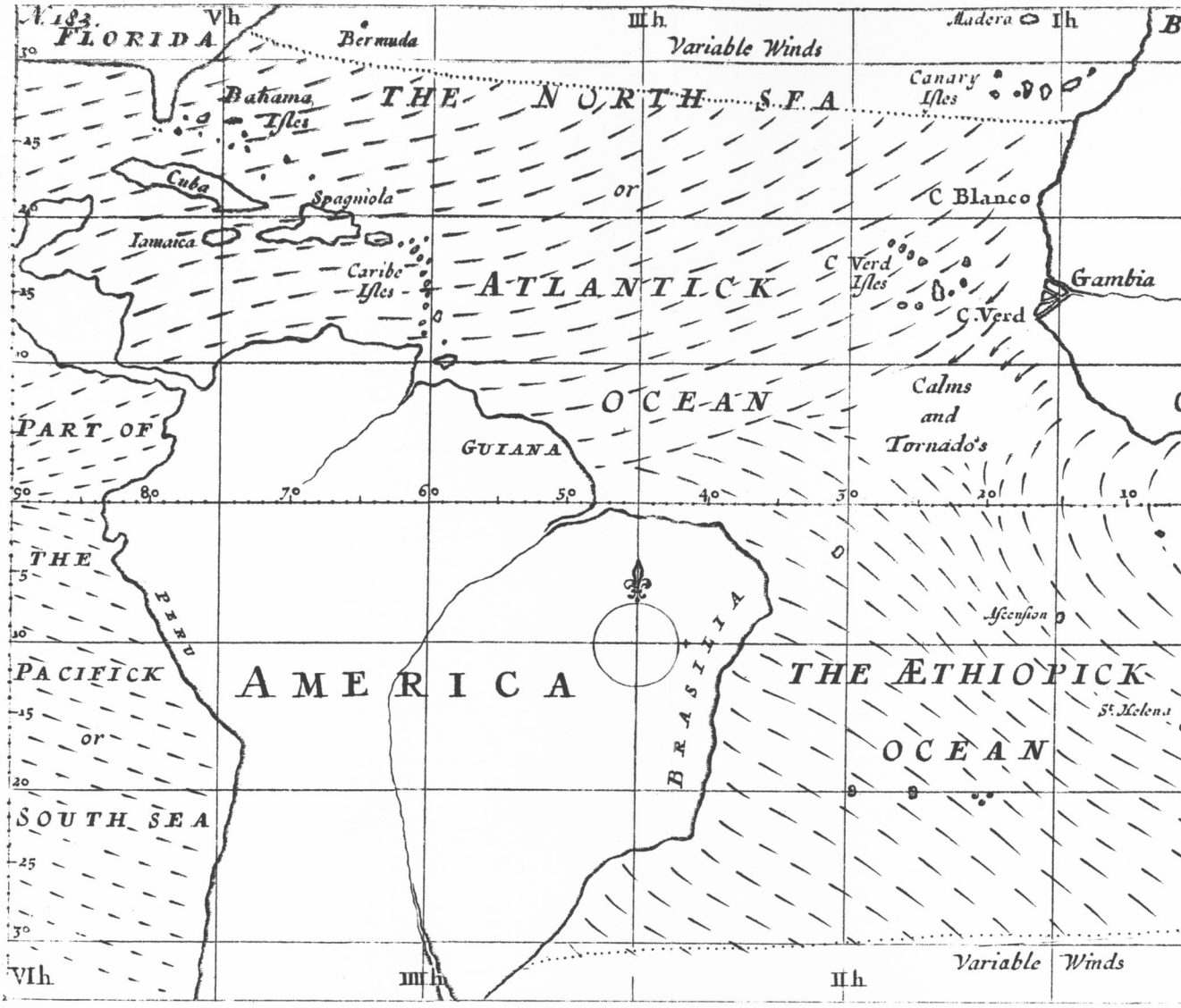
An Historical Account of the Trade Winds, and Monsoons, Observable in the Seas between and Near the Tropicks, with an Attempt to Assign the Phisical Cause of the Said Winds, By E. Halley
Author(s): E. Halley
Source: *Philosophical Transactions (1683-1775)*, Vol. 16 (1686 - 1692), pp. 153-168
Published by: The Royal Society
Stable URL: http://www.jstor.org/stable/101857
Accessed: 04/11/2009 12:43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FLORIDA
Bermuda
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Canary Isles
Bahama Isles
THE NORTH SEA
Cuba
Spagniola
or
C Blanco
Iamaica
Caribe Isles
ATLANTICK
C Verd Isles
Gambia
C Verd
OCEAN
Calms and Tornado's
PART OF
GUIANA
THE
PERU
PACIFICK
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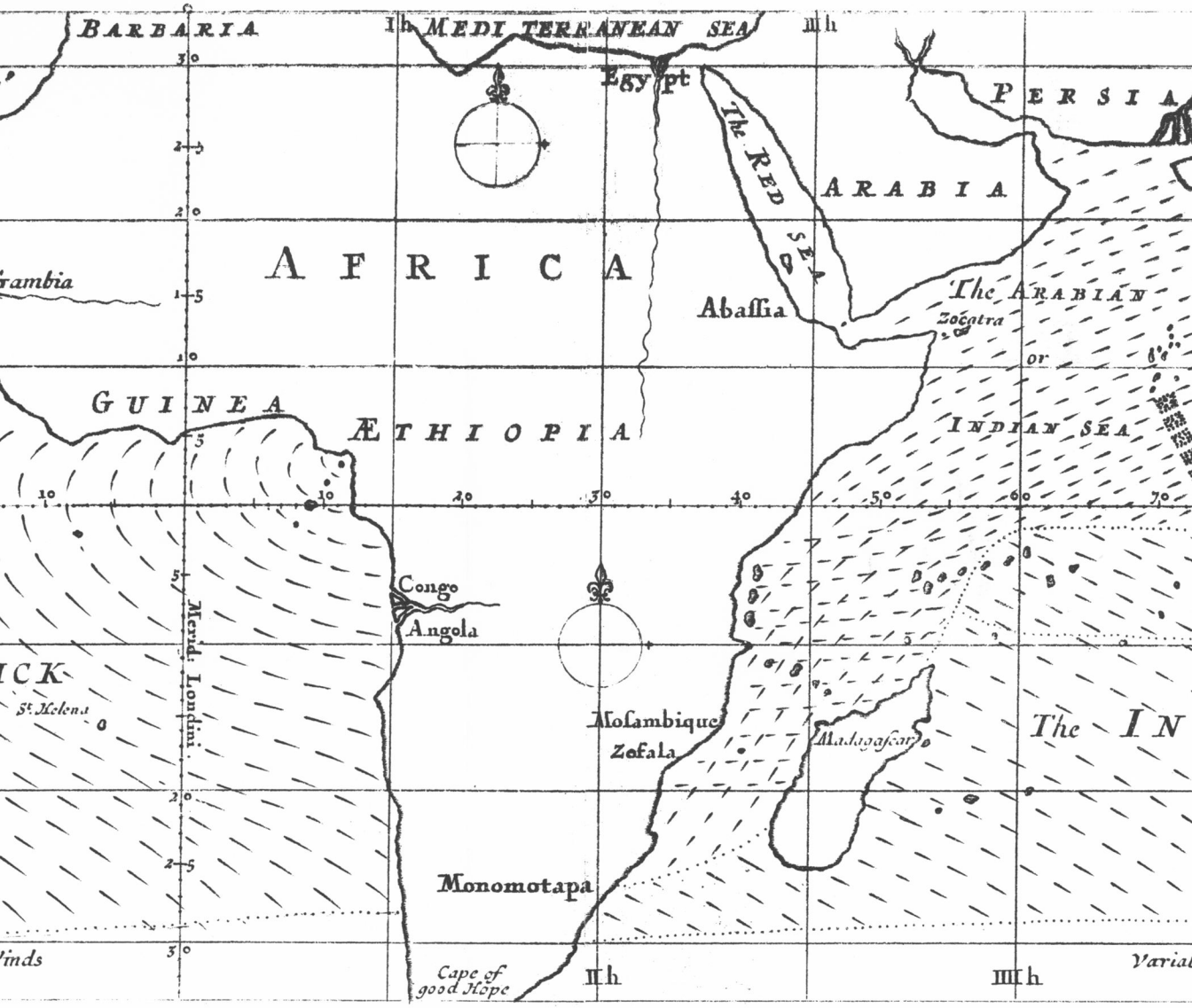
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I h. MEDI TERRANEAN SEA
III h
Egypt
PERSIA
The RED SEA
ARABIA
