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ART. I.—*On the Courses of Hurricanes ; with notices of the Tyfoons of the China Sea, and other Storms ;* by W. C. REDFIELD, Memb. of Conn. Acad. of Arts and Sciences, Corr. Memb. of U. S. Naval Lyceum, the Albany Institute, &c.

[Written for the London Nautical Magazine.]

IN a communication published in the Nautical Magazine for April, 1836, I attempted to correct some errors which had obtained currency in nautical books, relating to the supposed erratic character and progress of the hurricanes of the Atlantic. These corrections were accompanied by a summary statement of the results which my inquiries on this subject had appeared to establish. These results were first published in 1831, but have been further generalized and supported in subsequent papers. Their striking uniformity has been considered as indicating the operation of a general law, controlling the action and progress of these violent storms. The incipient essay now referred to, was illustrated by a chart containing delineations of the routes of two of these storms.\* To my communication in the Nautical Magazine was likewise appended a chart, on which were delineated the routes and daily progress of some ten or twelve of these gales,

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\* Silliman's Journal for April, 1831, Vol. XX, p. 17—51. See also Vol. XXI, p. 191—193; Blunt's Am. Coast Pilot, 12th edition, July, 1833, p. 626—629; Silliman's Journal, Vol. XXV, p. 114—135; Vol. XXVIII, p. 310—318; XXXI, p. 115—130; XXXIII, p. 50—65 & 261—265; Jour. Franklin Inst. Vol. XIX, Feb. 1837, p. 112—127; Am. Coast Pilot 13th edit.; Jameson's Edinb. Jour. Feb.—April, 1838.

The writer had never contemplated the publication of any of the observations which he had incidentally been led to make upon storms, till within a few weeks of the time when the earliest of the above papers was sent to the press; when he was induced by the suggestions of his friend Prof. Olmsted, to attempt a



which had been remarkable for their violence, and which were selected as illustrations of the general course and whirlwind character of many other storms, relating to which similar information had been obtained.

The favorable attention with which these statements have generally been received, together with the spirit and professional zeal with which the subject has been discussed in the pages of the *Nautical Magazine*, have seemed to invite a more detailed exhibition of the numerous facts which have claimed attention in the progress of my inquiries. Being informed, however, that Lieut. Col. Reid, of the Royal Engineers, had engaged in the investigation, with the design of publishing a more full exhibition of the facts than had yet been offered, I most willingly awaited the issue; being fully persuaded, that whatever doubts or difficulties might remain with those who had not thoroughly examined the subject, would not fail to be dispelled by his enterprising and judicious labors. The highly valuable work of Col. Reid, on the law of storms, is now before me; and I cannot but express my commendation of the talent and research by which he has so ably and satisfactorily exhibited the true natural system of hurricanes, and my acknowledgments, also, for the honorable and very flattering manner in which he has noticed my previous labors.

The mass of evidence and the numerous illustrations exhibited by Col. Reid, have happily left but little for me to attempt on the present occasion; and I proceed, Mr. Editor, to notice in a brief manner some few of the topics which your anonymous correspondent, under the signature of "Stormy Jack," has discussed in your pages; and whom, as the subject has now become more generally interesting, your readers will hope to meet under his own proper signature.

This writer appears, at an earlier period, to have assumed the hypothesis that the hurricanes of the inter-tropical latitudes originate in the *variables* or calm latitudes, which border upon the exterior limit of the trade winds. But in the reports of Lieut. James of H. M. Steam Packet *Spey*, and in other accounts,

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statement of his observations; and it is owing chiefly, perhaps, to this cause, that several redundancies, and some suggestions on collateral points, require to be expunged from that paper. This explanation is thought to be due to those readers who are now referred to the first named communication in *Silliman's Journal* for 1831, but need not be applied to the conclusions or opinions which have been advanced in the subsequent papers.



he thinks he finds evidence of a northerly or variable course, in the Barbadoes hurricane of 26th July, 1837; and also of a variable or northeastern course, in the Antigua hurricane of August 2d, 1837; or at least of a lateral movement or oscillation, in the course of these hurricanes.\* He also suggests that hurricanes may alternately dilate and contract during their course.

The inquiries of Col. Reid, aided by his excellent charts and delineations, appear to have done much towards settling these questions, so far at least as relates to the particular storms referred to by your correspondent; and it may be observed, that in tracing the course or track of a storm, we must be governed by its regular geographical developments or progress, rather than by any inductions from the directions and changes of the wind at a given place, grounded on the known whirlwind character of these storms. It is true that these inductions, if carefully made, will commonly harmonize, with wonderful accuracy, with the actual course or path of the storm; but there are various sources of error, which may at times mislead us in our deductions, when made from a limited number of observations; some of which may here be cursorily noticed.

1. The reported observations are not always correct as to the *point of compass* from which the wind blows, and the changes which it exhibits, during the storm. This is not unfrequently the case with the reports of unpractised observers; or with observations made in the gloom of night; or in the tumultuous crisis of the hurricane, when the whole energies of the seaman are directed to his more immediate duties, and the preservation of his ship; and when in the darkness and turmoil of the storm, the swinging of the ship may sometimes be mistaken and reported for the irregular veering of the wind. Verbal or typographical errors, will also have sometimes occurred in the reports which are under consideration; and in some localities, an important difference between the magnetic and the true points of direction, is frequently confounded, or unnoticed.

2. The inductions in question are usually made on the theory of an exact circle in the course of the winds, which in large storms, and for practical purposes, is, in most cases, sufficiently accurate. But it sometimes happens, that the higher portions of the storm, overrun the inferior portions, and reach the surface in

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\* See Nautical Magazine for January, 1838, pp. 35—40.



advance of the main storm ; thus presenting the wind, for a few hours, in a direction not accordant with that exhibited by the main body of the storm. It may also be added, that in the most violent of these storms, it is at least probable, if not certain, that the course of the surface wind is spirally inward, approximating gradually towards the center of the storm.

