels bound to San Francisco are prepared by Mr. George W. Blunt, and introduced by the *Editor*.

off the coast after crossing the equator, and shape her course in such a manner as to pass a little to the east of Clipperton's Rock, in order to be out of the influence of the contrary current and monsoon. She will go north of the parallel of Acapulco, and be careful to make the land north of this point.

Thus, bound from Cape Horn to the Mexican ports, Captain Osborne shows that by taking advantage of ^{From Cape Horn to Mexico.} the winds from the south, which are the winds that generally blow on the south coast of America, a ship must shape her course to cross the line in 98° west longitude, so as to get into the northeast trade-winds on a meridian of 6° or 7° to the eastward of the port (San Blas or Mazatlan), and to avoid the westerly currents as well as the variable winds met with in the vicinity of the Galapagos Islands. To go from these islands to Cape San Lucas, says Captain James Wood, it must be noticed that the trade-winds do not blow with force and regularity east of a line drawn from the cape to the Galapagos Islands. In this archipelago, the southeast winds are well established during 9 or 10 months of the year; it is in January, February, and sometimes in March that they are interrupted by long calms or by occasional winds from the N. and the N. N. W., which never have much strength. North of the archipelago, the eastern limit of the trade-winds seems to depend on the season of the year. In the beginning of April it has been found, that between the parallels of 8° and 13° N., this limit is 900 or 1,000 miles farther east than in the month of June, and in the other months it was more or less to the west as the season was more or less advanced. But in no case are the trade-winds to be met with anywhere so fresh and so regular as in the space west of the line we have mentioned. It is the prevalence of westerly winds and of calms, added to contrary currents in the space contained between the coast and this line, that render it so difficult to work to the west on leaving Panama. It has sometimes taken 40 days from the Bay of Panama to reach the meridian of 110° W.; the limit of the trade-winds; a distance of about 2,000 miles.

When in the trade-winds, the ship may make a west, south, or

north course; it must be remembered, we repeat, that the eastern limit of these winds depends on the season. Thus, in June and July fresh breezes from N. N. W., and even sometimes from the N. W., are found as far as the meridian of 125° W.; whilst in March and April light winds from the N. N. E., shifting to E. and E. S. E., have been met with on reaching the meridian of 98° W. These winds have extended gradually as far as the meridian of 110° (that of Cape San Lucas), to the westward of which the breeze was fresh from the N. N. E.

As a general rule, it is found that the wind hauls to the eastward in proportion to the distance from the land, without regard to the latitude.

Navigation on the coast of Chili. There are only two ways to navigate on the coast of Chili. In going north, steer for the port of destination, either directly, or as near as the winds permit.

In going south, also steer for the port of destination in the event of having a favorable wind. In the contrary case, keep as close to the wind as consistent with keeping a good full; for the principal object is to cross as soon as possible the contrary winds, in order to reach a latitude where the vessel can head directly for her port. It is always important on a wind to keep a good full.*

Navigation of the coast of Peru. There is no difficulty in sailing along the coast of Peru to the northward.

Route from Valparaiso to Callao. Thus, to go from Valparaiso to Callao, says Captain Basil Hall, the wind is almost always from the same point, — that is, from S. S. E.; it varies at times one or two points towards the east, and the voyage is always safe and easy.

The only precaution necessary is to stand off immediately from the land running northwest and keeping 150 miles from the coast, and then to steer directly for the island of San Lorenzo, which is high and easily recognized, forming the east entrance of the Bay of Callao. Usually the Morro Solar, which is about 10 miles south of Callao, is first made, and then the course is laid for the bay through the Boqueron Passage, or else

* Captain Fitz-Roy.

by rounding the northern extremity of San Lorenzo. On entering the Boqueron Passage, it is necessary to sound constantly, take bearings, and have an anchor ready to drop at an instant. The passage from Valparaiso to Callao is on an average 9 days.

To navigate the coast of Peru from north to south, requires a certain skill and a good deal of practice. There is some difference among seamen concerning the preference to be given to the inshore or offshore route. Captain Fitz-Roy gives the following directions concerning this navigation.

On leaving Guayaquil or Payta bound to Callao, Route from Guayaquil or Payta to Callao. beat along the land till up with and outside of the Lobos Islands. Endeavor to be always near the coast soon after sunset, for that is usually the moment when the land breeze begins to blow. Although light, it often allows the ship to hug the shore during the night, and leaves her in a good position for the commencement of the sea breeze.

After doubling the Lobos Islands, it is well to work up on their meridian until near the parallel of Callao. Then steer towards the coast, and if that stretch does not fetch the port, beat along the land, as we have said above. This passage, with a fast ship, is in general 20, and often 18 days.

The attempt has been made to perform this passage by keeping the offshore tack during several days, in the hope of fetching the port on the other tack; but generally little is gained in this way, on account of the north current experienced in approaching the equator.

From Callao to Valparaiso, it will without doubt From Callao to Valparaiso. take much longer to work to the southward along the coast than to cross, keeping a good full, the belt of the south-east trade-winds, to the southward of which are always found west winds. For the intermediate ports, however, except Coquimbo, the case is different, for they are situated within the belt of the trade-winds. To reach these ports, it will be well to work to windward near the land, as we have said above, till up with the island of San Gallan. From this island, the coast, trending more to the east, allows the ship to make a long and a

short leg, taking care to keep the land always in sight till reaching Arica, or one of the ports situated between it and Pisco.