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Abassia
The ARABIAN
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or
GUINEA
ÆTHIOPIA
INDIAN SEA
Congo
Angola
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Zofala
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Monomotapa
Cape of good Hope
II h.
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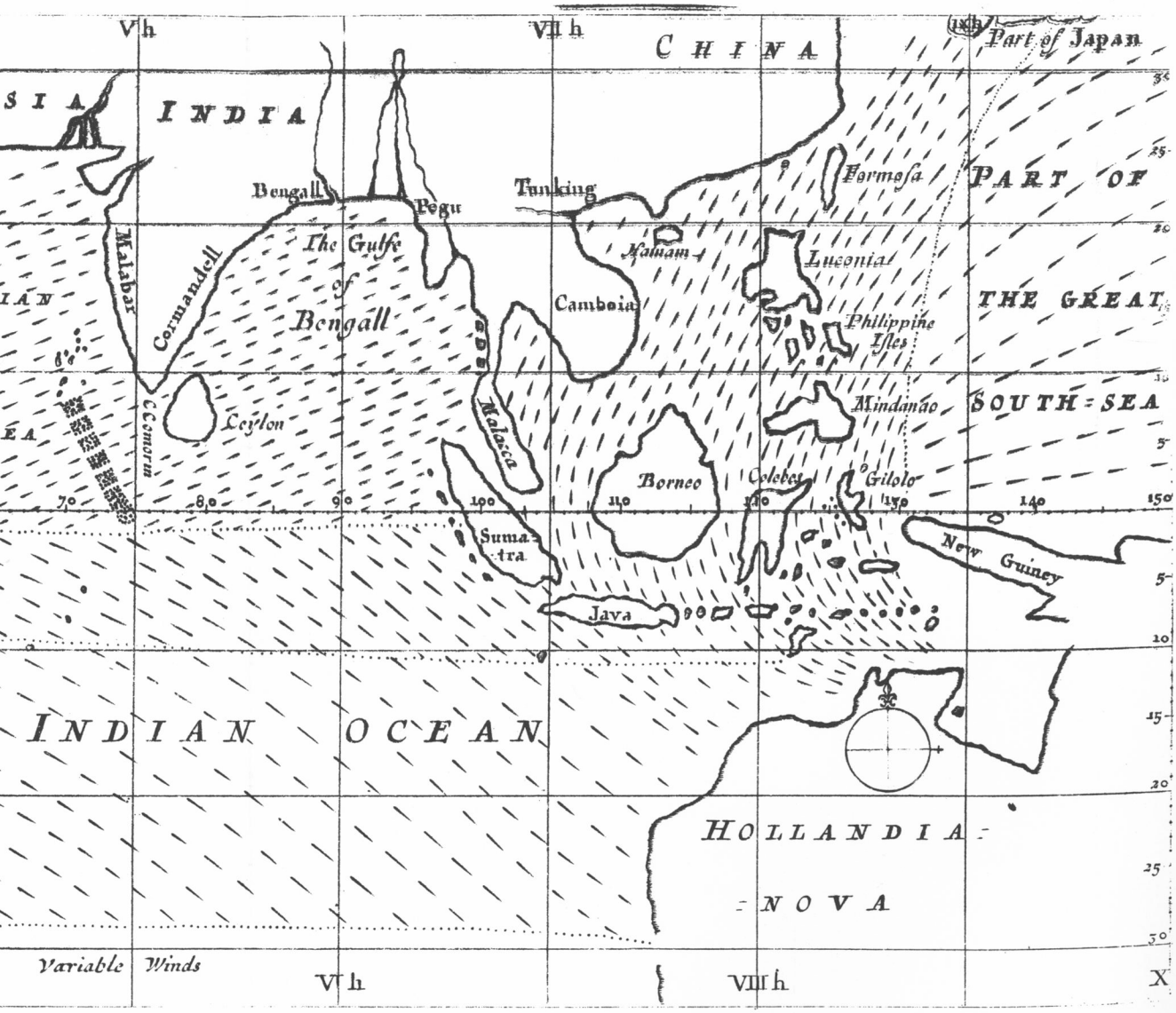
Vh
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THE GREAT
SOUTH-SEA
Malabar
Commandell
The Gulfe of Bengall
Camboia
Hainam
Lucconia
Philippine Isles
Mindanao
Ceylon
Comorin
Malacca
Borneo
Celebes
Gilolo
New Guiney
Sumatra
Java
INDIAN OCEAN
HOLLANDIA NOVA
Variable Winds
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100
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An Hiſtorical Account of the Trade Winds, *and* Monſoons, *obſervable in the Seas between and near the* Tropicks, *with an attempt to aſſign the Phiſical cauſe of the ſaid Winds, by* E. Halley.