3. At stations within the tropics, the changes of wind during the passage of the hurricane, are sometimes known to *exceed* those which pertain to the passage of a regular circuit of wind ; these changes sometimes running through the entire circuit of the compass, and even more. Again, they have been known to shift *back and forward*, in alternate and fitful changes, when near the crisis of the storm. These phenomena, so far from disproving the rotative character of these gales, only prove something more, and afford at least probable evidence, in support of one or both of the following positions, viz. 1. That high land, and other obstructions, often produce sudden and fitful gusts and changes in these violent winds. 2. That, in accordance with our observations of minor vortices, the axis of rotation is often impelled, excentrically, around a smaller circuit, in the interior of the advancing storm.

4. In the northern intertropical latitudes, the recession or departure of the southeastern limb of the storm, appears to be followed, not unfrequently, by strong squalls or gusts from southeast, this being the true course of the general trade wind that determines the track of the storm. These gusts or squalls, if taken for the regular action of the hurricane, may occasion erroneous deductions in regard to the course of the storm.

5. In the latitudes near the exterior limits of the trade winds, the change which here occurs in the course of the storm, produces apparent irregularities or anomalies in the series of changes presented by the wind. Owing to this cause I was misled to some small extent in my estimate of the path of the first August hurricane of 1830, as delineated on my first published chart, with an irregular deflection of the curve on the coast of South Carolina, which was predicated, in part, on the wind setting in at northeast at Charleston, and veering to southeast as the storm became more severe.

6. At stations apparently within the regular track of the storm, there will sometimes be an absence of violent wind ; or, the vio-



lence will pertain to only one of the phases which the storm presents, in its regular course over such locality. This may usually be accounted for, by the interposition of land within the course of the immediate circuit which the wind is found to pursue; and this result is perhaps most obviously exhibited in the South Atlantic or in the Southern Ocean, near the Cape of Good Hope, where the barometric column, not unfrequently, subsides and commences rising, before the full violence of the gale takes effect. The barometer, however, appears always to indicate the true extent and path of these whirlwind storms; and I have found no good grounds to infer, that a hurricane contracts in the width of its path, while sweeping upon the surface of an open sea.

7. Another source of apparent irregularity in the changes of wind in these storms, arises from the interposition of one storm upon the path of another, in their passage through the temperate latitudes. Col. Reid has shown something like this in the hurricane which overtook the *Castries*, August 24th, 1837, which was evidently impinging upon the path of the great hurricane which had previously swept along the American coast. That of the *Castries* appears to have pursued a course similar to the hurricane of October 1st, 1830, as delineated on my first published chart; thus advancing, by a shorter course, into the path of the larger hurricane, and probably with a greater progressive velocity. Col. Reid justly urges the influence of these causes in producing the irregular winds of the higher latitudes. Of the influence of such interposition in apparently arresting or modifying the regular development of a storm while in progress. I have for many years been convinced; but it is due to Mr. Espy, of Philadelphia, to mention, that, so far as I know, he was the first to publish the suggestion.\*

In tracing out the path of hurricanes, we justly discard all theory; and as the information obtained of their course and extent is necessarily limited, and is acquired at different and uncertain periods, our delineations are, therefore, necessarily subject to minor errors and to subsequent corrections. Such corrections, I have ever found to be in favor of the uniform rotation and regular course of progression, which have formerly been described. It is probable, therefore, that the narrowed track, and somewhat

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\* Journal of the Franklin Institute, Vol. xviii. October, 1836, p. 239.



deflected courses, near the windward islands, of the Barbadoes hurricane of July 26, and of the Antigua hurricane of August 2d, 1837, as laid down by Col. Reid, will ultimately prove to have been more symmetrical;\* and that the westerly recurvation of the track of the latter storm, across the shores of Georgia and Florida, to meet the case of the gale at Pensacola, will give place to a regular continuation of the track in a northeasterly direction. Was the gale at Pensacola, on the 7th or 8th of August, an offset from the Antigua hurricane? or will it not prove to have been another storm?

Although I deem it probable, Mr. Editor, that your correspondent will find occasion to abandon his former views of the supposed lateral motion of the main body of the hurricane, as well as its alternate contraction and dilatation, yet these views appear to be sometimes applicable, or, at least, partially so, to the *axis* or *nucleus* of the great whirling stratum which constitutes the hurricane. In the columnar whirlwinds, or water-spouts, also, these contractions and dilatations of the diminished portion which sweeps upon the earth's surface, are often made sufficiently evident. The suggestions of your correspondent, therefore, are very far from being unsuited to the inquiry, and it is hoped that he will continue to bestow his attention on such facts relating to these storms, as may aid us in gaining further light upon the subject. For his commendations of my imperfect labors, he is desired to accept my acknowledgments. In the further progress of the investigation, it is believed that he will find reason to abandon all reliance upon 'rarefactions' or 'local disruptions,' in the great aerial ocean, as causes of the origin or progress of these great storms.

#### *Hurricanes of 1838.*

Two hurricanes of the present season, (1838,) appear to invite our investigation;—that of the middle of June, in the North Atlantic, and also that which swept the American coast, from Florida to Newfoundland, in the early part of September. Those who have zeal for the undertaking, will find the inquiry both interesting and instructive.

#### *New Jersey Tornado of 1835.*

At the late meeting of the British Association, when Col. Reid's paper on storms was under discussion, Prof. Bache of Philadel-

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\* Reid on the Law of Storms, Charts V. and VI.



phia, very properly referred to the opposing theory of Mr. Espy, of that city, and stated, also, that in his own survey of the track of the water-spout, or tornado, which passed across the State of New Jersey in June, 1837, he had made observations which appeared to accord with Mr. Espy's theory of storms; and that he had found no evidence of a whirling motion at the surface of the ground, such as Col. Reid had ascribed to water-spouts and hurricanes. This view of the case Prof. Bache had also supported in an able paper on the phenomena of that tornado. I deem it proper to state here, that having also examined the track of the New Jersey tornado, within a few days of its occurrence, and having twice repeated the examination, at later periods, I have observed on each occasion, numerous facts which appear to demonstrate the *whirling* character of this tornado, as well as the *inward* tendency of the vortex at the surface of the ground; and further, that the direction of this rotation was *towards the left*, as in the North Atlantic hurricanes;—a result which I had not previously expected, as it appeared probable that the direction of rotation, in these small whirlwinds, must be entirely accidental. This leads me to notice the only point, perhaps, on which my inquiries have led to a result differing from that obtained by Col. Reid; for in many cases of this sort, since examined, I have found the course of rotation to be uniformly towards the left.