On leaving Pisco, the coast running nearly north and south, bound to the southward, it is best not to go farther from land than 15 or 20 leagues at most, so as to be sure to keep the sea breeze, and to beat on this meridian till on the parallel of the port of destination. On no account should the vessel make long offshore tacks, for in approaching the trade-winds the breeze turns gradually toward the east, and there is often great difficulty in even regaining the point left.

With a very dull sailer, it would do better to cross, keeping a good full, the belt of the trade-winds and get into the variables, returning north along the coast, than to try without success to make way against the trade-winds, which never vary more than a few points.

The average passage of a fast merchant vessel from Guayaquil to Callao is 15 or 20 days, and from Callao to Valparaiso about 3 weeks. In peculiar circumstances, — such, for example, as a northerly gale after the departure from Callao, — this passage has been made in much less time.

The prevailing winds along this part of the coast of Chili being from the southward, it will be necessary, in going from Valparaiso to Concepcion, to take advantage of every change in the breeze to get to the southward; beat in this way along the land, for it is seldom that the winds remain steady for 12 hours in succession. The passage from Valparaiso to Concepcion is generally made in 10 days.

Captain James Wood says that the voyage from the southward to the Bay of Panama can be made without difficulty during the greater part of the year; but in the fair season, when the north winds prevail, the following route may be pursued. Beat with short tacks near the land, because there is a current running north, which extends only a few miles off the coast. When this current ceases, there are at least regular tides, while at sea there is a steady current in the contrary direction. Between

From Valparaiso to Concepcion.

Navigation on the coast of Mexico.

Route from the southward to the Bay of Panama.

Chirambira Point and Cape Corrientes, the coast is bordered with banks formed by the rivers emptying here; but after doubling Cape Corrientes, the coast may be approached very near, except abreast Point Francisco Solano, where some patches of rock project from the shore. A vessel must not, however, get into the belts of calm occasioned by the high lands, because it is very difficult to get the breeze again, and because a heavy swell sets on shore, where there is no anchorage except very near the rocks.

In the Bay of Panama, during the fair season, the Eastern Channel, between the coast and Rey Islands, should be preferred; for there are no dangers, with a single exception. The sea is smooth, and, the tide being regular, it is easier to gain to the northward there than in the centre or on the west coast of the bay, where there is a strong current and a heavy sea. During the rainy season, a direct course in the bay is preferable to the one through this confined passage, for the current then depends on the prevailing wind.

There is always great difficulty in going to the south or west on leaving the Bay of Panama. It usually takes two days to get out of the bay, either beating along the coast against contrary winds, and contending against the current, or else standing off far enough to the southward to be able, on the starboard tack, to fetch the port of destination. Both routes are very tedious, and it often takes 20 days to go to Guayaquil, while from that port it takes 6 or 7 days to go to Panama.

Leaving Panama, bound to the westward during the season of the northerly winds, long delays will be avoided, by keeping near the coast and taking advantage of the changes of these winds, which will carry the vessel as far as the Gulf of Nicoya. After passing Morro Hermoso, look out for the *papagayos*, which winds will carry the vessel to the Gulf of Tehuantepec; and if bound for a port near this gulf or for Acapulco, after having crossed it by favor of these winds, she must keep near the coast and beat up. If, on the contrary,

From the Bay
of Panama
south.

From the Bay
of Panama
west.

she is bound westward, she will stand off as far as the wind will permit.

The western route from Panama, in the rainy season, is one of the most disagreeable possible, on account of calms, squalls, and contrary winds and currents. At this time a heavy swell and excessive heat prevail; the atmosphere is moist and rain falls every day. It often happens that the vessel does not make 20 miles westing in a week, and even this only by taking advantage of gusts, squalls, and of every favorable puff of wind.

The opinions of coasters differ with regard to the route to be taken. Some say that by beating directly to the southward it is possible to get out of the region of the bad weather; others prefer to beat at a moderate distance from the coast. The latter route is the one usually adopted, because the gusts and squalls that are often met with near the land sometimes allow of making a long stretch toward the northwest, while by keeping off at sea this advantage is sacrificed for the sake of meeting with less bad weather.

Navigation on
the coast of
California.

When bound direct to the ports of California from the southward, after having crossed by an oblique route the belt of the southeast trade-winds, the vessel will cut the equator about the meridian of 100° , and cross the belt of the northeast winds, keeping full and by to reach the limit of the variables, about 300 miles to the eastward of the Sandwich Islands. When in the variables steer for the port of destination, taking care to keep well to the north; for, in proportion to the approach to the land, the wind hauls more to the northward, and the southerly currents become stronger.*

From Panama
to San Fran-
cisco.

Vessels from Panama bound north, by keeping close to the coast, usually take three months to make the passage. A quicker passage may be made by the following route. On leaving Panama, steer between south and west while in the southeast trade-winds. If these winds are strong pass north of the Galapagos; if they are light and variable, pass south of this group; in all cases, in this first part of the route,

* Osborn.

make as little northing as possible, till on the meridian of 103° or 105° west longitude, in order to keep in the westerly current; when in the belt of the variable winds of the equator, cross it as quickly as possible, and often in this belt the vessel will be carried to the eastward by the equatorial counter-current. When in the northeast trade-winds, of which the southern limit is between 2° and 8° of north latitude, according to the season of the year, take the starboard tack (keeping a good full) to cross their belt, and to reach the prevailing westerly winds beyond it; then make for the coast, remembering that in the season of the northwest winds (March to November) the current sets to the southward near the shore, and that land must be made north of San Francisco. In the other season, with the southeast and southwest winds, the port may be made directly, and, in all cases, with these winds northing can be easily made if the ship should fall to the southward; for the southwest winds are frequent at this season. The passage that we have just given is, in general, from 37 to 40 days.