AN exact Relation of the conſtant and Periodical Winds, obſervable in ſeveral Tracts of the *Ocean*, is a part of Natural Hiſtory not leſs deſireable and uſeful, than it is difficult to obtain, and it's *Phænomena* hard to explicate: I am not Ignorant that ſeveral Writers have undertaken this ſubject, and although *Varenius* (*Lib. I. Chap. XXI. Geo. Gen*) ſeems to have endeavoured after the beſt information from *Voiagers*, yet cannot his accounts be admitted for accurate, by thoſe that ſhall attentively conſider and compare them togather; and ſome of them are moſt evident miſtakes; which, as near as I can, I ſhall attempt to rectify, having had the opportunity of converſing with Navigators acquainted with all parts of *India*, and having lived a conſiderable time between the *Tropicks*, and there made my own remarks.

The ſubſtance of what I have collected is briefly as follows.

The Univerſal *Ocean* may moſt properly be divided into three parts *viz.* 1. The *Atlantick* and *Æthiopick Sea*: 2. The *Indian Ocean*: 3. The Great *South Sea* or the *Pacifick Ocean*; and tho' theſe Seas do all communicate by the South, yet as to our preſent purpoſe of the *Trade Winds*, they are ſufficiently ſeparated by the interpoſition of great tracts of *Land*; the firſt lying between *Africa* and *America*, the ſecond between *Africa*, and the *Indian Iſlands* and *Hollandia Nova*; and the laſt, between the *Philippine Iſles*, *China*, *Japan* and *Hollandia Nova* on the *Weſt*, and the Coaſt of *America* on the *Eaſt*. Now following this natural diviſion of the Seas, ſo will we divide our Hiſtory into three parts, in the ſame order.

I. In the *Atlantick* and *Æthiopick* Seas, between the *Tropicks*, there is a general *Eaſterly Wind*, all the Year long, without any conſiderable variation, excepting that it is ſubject to be deflected therefrom, ſome few points of the Compas towards the *North* or *South*, according to the poſition of the place. The Obſervations which have been made of theſe deflections, are the following.

1. That near the coaſt of *Africa*, aſſoon as you have paſſed the *Canary Iſles* you are ſure to meet a freſh Gale of *N.E.* Wind about the Latitude of 28. degrees *North*, which ſeldom comes to the *Eaſtwards* of the *E.N.E.* or paſſes the *N.N.E.* This Wind accompanies thoſe bound to the Southward, to the Latitude of 10 North, and about 100. Leagues from the *Guinea* Coaſt, where till the *4th.* degree of North *Latitude*, they fall into calmes and *Tornadoes*, of which more hereafter.

2. That thoſe bound to the *Caribbe Iſles*, find, as they approach the *American* ſide, that the aforeſaid *North-Eaſt Wind*, becomes ſtill more and more *Eaſterly*, ſo as ſometimes to be *Eaſt*, ſometimes *Eaſt* by *South*, but yet moſt commonly to the *Northward* of the *Eaſt* a point or two, ſeldome more. 'tis likewiſe obſerved, that the ſtrength of theſe *Winds* does gradually decreaſe, as you ſaile to the *Weſtwards*.

3. That the limits of the *Trade* and *Variable Winds*, in this *Ocean*, are farther extended on the *American* ſide than the *African:* for whereas you meet not with this certain *Wind* till after you have paſſed the *Latitude* of 8 *degrees* on this ſide; on the *American* ſide it commonly holds to 30. 31 or 32 *degrees* of *Latitude*; and this is verified likewiſe to the *Southwards* of the *Equinoctial*, for near the *Cape* of *Good-Hope* the limits of the *Trade Winds*, are 3 or 4 *degrees* nearer the Line, than on the coaſt of *Brazile*.