Perhaps I should add further, that having also examined with some care, the reports of the meteorological committees at Philadelphia, made through Mr. Espy, their chairman, and also the meteorological essays of this gentleman, I have not been able to find evidence which disproved the rotation of a violent storm, or that established a course of wind from all sides of a storm directly towards its centre, in accordance with his theory; but, on the contrary, an analysis of the evidence which Mr. E. has adduced, together with the additional facts which I have been able to obtain, has appeared to contravene his conclusions. A valuable statement of facts relating to the snow storm which visited Pennsylvania and other states on the 17th and 18th of March last, drawn up by Mr. Espy, has recently been published by the Philadelphia committees.\* Should the facts contained in this paper be adduced in favor of Mr. Espy's theory, I would only say, that in

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\* See Journal of the Franklin Institute, Vol. xxii, 1838, pp. 161--175.



this, as in some of the former cases, the field of action of the whirlwind storm will have been in part mistaken. I would also remark, that the points at issue, do not relate to the common and often irregular winds, which, in different localities, accompany a general fall of rain or snow; or which sometimes attend the progress of a whirlwind storm, exterior to its limits.

*Test of Mr. Espy's Theory.*

The truth or error of Mr. Espy's theory may be ascertained by a very simple test. The hurricanes in the West Indies are known to move towards the W. N. W., nearly. Now, if this theory be true, at those islands which are in the centre of the storm's path, and where the gale is of the greatest duration, the wind will set in at about W. N. W., or exactly opposite to the course of the storm, and when its centre has passed over, will shift suddenly to E. S. E., and continue violent in this quarter till the storm is over. But if the gale be a whirlwind, as the facts seem to show, the wind at such places will set in at about N. N. E., and in the middle of the gale will shift nearly to S. S. W.,—the wind varying from these points, and veering more gradually, on either side, in proportion to the distance from the centre of the storm's track. That this corresponds, mainly, to the facts of the case, will hardly be doubted by those who institute the inquiry.

The same test may also be applied to these storms as they move in a N. E. direction along the shores of the United States; where, according to Mr. Espy's views, the gale, on the centre of its path, should blow, for the first part of its duration, from about N. E.; and in the second half, from nearly S. W.\* But all our inquiries serve to show, that the gale is violent at N. E. only on the northern portion of the track of the tempest, and that the usual changes from this direction, are not sudden, and to an opposite point of the compass; but, instead thereof, we observe a gradual veering, by the north, to the northwest.

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\* Some storms, as Mr. Espy has also acknowledged, are interrupted in their development by the near approach of another storm. Care must be taken, therefore, not to mistake the N. E. wind of a storm whose northwestern limb is thus intercepted by a bordering storm, and which hence is sometimes followed by the natural current of air from the S. W. quarter, for the changes that pertain to the centre of the gale. This error is easily avoided by extending the field of inquiry, and by a due attention to the indications of the barometer.



*Tyfoons of the China Sea.*

It can hardly be doubted that the general course which is pursued by hurricanes, is the same as that of the general mass of atmosphere or winds by which they are surrounded, and of which they form an integral portion. It becomes, therefore, a point of some importance in meteorology, to ascertain the true course of the hurricanes or tyfoons of the Asiatic seas. Should this course prove to be in conformity with the existing monsoons, this would be in accordance, it is believed, with the analogies in the tropical latitudes of the Atlantic; at least, if we have regard to the entire stratum of winds which lies below the common height of the clouds. But if the general course pursued by these storms, be the very same with those of the corresponding latitudes of the Atlantic, in which there are no monsoons, it may serve to show that the westerly monsoons, which are opposed to the course of the regular trade winds, consist only of a misplaced or minor stratum of current, which forms a thin layer of surface wind, less general than that of the regular trades, and which is therefore inefficient in opposing the progress of a great hurricane;—the latter being impelled by the stronger and more general current of the regular trade wind; which is supposed to overlie, at all times, the stratum of misplaced current which forms the westerly monsoon.

These remarks will apply equally to the monsoons of both north and south latitude. Col. Reid has been fortunate in obtaining full evidence of the opposite recurvation of a hurricane in south latitude, in open sea, and during the prevalence of the northwest monsoon; a result which can hardly be too highly valued. This storm, however, (Culloden's hurricane, of March, 1809,) was encountered to the southward of the limits of the northwest monsoon in the Indian ocean; but the hurricane of the *Albion*, noticed by Col. Reid, was exposed to the full influence of this monsoon. It becomes important, therefore, to ascertain its path, in order that the influence of the monsoon upon its course may be duly appreciated; and we hope that its path may yet be ascertained.

In regard to the northern hemisphere, Col. Reid has given us notices of several hurricanes or tyfoons in the Asiatic seas, with no indications of a course different from those in the North Atlantic. The following generalization, grounded on independent



evidence, was published by the writer in 1833.\* “The tyfoons and storms of the China sea and eastern coast of Asia, appear to be similar in character to the hurricanes of the West Indies and the storms of this coast, [United States,] when prevailing in the same latitudes.” This remark was made with special reference to both the rotative and progressive directions of these storms. One of the tyfoons noticed by Col. Reid, that of the *Raleigh*, which visited Canton, on the 5th and 6th of August, 1835, has been adduced, however, by the correspondent of the Nautical Magazine, as holding its course towards the southwest.† As this typhoon had previously attracted my attention, it will now be made the subject of our examination.