From San Francisco to the Sandwich Islands, the northwest winds often allow an almost straight course. With west winds a vessel must keep her starboard tacks aboard, and, if these winds hold on, she will get into the northeast trades, and make her westing in such a way as to sight the east side of the island of Hawaii. The southeast winds met with sometimes, especially in June, in the belt of the northeast trade between the parallels of 25° and 22° north latitude, are equally favorable for the run from San Francisco to the Sandwich Islands. This passage is usually from 16 to 18 days.

A vessel from Payta or Guayaquil, bound to San Francisco, should stand off to the westward, pass south of the Galapagos group, and cross the line between 98° and 101° west longitude. She will cross the belt of the variable winds of the equator as soon as possible, then, when she reaches the northeast trade-winds, will steer to the northward. She will cross the belt of the northeast trade-winds, and when in the variable winds from the west, which she will

From San
Francisco to
the Sandwich
Islands.

From Payta or
Guayaquil to
San Francisco.

take in 29° or 30° north latitude, she will steer direct for San Francisco, making land a little to the northward. This passage was made in October by the *Sérieuse*, which took 34 days from Payta to San Francisco.

Vancouver gives the following information concerning navigation on the coast of California:—

“The northwest winds, however, are by far the most general, and occasion great difficulty in passing along these shores to the northward. The practice of the Spaniards is to stand a great distance into the ocean, until they reach far to the northward of the parallel of the port, whither they are bound, and then steer for the land; but from our observations, during the time we were navigating these shores, such a precaution did not appear by any means necessary, at least at that season of the year; and as this coast had now been explored, and the direction of its shores and conspicuous places ascertained, so far as our survey had extended, I was convinced that vessels, with the winds we had from the Bay of San Francisco to Point Concepcion, or indeed farther to the northward, would make as good a passage with the assistance of the land winds, which in general blow from the east and southeast to the northwestward, as they could make with the sea breeze to the southeastward, since the land wind prevails during a larger proportion of the twenty-four hours than the sea breeze, and frequently blows stronger; besides which, most sailing vessels would gain some advantage, in the day time, by turning to windward with the sea breeze, which generally blows steadily and moderately, over a sea that is smooth and tranquil.”*

When running down from north to south along the west coast of America, the course will necessarily depend on the point to be reached and the monsoon which may prevail on certain parts of this coast.

A vessel bound from San Francisco to Valparaiso will keep to

* A Voyage of Discovery to the North Pacific Ocean and Round the World, &c., &c., in the *Discovery* sloop of war and Armed Tender *Chatham*, under the Command of Captain George Vancouver, Vol. II. pp. 490, 491.

the southward along the coast to get into the belt of the north-east trade-winds, as far eastward as possible, without nevertheless passing much to the eastward of the meridian of Cape San Lucas, in order to keep the fresh northeast trade-winds. She will be favored on this course by the currents which descend along the coast of California. She will cross the belt of the northeast trade-winds by an oblique course from south to east, in such a way as not to be swept too far west by the equatorial current, when she gets into the belt of the variable winds and calms of the equator. She must then cross as rapidly as possible this belt of variable winds, and endeavor to cross the line as far to the east as can be done. Usually she would cross it on the meridian of 118° west longitude; then cross the belt of the southeast trade-winds by another oblique course, and as soon as she gets the variable west winds, south of this belt, she can steer for Valparaiso. On this route she will sometimes sight Easter Island. The frigate *Poursuivante* took, about the month of October, 63 days to go from San Francisco to Valparaiso.

Course from
San Francisco
to Valparaiso.

In going, during the winter, from Acapulco to Panama or Guayaquil, a vessel will coast along at a little distance from the shore, keeping in the current of the coast of Mexico. She will have the northwest monsoon at the same time in her favor.

From Acapulco
to Panama and
Guayaquil in
winter.

If, on the contrary, she sail from Acapulco in summer, she must keep off and get out of the current of the coast of Mexico, at the same time avoiding the influence of the southeast monsoon which prevails at this period.

Same in
summer.

A vessel bound from Acapulco to Valparaiso will steer so as to cross the equator in 98° west longitude. Thence she will run south without passing the meridian of 103° or 105° if possible, to avoid the strong equatorial current sweeping her to the westward. It often happens that this course passes very near and even in sight of Easter Island. When out of the belt of the southeast trade-winds, shape the course to Valparaiso, steering to make the land to the southward, as a

From Acapulco
to Valparaiso.

set off to the effect of Humboldt's Current. The rest will depend on the monsoon that prevails on the coast of Mexico at the period of being there. A vessel may follow the land on leaving Acapulco and cross the line on the meridian of 87° west longitude, passing east of the archipelago of the Galapagos; cross next the belt of southeast trade-winds, which she will endeavor to leave on the meridian of 95° or 98° west longitude, and then make for Valparaiso with the variable west winds of the southern hemisphere.