4. That from the *Latitude* of 4 *degrees North*, to the aforeſaid limits on the *South* ſide of the *Equator*, the *Winds* are generally and perpetually between the *South* and *Eaſt*, and moſt commonly between the *South-Eaſt* and *Eaſt*, obſerving al-

always this Rule, that on the *African* ſide they are more *Southerly*, on the *Braſilian* more *Eaſterly*, ſo as to become almoſt due *Eaſt*, the little deflection they have being ſtill to the *Southwards*. In this part of the Ocean it has been my fortune to paſs a full year, in an employment that obliged me to regard more than ordinary the Weather, and I found the Winds conſtantly about the *South-Eaſt*, the moſt uſual point *S E b E*; when it was *Eaſterly* it generally blew hard, and was gloomy, dark, and ſometimes rainy weather; if it came to the *Southwards* it was generally Serene, and a ſmall gale next to a Calme, but this not very common. But I never ſaw it to the *Weſtwards* of the *South*, or *Northwards* of the *Eaſt*.

5. That the ſeaſon of the Year has ſome ſmall effect on theſe *Trade Winds*, for that when the the Sun is conſiderable to the *Northwards* of the *Equator*, the *South-Eaſt Winds*, eſpecially in the ſtraight of this Ocean (if I may ſo call it) between *Braſile* and the Coaſt of *Guinea*, do vary a point or two to the *Southwards*, and the *North-Eaſt* become more *Eaſterly*; and on the contrary when the Sun is towards the *Tropick* of ♑, the *South-Eaſterly Winds* become more *Eaſterly*, and the *North-eaſterly Winds* on this ſide the *Line* vere more to the *Northwards*.

6. That as there is no general Rule that admits not of ſome exception, ſo there is in this Ocean a tract of Sea wherein the *Southerly* and S. *Weſt* Winds are perpetual, *viz.* all along the Coaſt of *Guinea*, for above 500. Leagues together, from *Sierra Leona* to the *Iſle* of St. *Thomas*; for the *South-Eaſt* Trade-Wind having paſſed the *Line*, and approaching the Coaſt of *Guinea* within 80 or 100 *Leagues* inclines towards the ſhore, and becomes S. S. E, and by degrees, as you come nearer, it vears about to *South*, S. S. *Weſt*, and in with the land *South-Weſt*, and ſometimes *Weſt South-Weſt*; which variation is better expreſſed in the Mapp hereto annexed, than it can well be in words. Theſe are the Winds, which are obſerved on this coaſt when it blows

true, but there are frequent Calms, Violent ſuddain Guſts called *Tornado*'s, from all points of the compas, and ſometimes unwholſome foggy *Eaſterly Winds* called *Hermitaa* by the Natives, which too often infeſt the Navigation of theſe parts.

7. That to the *Northwards* of the Line, between 4 and 10 *degrees* of Latitude, and between the Meridians of *Cape Virde*, and of the *Eaſtermoſt Iſlands* that bear that name, there is a tract of Sea wherein it were improper to ſay there is any *Trade Wind*, or yet a Variable; for it ſeems condemned to perpetual Calms, attended with terrible Thunder and Lightning, and Rains ſo frequent, that our Navigators from thence call this part of the Sea the *Rains*: the little Winds that are, be only ſome ſuddain uncertain Guſts, of very little continuance and leſs extent; ſo that ſometimes each hour you ſhall have a different Gale, which dies away into a Calme before another ſucceed; and in a fleet of Shipps in ſight of one another, each ſhall have the Wind from a ſeveral point of the Compaſs; with theſe weak *Brizes* Shipps are obliged to make the beſt of their way to the *Southward* through the aforeſaid ſix degrees, wherein 'tis reported ſome have been detained whole months for want of Wind.

From the three laſt obſervables is ſhewn the reaſon of two notable occurrents in the *Eaſt-India* and *Guinea* Navigations. The one is, why notwithſtanding the narroweſt part of the Sea between *Guinea* and *Braſile* be about 500 leagues over, yet Shipps bound to the *Southward* ſometimes, eſpecially in the months of *July* and *Auguſt*, find a great difficulty to paſs it. This happens because of the *South-eaſt Winds*, at that time of the year commonly extending ſome degrees beyond the ordinary limit of 4 *degrees North Lat.* and withall they come ſo much *Southerly*, as to be ſometimes *South*, ſometimes a point or two to the *Weſt*; there remains then only to plie to Wind-ward, and if on the one ſide they ſtand away W. S. W. they gain the Wind ſtill more and more *Eaſterly*, but there is danger of not weathering the *Braſilian* ſhore, or at leaſt the ſhoals upon that Coaſt.

But

But if upon the other tack they go away E. S. E, they fall into the neighberhood of the Coaſt of *Guinea*, from which there is no departing without running *Eaſterly*, as far as the *Iſle* of St. *Thomas*, which is the conſtant practiſe of all the *Guiny* Shipps, and which may ſeem very ſtrang without the conſideration of the ſixth remark, which ſhews the reaſon of it. For being in with the Coaſt, the Wind blows generally at S. W. and W. S. W, with which Winds they cannot go to the *Northward* for the Land, and on the other tack they can lie no nearer the Wind than S. S. E. or *South*; with theſe courſes they run off the ſhore, but in ſo doing they alwaies find the *Winds* more and more contrary; ſo that when near the ſhore they could lie *South*, at a greater diſtance they can make their way no better than S. E. and afterwards E. S. E, with which courſes they fetch commonly the Iſle of St. *Thomas* and Cape *Lopez*, where finding the Winds to the *Eaſtward* of the *South*, they keep them favourable by running away to the *Weſtward* in the *South Lat.* of 3 or 4 *degrees*, where the *S. E. Winds* are perpetual.