### *Raleigh's Typhoon of 1835.*

The facts which have been chiefly relied on for establishing a southwestern course for this gale, are contained in the report of H. M. S. Raleigh, which was overset and disabled in this gale, in the China Sea, when under bare poles: which report I have as follows:

“*H. M. Brig Raleigh*. Aug. 1, 1835.—Working out of Macao Roads.—At noon, east end of Grand Ladrone, E.  $\frac{1}{2}$  S.—Aug. 2d, at noon, S. E. end of Formosa N. 85 E., 340 miles: fine weather all day.—Aug. 3d, at noon, S. end of Formosa N. 82 $\frac{1}{2}$  E., 252 miles. Fine weather all day.—Aug. 4th, 10h. 20m. a. m. close reefed topsails and courses:—12h. 30m. p. m.—barometer fell from noon  $\frac{1.5}{100}$ : took in mainsail and foresail;—at 1h. 30m. got all snug; vessel going through the water between 3 and 4 knots; barometer 29.40, falling;—at 7h. 30m. wind veered to N. N. E. and typhoon commenced;—at 8 p. m. barometer 29.36, falling;—8h. 30m. typhoon increasing;—10 p. m. close reefed fore trysail and set it;—typhoon veering to E. N. E. with a heavy sea;—at midnight typhoon increasing; barom. 29.04, falling.

“*Aug. 5th.*—3 a. m. typhoon veering round to E. S. E., still increasing in violence;—6h. 30m. barometer 28.25;—8 a. m. typhoon increasing;—9h. 30m. a. m., if possible blowing heavier, *ship went over*:—In this awful situation ship lay for about 20 minutes;—9h. 50m. lower masts went by the board and ship righted with seven feet water in her hold; barometer did not fall lower;—at noon typhoon moderated a little;—at 6 p. m. typhoon more moderate, with a heavy sea;—midnight, strong gusts of wind with heavy sea from south.”—*Abridged from Canton Register of March 14, 1837.*

See also the log of the Raleigh, as it appears in Col. Reid's work, which contains a sketch, showing the position of the Raleigh, as

\* American Coast Pilot, 12th edition, p. 629.

† See Nautical Magazine for May, 1837, pp. 303--306.



given in the log, and illustrating the direction of the wind. Col. Reid has also given the position of a schooner, which encountered the tyfoon in lat.  $18^{\circ} 2' N.$ , lon.  $115^{\circ} 50' E.$ , of which I had previously received no account. I will now submit such evidence as I possess, in addition to the account furnished by the Raleigh; adding, also, a sketch and figure illustrating the course and progress of the tyfoon; and which was prepared and stereotyped some months since, in reference to furnishing an account of this hurricane.

At *Macao*, where the tyfoon was experienced on the 5th and 6th, many houses were greatly damaged; also, many lives were lost in the inner harbor, and some vessels driven on shore. The direction and changes of the wind at *Macao* are not stated; but we are favored with the following valuable table of the state of the barometer during the period of the storm.

" August 5th.		h. m.	Barom.	h. m.	Barom.
h. m.	Barom.	0 45 a. m.	28.30	6 45 a. m.	29.12
1 00 a. m.	29.47	1 20 " (lowest)	28.05	7 45 "	29.20
2 30 p. m.	29.28	1 25 "	28.08	8 15 "	29.21
5 00 "	29.20	1 45 "	28.20	8 45 "	29.23
7 20 "	29.12	1 55 "	28.30	9 30 "	29.27
9 00 "	29.08	2 00 "	28.37	10 25 "	29.30
10 20 "	28.95	2 25 "	28.56	11 00 "	29.34
10 45 "	28.90	2 45 "	28.68	2 00 p. m.	29.42,
11 05 "	28.85	3 10 "	28.75	and continued rising to	
11 30 "	28.75	3 40 "	28.83	29.65, at which point it	
11 53 "	28.65	4 10 "	28.90	usually stands during	
August 6th.		4 45 "	28.97	fine weather."*— <i>Canton Register</i> , Aug. 15.	
0 15 a. m.	28.50	5 15 "	29.02		
0 30 "	28.40	6 00 "	29.08		

This table affords in itself good evidence of the passage of the centre of the vortex near to *Macao*.

At *Canton*, (60 miles north of *Macao*,) the tyfoon began on the evening of the 5th, after three or four days of very hot weather, with northerly winds, and continued throughout the night and the next day. Its violence was greatest about two o'clock on the morning of the sixth. The following is an account of the state of the barometer and winds at *Canton*:

\* This relates to "fine weather" of the S. W. monsoon; the mean of the barometer for July and August being, at *Canton*, 0.40 in. lower than for December and January, in the N. E. monsoon. This barometer at *Macao* appears to stand about 0.15 or 0.20 inch lower in its adjustment than that used at *Canton* for the reports in the *Canton Register*, the mean of which for five years is 30.027. Many, if not most of the common ship barometers, stand too low in their adjustment.



## August 4th.

9 a. m. barom. 29.79 Wind N. W. Fine weather.  
4 p. m. " 29.70 " N. by W. Moderate breeze.

## August 5th.

9 a. m. " 29.62 Wind N. and N. W. Fair Weather.  
4 p. m. " 29.54 " unsettled—Rain and fresh breeze.  
12 p. m. " 29.37 " N. blowing hard and in heavy gusts.