From Guayaquil to Valparaiso. A vessel bound from Guayaquil to Valparaiso will stand off to cross Humboldt's Current before passing the meridian of 88° west longitude; she will then keep between this meridian and that of 98° west longitude to avoid getting into the equatorial current. She will cross the southern tropic in 92° west longitude, and stand on south till she has passed the parallel of Valparaiso. She will then run toward the coast of America, passing to the north of and near to the islands of Masafuera and Juan Fernandez, and making the land south of Valparaiso. This passage is made on an average in 37 days.

From the coast of Chili and Peru to Pitcairn's Island, the Marquesas, and the Sandwich Islands. A vessel bound from the coast of Chili or the coast of Peru for Pitcairn's Island, will stand off from the land by the most direct course to reach the southeast trade-winds on the parallel of 20° south latitude; on this parallel she will in general have fresh winds and fair weather. She will then run west, keeping in the neighborhood of this parallel till she bring Pitcairn's Island to bear southwest. She will then steer toward this island, taking care not to fall to the westward; and she must, therefore, to balance the effect of the equatorial current running strong to the west, keep one or two points to windward of the direct course. It is only on coming near this island, and principally in the months of January and February, that northwest winds are found.

From Pitcairn's Island the course is direct to the Marquesas Islands, keeping well to the eastward on account of the westerly currents and of the trade-winds, which are the prevailing winds in these islands.

On leaving the Marquesas, or archipelago of Nouka-Hiva, it is desirable to cross the equator east of the meridian of 143° west longitude, so as to be 60 miles east of the Sandwich Islands. On crossing the equator, the northeast trade-winds will be found in 5° or 6° north latitude during the winter and spring, and in 9° or 10° north latitude during the summer and autumn.

The variable winds near the equator are in general from the west, and may be turned to account with the equatorial counter-current. If the variable winds should be from the eastward, it would be necessary to look out for the eurrents, which would in that case probably set to the westward. The navigator ought, therefore, always to endeavor to cross the equator far to the east of the meridian of the Sandwich Islands, in order to make the land easily to the eastward of this group. In passing beyond the island of Hawaii he will do well to keep 40 miles off, because nearer land there are calms lasting at times for several days.

On leaving the Sandwich Islands for the coast of Peru or Chili, touching at Tahiti, the vessel will run south until she is on the parallel of the southern part of Hawaii. She will then steer in such a manner as to cross the line if possible to the eastward of the meridian of Tahiti, or at least on the meridian of this island; for, in the event of meeting the southeast trade-winds on approaching the Society Islands, there would be great difficulty in working to the eastward against the equatorial current, if to the westward of this group. She should therefore make the land to the eastward of these islands; it is always easy to reach them then, whatever may be the prevailing wind.

Return routes from the Sandwich Islands to the coasts of Chili and Peru, touching at Tahiti.

On leaving the Society Islands for the coast of Chili or Peru, cross as speedily as possible the southeast trade-winds, keeping a good full, and make for the parallels of 34° or 35° south latitude, where west winds are commonly found, which are fair for the coast of America.

The passage from Tahiti to Pitcairn's Island may sometimes be quickly made, by crossing the southern part of the archipelago

of the Pomoutou or Low Islands. Only it is necessary to navigate with the greatest caution by night in this vicinity.*

From the
Sandwich Isl-
ands to the
ports of the
coast of Amer-
ica.

To sail from the Sandwich Islands to any port whatever of the northwest coast of America, the vessel must run north, get out of the northeast trade-winds, and reach the winds from the west, with which the port is easily made. On approaching the land, the greatest attention must be paid to keeping to the north of the port of destination, for she will probably have northwest winds and a current setting to the south. It is a general rule to keep to the northward, on account of the prevailing northerly winds and southerly current.

Although the Sandwich Islands are within the belt of the trade-winds and near their northern limit, still in the winter months winds from the south and southwest are often felt there. The rest of the year the winds are fresh from the eastward. On sailing from these islands for the coast of Chili or Peru, the plan is to cross the belts of the trade-winds, keeping on a wind and a good full, without caring about being set to the westward, provided southing is made, unless indeed bound to Tahiti. The winds in the northern zone being most frequently from E. N. E. and N. E., Tahiti may be reached on one stretch. If not going to stop at this group, it is useless to endeavor to pass to the eastward of it, for it would often be difficult to do so, and much time will be lost by hugging the wind with the currents running west with a velocity of 20 to 40 miles a day. In all cases, unless bound to the Marquesas Islands, it will be preferable, instead of navigating among the islands between the two groups, which is a dangerous and difficult navigation, to pass west of the Society Islands. After having rounded them, steer to the southward until up with the prevailing west winds in the parallel of 30° S. With these winds the ports of the coasts of Chili and Peru will be easily reached, care be taken, on approaching the land, to make the landfall south of the port of destination.

* Mr. Biddlecome, Master, R. N., H. M. S. *Acteon*. (*Nautical Magazine*.)

We will add nothing further to the navigation of the Pacific Ocean. The preceding directions, and the charts accompanying this Memoir, will be sufficient to point out to navigators what it will be best to do, according to the circumstances in which they may be placed and the ports to which they may be bound.

It is unnecessary to say that the various routes we have traced in the Pacific Ocean may be modified. It will be well, however, to keep near to them, whenever the destination of the vessel, the wind and weather shall admit of it; for these routes are the means of those pursued by a great number of navigators, and are those which in general have given the shortest passages.