For the ſake of theſe general *Winds*, all thoſe that uſe the *Weſt-Indian Trade*, even thoſe bound to *Virginia*, count it their beſt courſe to get as ſoon as they can, to the *Southwards*, that ſo they may be certain of a fair and freſh gale to runn before it to the *Weſtwards*; and for the ſame reaſon thoſe homewards bound from *America*, endeavour to gain the *Latitude* of 30 *degrees*, as ſoon as poſſible, where they firſt find the Winds begin to be Variable; though the moſt ordinary Winds in the *Northern* part of the *Atlantick* Ocean come from between the *South* and *Weſt*.

As to thoſe furious ſtormes called *Hurricanes*, which are as it were peculiar to the *Caribbe Iſles*; and which ſo dreadfully afflict them in the month of *Auguſt*, or not much before or after, they do not ſo properly belong to this place, both by reaſon of their ſmall continuance and extent, as likewiſe becauſe they are not Anniverſary, ſome years having more than one, and ſometimes for ſeveral years together

ther there being none at all. But their Violence is ſo unconceivable, and their other *Phænomena* ſo ſurpriſing, that they merit well to be conſidered apart.

What is here ſaid, is to be underſtood of the *Sea Winds* at ſome diſtance from the Land; for upon and near the ſhores, the Land and Sea Brizes are almoſt every where ſenſible; a nd the great Variety which happens in their Periods, Force and Direction, from the ſituation of the Mountains, Vallies and Woods, and from the various texture of the Soil, more or leſs capable of retaining and reflecting Heat, and of exhaling or condenſing Vapours is ſuch, that it were an endleſs task, to endeavour to account for them.

II. In the *Indian* Ocean, the Winds are partly General, as in the *Æthiopick* Ocean, partly Periodical, that is half the Year they blow one way, and the other half near upon the oppoſite points; and theſe points and times of ſhifting are different in different parts of this Ocean; the limits of each tract of Sea, ſubject to the ſame change or *Monſoon*, are certainly very hard to determine, but the diligence I have uſed to be rightly informed, and the care I have taken therein, has in a great meaſure ſurmounted that difficulty, and I am perſwaded that the following particulars may be relied upon.

1. That between the Latitudes of ten Degrees and thirty Degrees *South*, between *Madagaſcar* and *Hollandia Nova*, the General *Trade Wind* about the S. E. by E. is found to blow all the Year long, to all intents and purpoſes after the ſame manner as in the ſame Latitudes in the *Ethiopick* Ocean, as it is deſcribed in the 4*th. Remark* aforegoing.

2. That the aforeſaid S. E. Winds extend to within two Degrees of the *Equator*, during the Months of *June*, *July*, *Auguſt*, &c. to *November*, at which time between the *South Latitudes* of 3 and 10 Degrees, being near the *Meridian* of the North end of *Madagaſcar*, and between 2 and 12 *South Latitude*, being near *Sumatra* and *Java*, the contrary Winds from the N. W. or between the *North* and

and *Weſt*, ſet in and blow for half the Year, *viz.* from the beginning of *December* till *May*: and this *Monſoon* is obſerved as far as the *Molucca* Iſles, of which more anon.

3. That to the *Northward* of 3 Degrees *South Latitude*, over the whole *Arabian* or *Indian*-Sea and Gulph of *Bengall*, from *Sumatra* to the Coaſt of *Africa*, there is another *Monſoon*, blowing from *October* to *April* upon the *North Eaſt* Points; but in the other half Year, from *April* to *October*, upon the oppoſite Points of S. W. and W.S.W. and that with rather more force than the other, accompanied with dark, rainy weather, whereas the N. E. blows clear; 'tis likewiſe to be noted, that the Winds are not ſo conſtant, either in ſtrength or point, in the Gulph of *Bengall*, as they are in the *Indian*-Sea, where a certain ſteady Gale ſcarce ever fails. 'Tis alſo remarkable, that the S. W. Winds in theſe Seas are generally more *Southerly* on the *African* ſide, more *Weſterly* on the *Indian*.

4. That as an *Appendix* to the laſt deſcribed *Monſoon*, there is a Tract of Sea to the *Southwards* of the *Equator*, ſubject to the ſame changes of the Winds, *viz.* near the *African*-Coaſt, between it and the Iſland *Madagaſcar* or St. *Laurence*, and from thence *Northwards* as far as the Line: wherein from *April* to *October* there is found a conſtant freſh S. S. W. Wind, which as you go more *Northerly*, becomes ſtill more and more *Weſterly*, ſo as to fall in with the W. S. W. Winds, mentioned before, in thoſe Months of the Year to be certain to the *Northward* of the *Equator*: What Winds blow in theſe Seas, for the other half Year, from *October* to *April*, I have not yet been able to obtain to my full ſatisfaction, for that our Navigators always return from *India* without *Madagaſcar*, and ſo are little acquainted in this matter; the Account has been given me is only this, that the Winds are much *Eaſterly* hereabouts, and as often to the *North* of the true *Eaſt* as to the *Southwards* thereof.

5. That

5. That to the *Eaſtward* of *Sumatra* and *Malacca*, to the *Northwards* of the Line, and along the Coaſt of *Camboia* and *China*, the *Monſoons* blow *North* and *South*, that is to ſay, the N. E. Winds are much *Northerly*, and the S. W. much *Southerly*: This Conſtitution reaches to the *Eaſtwards* of the *Philippine*-Iſles, and as far *Northerly* as *Japan*. The *Northern Monſoon* ſetting in, in theſe Seas, in *October* or *November*, and the *Southern* in *May*, blowing all the Summer Months: Here it is to be noted, That the Points of the Compaſs, from whence the Wind comes in theſe Parts of the World, are not ſo fixt as in thoſe lately deſcribed; for the *Southerly* will frequently paſs a Point or two to the *Eaſtwards* of the *South*, and the *Northerly* as much to the *Weſtwards* of the *North*, which ſeems occaſioned by the great quantity of Land which is interſperſed in theſe Seas.