## August 6th.

5 a. m. " 29.34 Wind N. E. blowing hard with heavy rain.  
9 a. m. " 29.51 " S. E. " " " "  
11 a. m. " 29.58 " S. E. blowing hard,—moderating.  
5 p. m. " 29.70 " S. E. "  
11 p. m. " 29.85 " S. E. "

## August 7th.

8 a. m. " 29.94 Wind S. E. Cloudy.—*Compiled from the Canton Register.*

On Wednesday the 5th inst. a Typhoon swept over the city of Canton. It began in the evening and continued throughout the night and the next day, blowing its best about 2 o'clock in the morning. The damage done by the Typhoon at Canton is small, but not so at Kumsingmoon, Macao, and elsewhere on the coast.—*Canton Paper.*

The American ship *Levant*, Capt. Dumaresq, which arrived on the 7th of August, the day after the gale, came in with royals set, from Gaspar Island, in fourteen days, having had light winds all the way up the China sea, and *did not feel the typhoon.* This important fact is stated in the Canton Register of August 11th.

Extract from a private letter from on board the ship *Lady Hayes*, which left Macao Roads a day or two before the storm, and returned to Kumsingmoon, after the gale.

"Early on the morning of the 5th, we observed indications of bad weather. At 10 a. m. the wind freshened a little from the same quarter it had been for the last twenty four hours, viz. *north*; so we thought it best to turn her head back again to look for shelter, fancying ourselves to be about thirty five miles off the land. We carried a press of sail until noon, when we found we had too great a distance to run before we could get into shelter, and expecting it would get so thick that we could not see our way; so we turned her head to sea, and clapped on as much sail as she could stagger under, *steering S. E. by E.* The wind being then at north, we were desirous of getting as far off the land as possible, expecting the wind round to the eastward, there being a most *tremendous swell* from that quarter. At 4 p. m. it was blowing in severe gusts, and we shipping a good deal of water, and the ship becoming unmanageable. About 8h. 30m. *the wind began to veer to the west*, but continued to blow as hard as ever, till midnight, when it *drew round to south*, and moderated a little. It continued to blow hard from that quarter until noon of the 6th, when it moderated fast, and we began bending other sails in room of those that were split. When the gale commenced, which we consider



it did at 1 p. m. on the 5th, we were about twenty miles east of the Lema ; where we were when it ended, it is hard to say, as we saw nothing till the morning of the 7th, when we made Mondego Island. We hardly think we could have had the gale so heavy as those inside ; and what is most extraordinary, the wind with them veered to the eastward round to south ; but with us it veered to the westward round to the south. It was fortunate for us that it veered to the westward ; for had it veered to eastward, we should most likely have been driven on shore among the islands, as we could not have been more than fifty miles off the land [?] at 8 p. m. on the 6th."—*Abridged from the Canton Register of August 18th.*

On the reduced chart which is given herewith, the tracks of the Lady Hayes and the Levant are laid down by estimate, from the printed accounts. The small dotted circle B, surrounded by the storm arrows, is supposed to indicate the position of the centre of the storm at the time the Raleigh was overset ; and the position of the latter should be marked somewhat nearer this circle, according to the lat. and long. of the Raleigh on the 5th, which Col. Reid has given in her log. The course of the storm appears to have been N. 72° W., and its centre is supposed to have been opposite the Raleigh, about 8h. 20m. a. m. on the 5th ; but this cannot be ascertained with precision, as the indications of the barometer do not appear to have been closely watched and recorded during this terrific period of the storm.

Having shown the rotatory character of these tempests, I consider the depression of the barometer which attends them, as being due to the rotative action ; and the point of greatest depression, as indicating the true centre or axis of the storm.

From the evidence now before us, we arrive at the following facts :

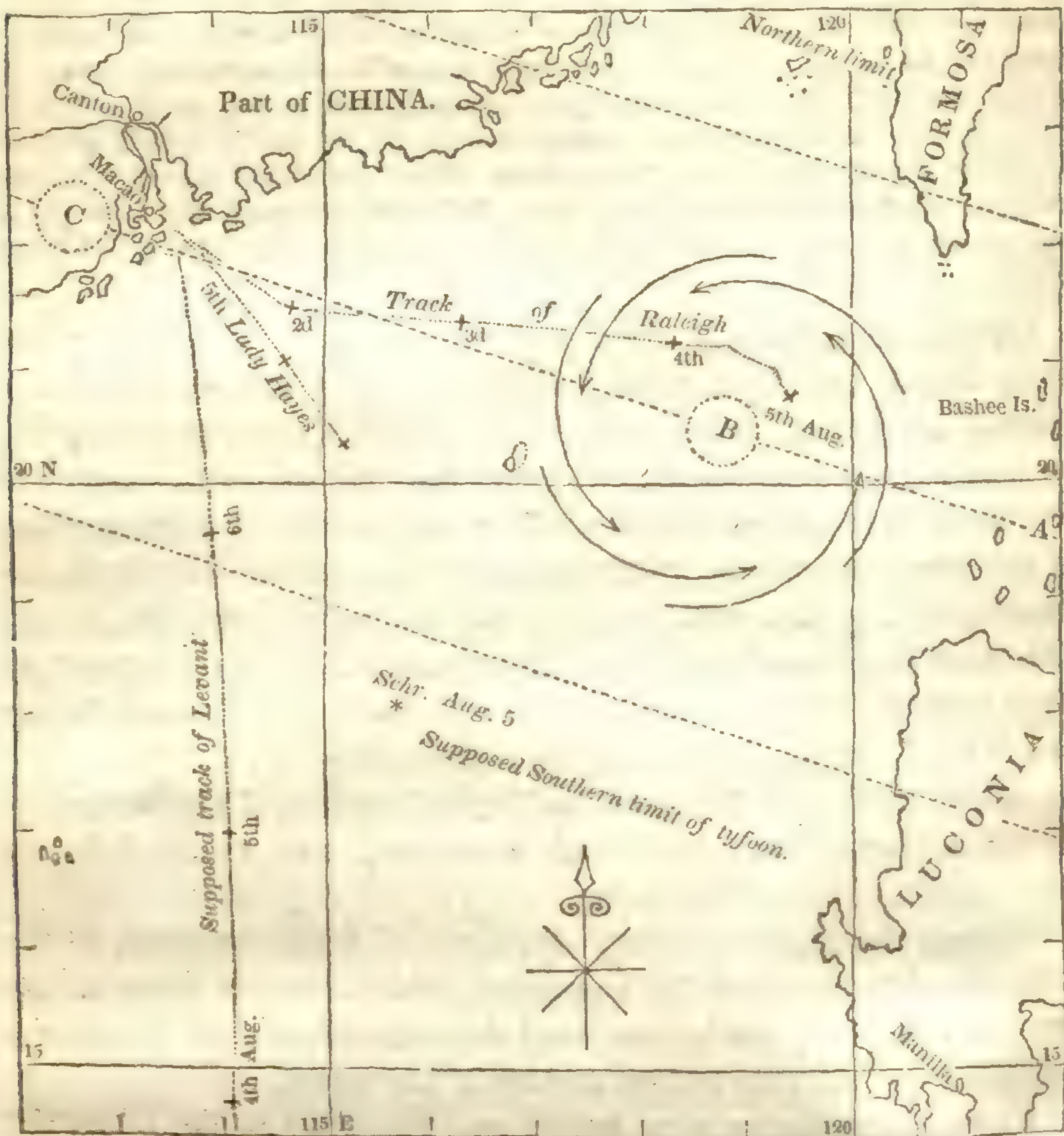
1. That the *Raleigh* met a gale which set in with the wind at N., veering round by the E. to S. E. and South.