*Table showing the Length of Passages made in the Pacific Ocean.**

Names of Places of Departure and Arrival.	Number of Days of Passage.	Names of Vessels.	Months in which the Passages took place.
From Acapulco to Panama . . .	31	Prudente.	December.
“ “ to Valparaiso . . .	42	Sérieuse.	May, June.
“ Arica to Callao	6	Poursuivante.	January.
“ Bass (Strait) to Tonga . . .	31	Esmerald.	February, March.
“ Caldera to Cobija	5	Prudente.	January.
“ Callao to Sandwich Islands .	37	Poursuivante.	July, August.
“ “ to Marquesas	23	“	Average; March, April.
“ “ to San Francisco	50	Prudente.	Sept., October, Nov.
“ “ to Tahiti	29½	“	Average.
“ “ to Valparaiso	25	“	Average; Feb., March.
“ Chiloé to Talcahuano	3	“	December.
“ the Chinha Islands to Callao	2	“	February.
“ “ “ to Valparaiso	19	Obligado.	August.
“ Cobija to Arica	3	Poursuivante.	January.
“ “ to Callao	7	Obligado.	October.
“ “ to Iquique	2	Prudente.	January.
“ Coquimbo to Caldera	3	“	January.
“ “ to Valparaiso	4	Poursuivante.	November.
“ Guam Island to Manilla . . .	22	Orixa.	October.
“ Guayaquil to Callao	27	“	Average.
“ “ to Nouka Hiva	23	Poursuivante.	April.
“ the Sandwich Islands to Gu-			
am Island	25	Orixa.	September.
“ “ “ to Petropawłowski	25	Obligado.	September, October.
“ “ “ to San Francisco . . .	25	Velocity.	June, July.
“ “ “ to Tahiti	22	Poursuivante.	July.
“ Hobart Town to Tahiti	50	Alert.	March, April.
“ Ipula to Tahiti	52	“	Average; May, June.
“ Iquique to Arica	2	Prudente.	January.
“ “ to Islay	3	“	February.

* This table has been prepared from information communicated to us by Captains de Leyritz and le Roux de Rosencot, who had in their possession the log-books of a considerable number of vessels. We give it as a collection which may be useful. Wherever we have been able to obtain averages, we have been careful to do so, marking it in the table, which is arranged in alphabetical order.

Names of Places of Departure and Arrival.	Number of Days of Passage.	Names of Vessels.	Months in which the Passages took place.
From Islay to the Chinha Islands	5	Prudente.	February.
“ Macao to the Sandwich Isl'ds	50	Bayonnaise.	May, June.
“ Manila to Tahiti	116	Orixa.*	December to April.
“ Mazatlan to Acapulco	10	Prudente.	December.
“ “ to San Blas	3	Sérieuse.	May.
“ Nouka Hiva to Tahiti	8	Anna.	Average; September.
“ “ to Sandwich Isl'ds	14	Obligado.	July.
“ Panama to Guayaquil	19	Prudente.	February.
“ “ to San Francisco	37	“	Average.
“ Petropawloviski to San Francisco	27	Obligado.	September.
“ Pitcairn to the Sandwich Isl'ds	20	Velocity.	May.
“ San Blas to Acapulco	9	Sérieuse.	May.
“ San Francisco to the Sandwich Islands	16	“	November.
“ “ to Mazatlan	14	Prudente.	November.
“ “ to Nouka Hiva	34	Helegonda.	February, March.
“ “ to Tahiti	31	“	Average of the months from March to Aug.
“ “ to Valparaiso	63	Poursuivante.	October.
“ San-José to Callao	42	Obligado.	March, April.
“ Sydney to Pitcairn	39	Velocity.	March, April.
“ “ to Tahiti	42	Poursuivante.	Aver.; Jan., Feb., Aug.
“ Tahiti to the Sandwich Isl'ds	19	Orixa.	Average; April, June.
“ “ to Nouka Hiva	30	Anna.†	April, May.
“ “ to New Zealand	28	Seine.	March, April.
“ “ to Sydney	26	“	Aver.; Nov., April, May.
“ “ to Tonga	13	Moselle.	November.
“ “ to Valparaiso	36	“	Aver.; Dec., Jan., Feb., May, June, July, Aug.
“ Talcahuano to Valparaiso	2½	“	Average.
“ Tonga to Tahiti	49	Cocyste.‡ (Steamer.)	March, April.
“ “ to Tahiti	26	Esmerald.	May. Same route south of the Tropic.
“ “ to Sydney	21	Moselle.	December.
“ Valparaiso to Callao	10	“	Average.
“ “ to Chiloe	19	Prudente.	November.
“ “ to Cobija	8	Poursuivante.	January.
“ “ to Coquimbo	2½	“	Average.
“ “ to Guayaquil	17	Prudente.	April.
“ “ to Nouka Hiva	41	Moselle.	May.
“ “ to Puña	15	Prudente.	April.
“ “ to San Francisco	62	Superbe.	August, Sept., October.
“ “ to Tahiti	41	“	Average.
“ “ to Talcahuano	6	Poursuivante.	December.

* This ship kept on the Equator nearly as far as 163° west longitude; she would have reached her destination much sooner by taking either the northern or the southern route across the Pacific Ocean.

† Route North of the Tropic of Capricorn.

‡ The *Cocyste* navigated under sail, and her route is south of the Tropic of Capricorn.

APPENDIX.

(PAGE 14.)

NAUTICAL DIRECTIONS FOR AVOIDING HURRICANES.

WE have not thought best to give in the body of this work the nautical directions for endeavoring to escape from the violence of hurricanes. Reasons which it is not worth while to enter into induced us to refrain from introducing them.