6. That in the ſame *Meridians*, but to the *Southwards* of the *Equator*, being that Tract lying between *Sumatra* and *Java* to the *Weſt*, and *New Guinea* to the *Eaſt*, the ſame *Northerly* and *Southerly Monſoons* are obſerved, but with this difference, that the inclination of the *Northerly* is towards the N. W. and of the *Southerly* towards the S. E. but the *plagæ venti* are not more conſtant here than in the former, *viz.* variable 5 or 6 Points; Beſides the times of the Change of theſe Winds, are not the ſame as in the *Chineſe* Seas, but about a Month or ſix Weeks later.

7. That theſe contrary Winds do not ſhift all at once, but in ſome places the time of the change is attended with Calms, in others with variable Winds; and it is particularly remarkable, that the End of the *Weſterly Monſoon* on the Coaſt of *Coromandel*, and the two laſt Months of the *Southerly Monſoon* in the Seas of *China*, are very ſubject to be tempeſtuous: The violence of theſe ſtorms is ſuch, that they ſeem to be of the nature of the *Weſt-India Hurricanes*, and render the Navigation of theſe parts

parts very unſafe about that time of the Year. Theſe Tempeſts are by our Seamen uſually termed, *The breaking up of the Monſoons.*

By reaſon of the ſhifting of theſe Winds, all thoſe that ſail in theſe Seas, are obliged to obſerve the ſeaſons proper for their Voiages, and to doing they fail not of a fair wind and ſpeedy paſſage; but it ſo be they chance to out-ſtay their time, till the contrary *Monſoon* ſet in, as it frequently happens, they are forced to give over the hopes of accompliſhing their intended Voiages, and either return to the port from whence they came, or elce put in to ſome other Harbour, there to ſpend the time till the Winds ſhall come favourable.

III. The third Ocean called *Mare Pacificum*, whoſe extent is equal to that of the other two, (it being from the Weſt Coaſt of *America* to the *Philippine* Ilands, not leſs than 150 degrees of Longitude) is that which is leaſt known to our own or the neighbour Nations; that Navigation that there is on it, is by the *Spanyards* who go yearly from the Coaſt of new *Spain* to the *Manilha's*, but that but by one beaten track; ſo that I cannot be ſo particular here as in the other two. What the *Spaniſh* Authors ſay of the Winds they find in their Courſes, and what is confirmed by the old Accounts of *Drake* and *Canaiſh*, and ſince by *Schooten*, who ſailed the whole breadth of this Sea in the Southern Latitude of 15 or 16 degrees, is, that there is a great conformity between the Winds of this Sea, and thoſe of the *Atlantick* and *Æthiopick*; that is to ſay, that to the Northwards of the *Equator*, the predominant Wind is between the *Eaſt* and *North-Eaſt*, and to the S*outhwards* thereof there is a conſtant ſteady gale between the *Eaſt* and *South-Eaſt*, and that on both ſides the *Line* with ſo much conſtance, that they ſcarce ever need to attend the Sails, and ſtrength, that it is rare to fail of croſſing this vaſt Ocean in ten weeks time, which is about 13 miles *per diem*; beſides 'tis ſaid that Stormes and Tempeſts are never known in theſe parts: So that here is the ve-

y beſt of Sailing; no want of a freſh fair Wind, and yet no danger of having too much: Wherefore ſome have thought it might be as ſhort a Voiage to *Japan* and *China*, to go by the Streights of *Magellan*, is by the *Cape* of *Good-hope*.

The limits of theſe General Winds are alſo much the ſame as in the *Atlantick* Sea, *viz.* about the 30*th.* degree of Latitude on both ſides; for the *Spanyards* homewards bound from the *Manilha's*, alwaies take the advantage of the Southerly *Monſoon*, blowing there in the Summer months, and run up to the *Northwards* of that Latitude, as high as *Japan*, before they meet with variable Winds, to ſhape their courſe to the *Eaſtwards*. And *Schooten* and others that have gon about by the *Magellan* Streights, have found the limits of of S. E. Winds, much about the ſame Latitude to the *Southwards*; beſides a farther *Analogy* between the Winds of this Ocean, and the *Ethiopick*, appears in that, upon the Coaſt of *Peru*, they are alwais much *Southerly*, like as they are found near the Shores of *Angola*.

Thus far matter of Fact, wherein if the information I have received be not in all parts Accurate, it has not been for want of inquiry from thoſe I conceived beſt able to inſtruct me; and I ſhall take it for a very great kindneſs if any Maſter of a Ship, or other perſon, well informed of the Nature of the Winds, in any of the aforementioned parts of the World, ſhall pleaſe to communicate their Obſervations thereupon; that ſo what I have here collected may be either confirmed or amended, or by the addition of ſome material Circumſtances enlarged. It is not the work of one, nor of few, but of a multitude of Obſervers, to bring togather the experience requiſite to compoſe a perfect and compleat Hiſtory of theſe Winds; however I am not much doubtful that I have erred in, or omitted any of the principal Obſervables, whatever leſſer particulars may have eſcaped my knowledg.

To help the conception of the reader in a matter of ſo much difficulty, I believed it neceſſary to adjoyn a Scheme, ſhew-

ſhewing at one view all the various Tracts and Courſes of theſe Winds; whereby 'tis poſſible the thing may be better underſtood, than by any verbal deſcription whatſoever.

