

*An Historical Account of the Trade Winds, and Monsoons, observable in the Seas between and near the Tropicks, with an attempt to assign the Physical cause of the said Winds, by E. Halley.*

**A**N exact Relation of the constant and Periodical Winds, observable in several Tracts of the Ocean, is a part of Natural History not less desirable 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 together; 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 *Aethiopic Sea*: 2. The *Indian Ocean*: 3. The Great *South Sea* or the *Pacific 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.

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I. In the *Atlantick* and *Aethiopic* 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 *Compass* 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*, as soon 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; seldom 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 strait 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 *vs*, the *South-Easterly Winds* become more *Easterly*, and the *North-easterly Winds* on this side the *Line* were 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 veers 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 unwholfome foggy *Easterly Winds* called *Hermitaa* by the Natives, which tooften 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 Verde*, 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 Shippes in sight of one another, each shall have the Wind from a several point of the Compass; with these weak *Brizes* Shippes 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 Shippes 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 *Brazilian* 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 neighborhood of the Coast of *Guinea*, from which there is no departing without running *Easterly*, as far as the *Ile* of *St. Thomas*; which is the constant practise of all the *Guiny* Shippes, 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 *Ile* 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 run 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 surprizing, 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; and 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 *Æthiopic* 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 *Æthiopic* Ocean, as it is described in the 4<sup>th</sup>. Remark foregoing.

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 *Malagascar*, 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 *J. pin.* 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 *plaga 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 if 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* Islands, 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 *Spaniards* who go yearly from the Coast of new *Spain* to the *Manilla'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 *Canuiss*, 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 *Aethiopic*; that is to say, that to the Northwards of the *Equator*, the predominant Wind is between the *East* and *North-East*, and to the *Southwards* thereof there is a constant steady gale between the *East* and *South-East*, and that on both sides the *Line* with so much constancy, 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 laid 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<sup>th</sup>. degree of Latitude on both sides; for the *Spaniards* homewards bound from the *Manilla'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 alwaies 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 together 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 delign 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 30dg. 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 follows 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 elsewhere; 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 left 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 remains therefore to substitute some other cause, capable of producing a like constant effect, not liable to the same Objections, but agreeable 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 adjoining Continents: I say therefore, first that according to the Laws of *Statics*, 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 *Equilibrium*; and secondly, that the presence of the Sun continually shifting to the Westwards, that part towards which the Air tends, by reason of the Rarification made by his greatest *Meridian* Heat, is with him carried Westward, 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 *Æthiopic* 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 *Æquilibrium* 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 ridge 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 *Aethiopic*, 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 seldom 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 us'd to Philosophick Contemplation, shall have leasure to apply their serious thoughts about it.