Having received many inquiries concerning this subject, and its omission in the *General Examination* having been commented upon, we avail ourselves of the kindness of M. Keller to supply the deficiency. Not only has this learned hydrographical engineer had the goodness to authorize our taking from his first Memoir* (of 1847) the nautical directions published at that time, but he has also given us an extract from a much more extended Memoir on the same subject. This last Memoir of M. Keller is still unpublished, and we cannot be too grateful to the author for the readiness with which, for the general benefit of navigators, he has been willing to communicate to us that portion of it which is of the greatest importance to them.

DE KERHALLET.

* On *Hurricanes, Tornadoes, Typhoons, Tempests*, etc.

EXTRACT FROM THE MEMOIR OF M. KELLER, PUBLISHED IN 1847.*

We will recapitulate the nautical directions for endeavoring to avoid the violence of hurricanes, separately for each hemisphere, to facilitate their application by navigators in danger of being involved in a storm.

IN THE NORTHERN HEMISPHERE.

(*Tornadoes of the Antilles, West India Hurricanes, Typhoons of the China Sea.*)

“If the wind turns on the compass to the right, or in the direction of motion of the hands of a watch, the vessel is in the dangerous semicircle of the storm, and, whatever may be the latitude, she should lie to on the starboard tack, or, if the violence of the hurricane is not excessive, stand on as close to the wind as possible on the starboard tack.

“If, on the contrary, the wind turns on the compass to the left, or in a direction opposite to the motion of the hands of a watch, she is in the manageable circle of the storm, and, if the sea is not too heavy, she should run free with the wind on the starboard quarter, or, if the sea is very heavy, lie to on the port tack.”

IN THE SOUTHERN HEMISPHERE.

(*Hurricanes of the Mozambique Channel, Isle of Bourbon, etc.*)

“If the wind turns on the compass to the left, or in the inverse direction to the movement of the hands of a watch, the vessel is in the dangerous semicircle, and whatever the latitude may be, she should lie to on the port tack, or, if the storm is not excessively violent, stand on as near the wind as possible on her port tack.

* *On Hurricanes, Tornadoes, etc.*, p. 19. (Memoir of 1847.)

“On the contrary, should the wind turn on the compass to the right, or in the direction of movement of the hands of a watch, the vessel is in the manageable semicircle, and, if the sea is not too heavy, she should run free with the wind on the port quarter; if the sea is very heavy, she should lie to on the starboard tack.

“We will also add, that after having experienced a hurricane in less than 26° south latitude or 30° north latitude, a vessel should for some days avoid steering toward the pole, so as not a second time to encounter the hurricane in that branch of its course farthest removed from the equator; for, although its velocity of translation much exceeds that of a ship, the latter may describe the chord which joins the two branches of the curve of the hurricane, while the meteor is travelling the arc of that chord.

“This precaution is unnecessary in the hurricanes of the Bay of Bengal and the typhoons of the China Sea, because these seas do not extend as far as the 30th degree north latitude, and only comprehend a limited and sensibly rectilinear portion of the general course which the storms take when they complete on the land their direction toward the N. W.

“The practical directions we have here drawn up are independent of the latitude of hurricanes, apply to all directions of typhoons, and secure an escape in the right direction, when it is possible.”

EXTRACT FROM THE UNPUBLISHED MEMOIR OF M. KELLER, RELATIVE TO EVOLUTIONS IN HURRICANES, TORNADOES, TYPHOONS, AND TEMPESTS.

“The rotary movement of the hurricane determines the tack.

“The movement of translation decides the course to be taken by the vessel.

“In the northern hemisphere, the rotary movement is in an

inverse direction to that of the hands of a watch, and, in the southern hemisphere, it is in the same direction as the hands.

“The rotary movement being invariable in each hemisphere, the tack to be taken is equally invariable. It is the starboard tack in the northern hemisphere, and the port tack in the southern hemisphere.

“The movement of translation of the hurricane determines for the two hemispheres.

“1st. In the dangerous semicircle the course by the wind as long as the barometer falls, and the course off the wind when it rises again.

“2d. In the manageable semicircle the course with the wind on the quarter while the barometer falls, and the course free when it rises again.

“The dangerous semicircle being to the right of the central path in the northern hemisphere, and to the left in the southern, the course for escape (that is, the course to be made to escape from the centre of the hurricane) will be known if it is understood on which side of the central path of the hurricane the vessel is situated; now this side is shown* by changes of the wind produced by the displacement of the centre of the hurricane.

“If the winds continue changing more and more to the right, the vessel is to the right of the central path; if, on the contrary, the winds change successively to the left, the vessel occupies the left of the central path. Accordingly:—

“The course for escape depends exclusively on the direction in which the wind changes.

“This change should be observed while lying to, in order that it may be the result of the translation of the body of the hurricane, and not of a change of place of the ship; moreover, it should correspond to a fall of the barometer, which distinctively marks the entrance of the vessel into the body of the storm.

“The indications of the approach of a hurricane being a

* See *Considérations Générales sur l'Océan Atlantique*, 3d edition, or those *sur l'Océan Indien*, 2d edition.

heavy swell, a continued fall of the barometer and the increasing violence of the wind, as soon as these indications appear, the vessel should shorten sail and heave to on the starboard tack in the northern hemisphere, and on the port tack in the southern, without minding the direction of the sea, so as to escape from the centre of the storm and to be in a position to execute promptly the succeeding evolutions determined by the direction of the change of the wind observed while lying to.