The limits of theſe ſeveral Tracts, are deſigned every where by prickt lines, as well in the *Atlantick* and *Æthiopick*, where they are the boundaries of the Trade and Variable Winds, as in the *Indian* Ocean, where they alſo ſhew the extent of the ſeveral *Monſoons*. I could think of no better way to deſign the courſe of the Winds on the Mapp, than by drawing rows of ſtroaks in the ſame line that a Ship would move going alwaies before it; the ſharp end of each little ſtroak pointing out that part of the Horizon, from whence the Wind continually comes; and where there are *Monſoons* the rows of the ſtroaks run alternately backwards and forwards, by which means they are thicker there than elſewhere. As to the great South Sea, conſidering its vaſt extent, and the little Variety there is in its Winds, and the great *Analogy* between them, and thoſe of the *Atlantick* and *Æthiopick* Oceans, beſides that the greateſt part thereof is wholly unknown to us; I thought it unneceſſary to lengthen the Mapp therewith.

In the foregoing Hiſtory are contained ſeveral Problems, that Merit well the conſideration of our acuteſt Naturaliſts, both by reaſon of the conſtancy of the effect, and of the immenſe extent thereof; near half the ſurface of the Globe being concerned. The chief of theſe Problems are. 1. Why theſe Winds are perpetually from the Eaſt in the *Atlantick* and *Æthiopick*, as likewiſe in the *Pacifick* Ocean, between the Latitudes of 30 North and South. 2. Why the the ſaid Winds extend no farther with Conſtancy than to the Latitudes of 30 *deg.* 3. Why there ſhould be a conſtant South-weſterly Wind upon and near the Coaſt of *Guinea*. 4. Why in the North part of the *Indian* Ocean the Winds, which for one half year do agree with thoſe of the other two Oceans, ſhould change in the other half Year, and blow from the oppoſite Points; whilſt the Southern part of that Ocean followes the

General Rule, and has perpetual Winds about S. *E.* 5. Why in theſe General Trade-Winds it ſhould be alwaies true, that to the Northward of the *Equator* it is enclined to the Northwards of the Eaſt; and in South Latitudes, to the Southward thereof. 6. Why in the Seas of *China* there ſhould be ſo great an Inclination from the Eaſt to the North, more than elcewhere; with many more, which it would be much eaſier to propoſe than Anſwer.

But leaſt I ſhould ſeem to propoſe to others, difficulties which I have not thought worth my own time and Paines, take here the reſult of an earneſt endeavour after the true reaſon of the aforeſaid *Phænomena*, wherein if I am not able to account for all particulars, yet 'tis hoped the thoughts I have ſpent thereon, will not be judged wholly loſt, by the curious in Natural Inquiries.

Wind is moſt properly defined to be the Stream or Current of the Air, and where ſuch Current is perpetual and fixt in its courſe, 'tis neceſſary that it proceed from a permanent unintermitting Cauſe. Wherefore ſome have been enclined to propoſe the diurnal *Rotation* of the Earth upon its *Axis*, by which, as the *Globe* turns Eaſtwards, the looſe and *fluid* particles of the Air, being ſo exceeding light as they be, are leſt behind, ſo that in reſpect of the Earths *ſurface* they move Weſtwards, and become a Conſtant Eaſterly Wind. This opinion ſeems confirmed, for that theſe Winds are found only near the *Equinoctial*, in thoſe Parallels of Latitude where the diurnal Motion is ſwifteſt; and I ſhould readily aſſent to it, if the conſtant Calms in the *Atlantick* Sea, near the *Equator*; the Weſterly Winds near the Coaſt of *Guiny*; and the *Periodical* Weſterly *Monſoons* under the *Equator* in the *Indian* Seas, did not declare the inſufficiency of that *Hypotheſis*. Beſides the Air being kept to the Earth by the principle of *Gravity*, would acquire the ſame degree of *Velocity* that the Earths *ſurface* moves with, as well in reſpect of the diurnal *Rotation*, as of the Annual about the Sun, which is about thirty times ſwifter.

It

It remains therefore to ſubſtitute ſome other cauſe, capable of producing a like conſtant effect, not liable to the ſame Objections, but agreable to the known properties of the Elements of Air and Water, and the laws of the Motion of fluid Bodies. Such an one is, I conceive, the Action of the Suns Beams upon the Air and Water, as he paſſes every day over the Oceans, conſidered together with the Nature of the Soyl, and Scituation of the adjoyning Continents: I ſay therefore, firſt that according to the Laws of *Staticks*, the Air which is leſs rarified or expanded by heat, and conſequently more ponderous, muſt have a Motion towards thoſe parts thereof, which are more rarified, and leſs ponderous, to bring it to an *Æquilibrium*; and ſecondly, that the preſence of the Sun continually ſhifting to the Weſtwards, that part towards which the Air tends, by reaſon of the Rarifaction made by his greateſt *Meridian* Heat, is with him carried Weſtwards, and conſequently the tendency of the whole Body of the lower Air is that way.

Thus a general Eaſterly Wind is formed, which being impreſſed upon all the Air of a vaſt Ocean, the parts impel one the other, and ſo keep moving till the next return of the Sun, whereby ſo much of the Motion as was loſt, is again reſtored, and thus the Eaſterly wind is made perpetual.

From the ſame Principle it follows, that this Eaſterly Wind ſhould on the North Side of the Equator, be to the Northwards of the *Eaſt*, and in South Latitudes to the Southwards thereof; for near the *Line*, the Air is much more rarified, than at a greater diſtance from it; becauſe of the Sun twice in a year Vertical, and at no time diſtant above 23dg. and a half, at which diſtance the heat, being as the Sine of the Angle of Incidence, is but little ſhort of that of the perpendicular Ray. Whereas under the Tropicks, though the Sun ſtay long Vertical, yet he is as long 47dg.off; which is a kind of Winter, wherein the Air ſo cools, as that the Summer Heat cannot warm it to the ſame Degree with that under the *Equator*. Wherefore the Air to the Northwards

wards and Southwards, being leſs rarified than that in the middle, it follows, that from both ſides it ought to tend towards the *Equator*: This Motion compounded with the former *Eaſterly* Wind anſwers all the *Phænomena* of the general Trade Winds, which if the whole ſurface of the Globe were Sea, would undoubtedly blow all round the World, as they are found to do in the *Atlantick* and *Æthiopick* Oceans.