2. That at the harbors and roads "inside," (Macao, Kumsing-moon, &c.) as well as at *Canton*, the gale occurred at a later period ; and the wind also set in at North, and veered to E. and S. E., in a manner similar to that reported by the Raleigh.

3. That with the ship *Lady Hayes*, off the islands near Macao, the wind also set in at North ; but the ship steering S. E. by E. under a press of sail, (and doubtless falling off with the heavy sea from eastward,) the wind, towards the middle of the gale, began to veer towards the West ; whence it drew round to South, towards the close of the gale.



4. That the violence of the wind was apparently *greater with the Raleigh*, than with the *Lady Hayes*.



5. That the gale was experienced by an English schooner, Aug. 5th, in lat.  $18^{\circ} 2' N.$  lon.  $115^{\circ} 50' E.$ ; but the *Levant*, arriving on the 7th, in her course through the China sea, *did not encounter the gale.*

6. That the fall and rise of the barometer at Macao, and with the *Raleigh*, and the strength and changes of wind with the latter, were such as are often exhibited near the centre of a hurricane; and that the minimum depression of the barometer occurred about *seventeen hours later at Macao*, than with the *Raleigh*.

These facts seem to establish the following conclusions:

1. That the Typhoon advanced *in a westerly direction.*
2. Negatively;—that it *did not* pass through the China sea, from N. E. to S. W., nor on the opposite of this course.



3. That it was a *progressive whirlwind storm*; turning to the left, around its axis of rotation.

4. That its centre of rotation passed to the *northward* of the *Lady Hayes*; and to the *southward* of the *Raleigh* and of *Canton*, and the anchorages near *Macao*; and nearly on the line A, B, C, as marked on our chart.

5. That the rate of its progress was about *seventeen nautical miles per hour*.

6. That the extent or diameter of the violent part of the gale, as deduced from its duration and rate of progress, was about four hundred nautical miles, or equal to six or seven degrees of latitude.

7. That the latter induction agrees with the geographical evidence which has been obtained of the visitation of the storm.

The progress of the typhoon being taken at 17 miles per hour, it follows that the excess of velocity of the wind at E. with the *Raleigh*, over that of the wind at W. with the *Lady Hayes*, supposing the rotation to have been in a circle, would be more than thirty miles an hour; allowing nothing, however, for difference of retardation of the surface wind, and not taking into the account the additional retardation which the west wind of the *Lady Hayes* must have been subject to, in its recurving course over the land. If a circle be drawn on the chart around each of the points B and C, with a radius equal to 3 or  $3\frac{1}{2}$  degrees of latitude, these circles will comprise, somewhat nearly, the field of action of the storm, at the two periods of 9 a. m. of the 5th, and 2 a. m. on the 6th of August.

The progressive velocity and course of this typhoon, is nearly the same as that of the *Trinidad* hurricane of June, 1831; and the rate of progression also corresponds nearly to that of the *Antigua* hurricane of August 12th, 1835. See tracks Nos. I, and V, on my chart of the courses of hurricanes, in the April No. of the *Nautical Magazine*, 1836.\*

This examination of the case before us, appears to show that the direction of rotation, and the course of progression of this typhoon, while crossing the *China sea*, agree with those of the hurricanes of the *West Indies*; and that *its course was not controlled, or materially influenced, by the existing southwest monsoon*.

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\* For this chart, see also *Silliman's Journal*, Vol. XXXI, or *Reid on the Law of Storms*, Chart III.



*Methods for Escaping its Violence.*

The professional readers of the Nautical Magazine will naturally inquire for the best method by which the Raleigh might have avoided the heart of the typhoon, had its true character, and probable course, been known. To this I answer, that the Raleigh being bound to the Bashee islands, and having sea room, and the gale having set in from N. or N. N. E., which showed that the ship was then not far from the centre of its path, its greatest severity could have been avoided by either of the following methods:

*First*, by tacking to the N. W., upon the wind, and, as the latter veered eastward, hauling up for Formosa and the Bashee islands, so far and as fast as the veering of the gale in this direction might allow.

*Second*, by standing away to W. S. W. with a view of saving time as well as distance, in the escape, and keeping off more to the southward, as the wind should veer to the westward; and when the barometer began to rise, by bearing away, under the heel of the storm, for her point of destination.