“ These evolutions are summed up in the following directions :

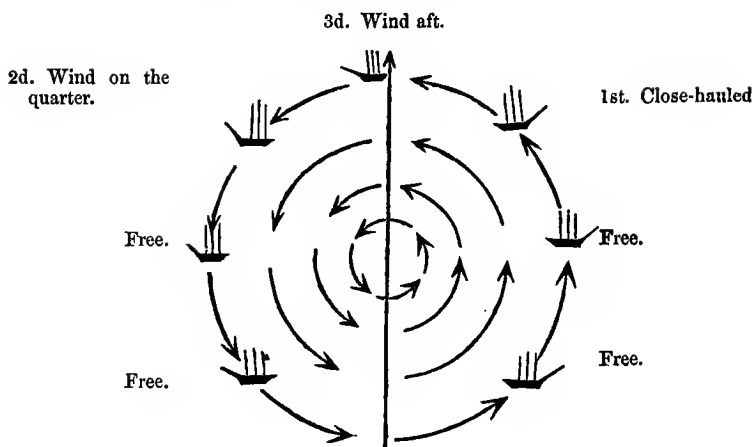
“ EVOLUTIONS IN THE HURRICANES OF THE NORTHERN HEMISPHERE.

“ Lying to on the starboard tack, the barometer falling :

“ 1st. If the wind changes to the right, or in the direction of the movement of the hands of a watch, the vessel is on the right of the central path, in the dangerous semicircle ; she should continue on the starboard tack close hauled, and remain so until the barometer rises, when she can run free.

“ 2d. If the wind changes to the left, or in the inverse direction to the movement of the hands of a watch, the vessel is on the left of the central path in the manageable semicircle of the storm. She should stand on with the wind on the starboard quarter, and keep the same compass course during the subsequent changes of the wind, until the barometer rises, and, when this occurs, run with the wind free.

“ 3d. If, while lying to, the wind does not change its direction during the continued fall of the barometer, the vessel is in the central path and should run before the wind, keeping the same compass course on the starboard tack, until the barometer rises ; afterwards a free course should be kept, until the end of the storm.

Northern Hemisphere, starboard tack.

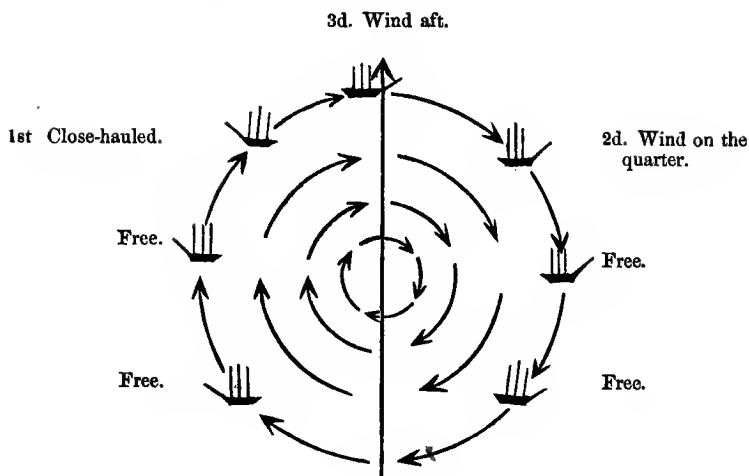
“EVOLUTIONS IN THE HURRICANES OF THE SOUTHERN HEMISPHERE.

“Lying to on the port tack, the barometer falling:—

“1st. If the wind changes to the left, or in the inverse direction to the movement of the hands of a watch, the vessel is on the left of the central path, in the dangerous semicircle; she should stand on close-hauled on the port tack, and keep so until the barometer rises, and then run free.

“2d. If the wind changes gradually to the right, or in the direction of the motion of the hands of a watch, the vessel is on the right of the central path, in the manageable semicircle of the storm; she should run with the wind on the port quarter, keeping the original compass course during the subsequent changes of the wind until the barometer rises, and after that run free.

“3d. If the wind, while lying to, does not change during the continued fall of the barometer, the vessel is in the central path, and should run before the wind, keeping the same compass course on the port tack, until the barometer rises, and after that run free until the storm is over.

Southern Hemisphere, port tack.

“ These directions relative to evolutions in the hurricanes of the two hemispheres differ from those given page 19 of our Memoir on Hurricanes, Tornadoes, Typhoons, and Tempests ; as the evolution recommended by Reid, in his recent work, *The Progress of the Development of the Law of Storms*, page 27, differs from that which he recommended in the two editions of his first work, *The Law of Storms*, and which has been praised by Peddington, Thom, etc., etc. This latter direction advised lying to on the port tack in the manageable semicircle of the hurricanes of the northern hemisphere, and on the starboard tack in the southern hemisphere, to avoid the danger of being taken aback in sudden shifts of wind. But this evolution having the serious disadvantage of forcing a vessel toward the centre and hurrying her into a danger more certain and more to be dreaded, Reid, struck with this objection, now recommends giving it up, and taking, in all cases, the starboard tack in the northern hemisphere, and the port tack in the southern.

“ We adhere entirely to this opinion which simplifies the evolution by reducing it to a question of direction, and by throwing out that of the tack, the more so as the running with the

wind on the quarter and aft being substituted in the new directions for lying to on opposite tacks in the manageable semicircle of the hurricane, vessels need not fear being taken aback, for the shifts of wind are never so great in the beginning of a hurricane as to pass through sixteen points.