But ſeeing that ſo great Continents do interpoſe and break the continuity of the Oceans, regard muſt be had to the Nature of the Soil, and the poſition of the high Mountains, which I ſuppoſe the two principal Cauſes of the ſeveral Variations of the Winds, from the former general Rule: for if a Country lying near the Sun, prove to be flat, ſandy, low Land, ſuch as the Deſarts of *Lybia* are uſually reported to be, the heat occaſioned by the reflection of the Suns Beams, and the retention there of in the Sand, is incredible to thoſe that have not felt it; whereby the Air being exceedingly rarified, it is neceſſary that this cooler and more denſe Air ſhould run thitherwards to reſtore the *Æquilibrium*: This I take to be the cauſe, why near the Coaſt of *Guinea* the Wind always ſets in upon the Land, blowing Weſterly inſtead of Eaſterly, there being ſufficient reaſon to believe, that the Inland Parts of *Africa* are prodigiouſly hot, ſince the Northern borders thereof were ſo intemperate, as to give the Ancients cauſe to conclude, that all beyond the *Tropick* was made inhabitable by exceſs of heat: From the ſame cauſe it happens, that there are ſo conſtant Calms in that part of the Ocean, called the *Raines*. (deſcribed in the *7th*. Remark on the *Atlantick* Sea) for this Tract being placed in the middle, between the Weſterly Winds blowing on the Coaſt *Guinea*, and the Eaſterly Trade-Winds, blowing to the Weſtwards thereof, the tendency of the Air here, is indifferent to either, and ſo ſtands in *Æquilibrio* between both; and the weight of the incumbent Atmoſphere being diminiſhed by the continual contrary Winds blowing *from* hence, is the reaſon

that

that the Air here holds not the copious Vapour it receives, but lets it fall in ſo frequent Rains.

But as the cool and denſe Air, by reaſon of its greater Gravity, preſſes upon the hot and rarified, 'tis demonſtrative that this latter muſt aſcend in a continued ſtream as faſt as it Rarifies, and that being aſcended, it muſt diſperſe it ſelf to preſerve the *Æquilibrium*; that is, by a contrary Current, the upper Air muſt move *from* thoſe parts where the greateſt Heat is: So by a kind of Circulation, the North-Eaſt Trade Wind below, will be attended with a South Weſterly above, and the South Eaſterly with a North Weſt Wind above; that this is more than a bare conjecture, the almoſt inſtantaneous change of the Wind to the oppoſite Point, which is frequently found in paſſing the limits of the Trade Winds, ſeems to aſſure us; but that which above all confirms this *Hypotheſis* is the *Phænomenon* of the *Monſoons*, by this means moſt eaſily ſolved, and without it hardly explicable.

Suppoſing therefore ſuch a Circulation as above, tis to be conſidered that to the Northward of the *Indian* Ocean there is every where Land within the uſual limit of the Latitude of 30. *viz. Arabia. Perſia, India* &c. which for the ſame reaſon as the *Mediterranean* Parts of *Africa*, are ſubject to unſufferable heats when the Sun is to the North, paſſing nearly Vertical; but yet are temperate enough when the Sun is removed towards the other *Tropick*; becauſe of a ridg of Mountains at ſome diſtance within the Land, ſaid to be frequently in Winter covered with Snow, over which the Air, as it paſſes, muſt needs be much chilled. Hence it comes to paſs, that the Air coming according to the general Rule, out of the *N. E.* in the *Indian* Seas, is ſometimes hotter, ſometimes colder, than that which by this Circulation is returned out of the *S. W.* and by conſequence, ſometimes the under Current or Wind is from the *N. E.* ſometimes from the *S. W.*

That this has no other cauſe, is clear from the times wherein theſe Winds ſet in: *viz.* in *April*, when the Sun begins to warm thoſe Countries to the North, the S. W. *Monſoon* begins, and blows during the Heats till *October*; when the Sun being retired, and all things growing cooler Northward, and the Heat encreaſing to the South, the North-Eaſt Winds enter and blow all the winter till *April* again. And it is undoubtedly from the ſame Principle that to the ſouthwards of the *Equator*, in part of the *Indian* Ocean, the North-Weſt Winds ſucceed the South-Eaſt, when the Sun draws near the *Tropick* of *Capricorn*; but I muſt confeſs, that in this latter occurs a difficulty, not well to be accounted for, which is, why this Change of the *Monſoons* ſhould be any more in this Ocean, than in the ſame Latitudes in the *Æthiopick*, where there is no thing more certain than a *S. E.* Wind all the Year.

'Tis likewiſe very hard to conceive why the limits of the Trade Wind ſhould be fixt, about the thirtieth degree of Latitude all round the Globe; and that they ſhould ſo ſeldome tranſgreſs or fall ſhort of thoſe bounds; as alſo that in the *Indian* Sea, only the Northern Part ſhould be ſubject to the changeable *Monſoons*, and in the Southern there be a conſtant *S. E.*

Theſe are particulars that merit to be conſidered more at Large, and furniſh a ſufficient Subject for a juſt Volume; which will be a very commendable Task for ſuch, who being uſed to Philoſophick Contemplation, ſhall have leaſure to apply their ſerious thoughts about it.