The advantage of the first method would consist in having to run a shorter distance off her course, in order to avoid the centre of the gale. Its disadvantages consist in being too much headed off at the outset, and perhaps, in getting too far northward to make the best of the S. W. monsoon, after the gale should have terminated. The advantages of the second method would consist, in running off more rapidly, with a fair wind and sea; in getting under the southern semi-circuit of the gale, where, owing to the course of the wind being counter to the progress of the storm, it becomes less violent; in having almost throughout, a fair, instead of a head wind; and, finally, in being left by the storm to the windward of the point of destination, as regards the existing monsoon. The disadvantage, if any, of this method would consist in the greater extent of the rout; but as this would be accomplished under far more favorable circumstances, and probably in much less time than the northern, it can hardly be counted as an objection. It would, however, have been necessary to avoid the *Paracels*, in shaping the southern course.

The second method for avoiding the heart of this storm, therefore, would appear to have been preferable. But had the ship fallen under the more northern portion of the gale, toward the dot-



ted line which crosses Formosa, thus taking the wind first at N. E., or E. N. E., she should have kept to the wind, with her head to the northward. But if her position had been nearer the dotted line which crosses Luconia, taking the wind first at N. W., she should first have brought the wind on her starboard quarter, and subsequently have bore away, as the wind veered by the west.

Some further notices of tyfoons may now be added, to show that the results just noticed, are not peculiar to this storm alone, and that other tyfoons of the China sea pursue a similar course, and exhibit the same rotative action.

#### *Canton Typhoon of Aug. 3d, 1832.*

At *Macao* the wind set in from the north, and reached its greatest height about 1 p. m. ; continuing with the same violence till 5 p. m., when it veered suddenly to the southward, but with diminished strength. When the fury of the gale was exhausted, the quicksilver rose at the rate of three tenths per half hour. *Barometer Aug. 2d, 8 a. m. 29.68 ;—8 p. m. 29.34 ;—Aug. 3d, 8 a. m. 29.34 ;—5 p. m. 27.88.* Other land barometers differently adjusted, fell to 27.96 and 28.05.

At *Cap-shuy-moon* the gale began at N. and N. W., between which points it blew with tremendous violence ; shifting, towards the conclusion, to S. E. whence it blew more moderately. The *barometer*, in the early part, fell to 28.20.

The American ship *Don Quixote* left on the day before the typhoon ; and returned on the 5th with loss of mainmast.

Since the typhoon, the British brig *John Biggar*, from Manilla, has come in dismasted. The Spanish brig *Veloz*, also from Manilla, has arrived with loss of mainmast.

A letter from the commander of the Dutch ship *Fair Armenian*, which foundered about thirty miles westward of the Grand Ladrone, says :—“ On the evening of the 2d inst. we made the Grand Ladrone, and on the morning of the 3d it came on a typhoon blowing off the land ; this about noon increased to a tremendous height and dismasted us ; unshipped and broke our rudder, and carried away a great part of the bulwarks. The gale was at its height about 4 or 5 p. m., and after dark gradually moderated.”

The *Edmonston*, *Caledonia*, *Esperança* and *Italy* have come in without damage. The *Caledonia* on the 3d, when in lat. 17° N., lon. 113° 50' E. experienced a strong gale from W. veering to S. W. and S., with a heavy and confused sea. The *barometer* fell to 28.50. The *Edmonston*, on the same day, when within seventy miles of the land, felt the same weather, which brought her under bare poles for four hours.

At *Bocca Tigris*, the weight of the typhoon, which in *Canton* and *Whampao* ranged from N. to N. E., was felt about 4 or 5 p. m. ; the *barometer* standing at 29.10. About 6 p. m. the quicksilver rose and the gale began to abate.

At *Canton*, Aug. 3d. Blowing hard at N. and N. E. with violent gusts ; *barometer* 29.15 ; and for the most part rain. Aug. 4th. First part blowing hard, wind S. E. *barom.* 29.70 ;—middle and latter part strong breezes and fine weather.—*Canton papers of August, 1832.*



*Extract from the journal of an American shipmaster bound to Canton.* "Aug. 2d, 1832, (nautical time,) *lat.*  $18^{\circ} 34' N.$ , *lon.*  $114^{\circ} E.$ ; *barom.* 29.56. First part light and baffling winds from *E. to N. E. and N.* and hazy:—middle part the same:—At 4 a. m. *calm*, *barom.* 29.59:—At 4.30 a. m. a breeze sprung up from *W. N. W.*;—made all sail by the wind. Latter part and end, strong *W. N. W.* wind and rough head sea. Took in the royals, flying jib, and fore and mizen top gallant sails. *Barometer at noon* 29.40. The weather, however, looks very fine, and the breeze is steady at *W. N. W.* *lat.*  $19^{\circ} 54' N.$ , *lon.*  $113^{\circ} 50' E.$

*Aug. 3d* commences with a strong steady breeze at *W. N. W.* and hazy weather, barometer falling fast. At 2 p. m. down to 28.98, but not the least unfavorable *appearance* in the clouds, sea, or weather. [The ship was at this time running into the path of the gale, from its southern side.] I must acknowledge that the rapid fall of the mercury, within the last ten hours, has alarmed me not a little, and we are now preparing for the worst of weather.—At 4 p. m. *barom.* 29.25 and the wind freshening; single reefed topsails. The old tars who have seen sail carried on this ship through thick and thin in the stormy regions of the southern ocean, now look at each other with amazement at such preparation for apparently nothing. Towards evening the weather begins to look unfavorable; the sun went down in a body of clouds, deeply tinged with red; not the rich and variegated tints that give rise to pleasurable sensations to all who look upon them, but the fierce, glaring, angry red that creates distress in the bosom, particularly of a mariner. After sunset the moon (at the 2d quarter) could be seen at intervals through the clouds that are driving from the *N. E.* at the rate of twenty knots, and the lightning shooting up from every point of the compass. At 8 p. m. *barom.* 29.15. Took in all sail but the close reefed fore and main topsails and fore-topmast staysail; the wind still steady at *W. N. W.* Sounded in 45 fathoms, the *Grand Ladrone* bearing *W. N. W.* 38 miles. At 10 p. m. the wind suddenly shifted to *W. N. W.* [*N. N. W.?*] in a squall.—Heavy rain and distant thunder until 5 a. m.:—*Had continued shifts of wind all round the compass.* At 7 a. m. a steady gale very severe, from about *N. W.* and constant rain:—hove to under the reefed main topsail:—At 8 a. m. *barom.* 29.!!—Latter part and end, the real, genuine, unadulterated Chinese *Tyfoong*; a steady roar and constant rain; took in the main topsail.