“On the other hand, the changes of wind arising from the penetration of the vessel into the body of the hurricane are greater in a given time, according as the penetration itself is greater, or the velocity of translation of the hurricane is greater. Now, this velocity being subtracted from the velocity of the wind in the manageable semicircle, the wind is less strong in proportion as the hurricane advances on its path ; consequently, the greatest changes in the direction of the wind which could give rise to a fear of being taken aback, take place only with light winds, not much to be dreaded ; and if, on the contrary, the wind is strong, it varies little in direction, because the velocity of translation is slight, and therefore there is no danger of being taken aback, although in this case the violence of the wind in the manageable semicircle differs but little from that in the dangerous semicircle.

“We will add, that the evolution of running before the wind implies a great reduction of sail, even to bare poles, if the violence of the wind is considerable, so as to lessen the velocity of the vessel and the force of impulsion of the seas. However, it is better to take the risk of shipping a few seas than that of keeping still ; and it is always best to carry some sail on other courses than before the wind, for the vessel under bare poles will not steer, and will be at the mercy of the waves.

“In order that navigators may judge of their evolutions according to the state of the sea, we will give the direction of the prevailing sea in the different courses.”

DIRECTION OF THE HEAVE OF THE SEA IN THE DIFFERENT COURSES.

In the northern hemisphere, starboard tack.

The vessel being first hove to on the starboard tack :

Running free } She
receives
the sea } on the starboard quarter.

In the dangerous semicircle,

By the wind } She
receives
the sea } on the starboard beam.

In the manageable semicircle,

1st. Wind aft)	She receives the sea	}	on the port quarter.
2d. On the quarter . .)			astern.
3d. Free)			on the starboard quarter.
4th. By the wind . . .)			on the starboard beam.

In the southern hemisphere, port tack,

The vessel being first hove to on the port tack,

Running free } She
receives
the sea } on the port quarter.

In the dangerous semicircle,

By the wind } She
receives
the sea } on the port beam.

In the manageable semicircle,

1st. Wind aft)	She receives the sea	}	on the starboard quarter.
2d. On the quarter . .)			astern.
3d. Free)			on the port quarter.
4th. By the wind . . .)			on the port beam.

According to this, the most unfavorable direction of the sea would be by the wind in the dangerous semicircle; but on this course, the vessel being eased up by the wind, the rolling is not dangerous for the masts; the pitching will be moderate; and, moreover, the man at the wheel may ease her a little when a heavy sea comes. This course should not be given up, for it is the only one for avoiding subsequent danger, and the immediate difficulty may be met by skilful steering.

“The danger here spoken of ought never to induce the seaman to neglect the above directions; he should follow them at all hazards, whatever may be the actual state of the sea, for his situation will certainly become the more dangerous the longer he delays the evolution, which alone can insure his safety by removing him from the centre of the storm.

“The following table condenses, for the two hemispheres, the practical directions just given.”

• GENERAL TABLE

OF EVOLUTIONS IN HURRICANES, TYPHOONS, AND TEMPESTS.

‘As soon as the continued fall of the barometer, and an increasing violence of the wind, announce the approach of a hurricane, the usual precautions in such circumstances must be taken; and the vessel must be laid to in such a manner as to remain as nearly as possible in the same place, or at least to make but little headway, in order to observe the wind during the subsequent fall of the barometer, and to decide on the course for escape, as follows:—

In the northern hemisphere, starboard tack :

The starboard tacks should be hauled aboard, both for lying to and for the course of escape.

If, during the lying to, at the beginning,
the barometer falls, and the wind un-
dergoes no change of direction, run
before the wind, keeping on one and
the same compass course.

If the wind shifts to the left, run with the wind on the quarter, keeping the same compass course,		If the wind shifts to the right, haul by the wind, and keep this course,
---	--	--

Until the barometer rises.

After that, and as long as the wind blows hard, run free on the star-board tack.

In the southern hemisphere, port tack :

The port tacks should be hauled aboard both for the first lying to and for the course of escape.

If, during the lying to, at the beginning, the barometer falls, and the wind undergoes no change of direction, run before the wind, keeping on one and the same compass course.

<p>If the wind shifts to the left, haul by the wind, and keep this course,</p>	<p>If the wind shifts to the right, run with the wind on the quarter, keeping the same compass course,</p>
<p>Until the barometer rises.</p>	

After that, and as long as the wind blows hard, run free on the port tack.

“ These practical rules are general and independent of any conjecture as to the direction, the velocity, and the diameter of the storm ; they reduce the evolution to a question of courses on tacks, which are the same for both hemispheres ; they must be strictly followed without regard to the sea, which if attended to, might lead to a false evolution ; they embody the conclusions of the work which we shall hereafter publish to confirm them, and to justify the confidence of seamen.

“ In this work we shall point out the great variety in direction of the tracks of hurricanes in the same latitudes, and often in the same vicinity, in order to show the necessity for rules, in-

dependent of any particular direction of these storms, and thus to prove to navigators how dangerous it would be to be governed by merely conjectural modes of proceeding. On the other hand, to confirm our own directions, we will give a large list of vessels which, in consequence of having violated our rules, have become more and more involved in the storm, and have suffered much injury.”

KELLER.

*Senior Scholar of the Polytechnic School, Naval
Hydrographic Engineer.*

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