*Aug. 4th.* (P. M. of 3d.) The first quarter of this day extremely severe gale and thick weather.—At 2.30 p. m. *barom.* 28.88; shortly after which it began to rise:—at 6 p. m. 29.05;—at 8 p. m. 29.08, and moderating.—During the night, *hard gale from W. to W. S. W.* and torrents of rain.—At 4 a. m. wind *S. W. to S. S. W.* and hazy:—made sail and by 6 a. m. had royal and studding sails set. During the day passed a number of wrecks, and when we arrived, (5th,) found that the hurricane had been very severe and caused immense destruction."—*New York Journal of Commerce.*

#### *Canton Typhoon of Sept. 23d, 1831.*

The American ship *Galen*, from the Sandwich Islands, bound to Canton, encountered bad weather off the Bashee Islands on the 21st of September, and on the 23d near the Lema Islands, lost her mizen mast, fore and main topmasts, &c.



The British barque *Agnes*, from Singapore, also lost her foremast on the 23d, and was obliged to cut away the remaining masts. She was at anchor on the 27th, about nine miles southward of the Grand Ladrone.

H. C. ship *Hertfordshire* and Danish ship *Norden*, arrived on the 25th [from the southward] and experienced no bad weather; the latter reports that on the 24th a very violent swell was running down from the north-eastward, but the barometer indicated no change, and neither of these vessels were aware of the tempest till their arrival at Macao.

At *Canton* early in the morning of the 23d September commenced a *hard northerly gale*, which continued without intermission for twenty four hours. The tide rose to a great height and much damage was sustained; an official return to the authorities at *Canton*, states, that after it was past, *one thousand four hundred and five* dead bodies were picked up along the coast. The gale was far more severely felt at *Macao* and *Kum-sing-moon*, where it is described as having been truly dreadful.—*Canton papers*.

The narrative of Capt. Lynn, of H. C. S. *Duke of Buccleugh*, appended to his Star tables for 1822, contains accounts of *four* several tyfoons which were encountered by the convoy under H. M. S. *Swift*, Capt. Hayward, which left *Macao Roads* on the 15th of June, 1797, bound homeward by the eastern passage. The first of these storms occurred on the 19th June, in lat.  $22^{\circ} 9' N.$ , lon.  $117^{\circ} 3' E.$  The wind set in at N., and veered to N. E. by N.; but owing, probably, to the course of the ship, veered back to N., and subsequently by N. W. and W. to S. Barometer, 29.

The second was met on the 2d July, in lat.  $19^{\circ} 4' N.$ , lon.  $124^{\circ} 18' E.$ , and ended on the 3d. The wind set in at N. E., and veered by N. and W., as on the 19th of June; the ship having been kept before the wind, probably as before. Barom. 28.77. The *Swift* is supposed to have foundered in this storm.

The third typhoon was encountered on the 8th July, in lat.  $16^{\circ} 54' N.$ , lon.  $126^{\circ} 9' E.$  Barometer, at lowest, 28.40. This gale commenced at N. N. E.; but the ship running to the southward, as before, the wind again veered to N. and N. N. W., and thence shifting, after a lull, to S. S. W.

A fourth typhoon was encountered on the 17th July, lat.  $16^{\circ} 54' N.$ , long.  $126^{\circ} 9' E.$ , in which the wind set in at the same point as before, and veered also in the same manner. Barometer, 28.55.

These and other facts had been the basis of my inductions, in relation to the tyfoons of China and the storms of the North Pacific; and the voyages of Cook and others upon the coasts of Japan and China, and the journals of whale ships in the Northern Pacific, had afforded good evidence that the same system of storms prevailed in the North Pacific as in the North Atlantic



From a comparison of the foregoing accounts, it appears that those ships suffered most severely, which fell under the *northern* semi-circle of the storm. This result, probably, would not follow in the higher latitudes, where the storm has recurved to the northward and commenced its easterly course.

*Hurricanes of the Asiatic Seas.*

It is generally believed that the hurricanes of the Indian seas occur only or chiefly at the change of the monsoons; but this opinion appears to be of doubtful accuracy.

From the valuable meteorological journal which appears monthly in the Canton Register, I have compiled the following statement of the periods of change in the N. E. and S. W. monsoons at that place :

Vernal change from N. E. to S. W.	Autumnal change, from S. W. to N. E.
1830. From 20th to 28th of April.	From 5th to 12th of October.
1831. " 7th to 17th "	" 1st to 14th "
1832. " 4th to 7th "	on 25th September.
1833. " 9th to 14th "	" 9th to 30th "
1834. " 3d of April to 8th of May.	" 19th to 30th "
1835. " 8th to 21st of April.	" 10th to 24th "*

The American ship *Parachute*, at Boston from Calcutta, experienced a very heavy gale to the northward of 18° N. lat. in the Bay of Bengal, on the 23d, 24th, and 25th of August, 1831. Spoke the *Nandi* from Bengal to Liverpool, dismasted in the gale.—*London shipping lists.*

*Bombay, June 24th, 1837.*—One of the severest gales that has occurred here for the last forty eight years, commenced on the evening of the 14th inst. On the morning of the 15th the scene of destruction was displayed. The roaring of the wind and thunder was truly awful; large palmira trees, six feet in diameter and seventy feet in height, were torn up by the roots, and many houses completely unroofed.

The accounts of hurricanes in the Asiatic seas, given us by Col. Reid, are also more common to the regular monsoons than to the periods of change.

*Typhoon at Manilla and Hurricane at Balasore, Oct. 1831.*

The following account of a typhoon in the China sea in 1831, is interesting insomuch as it affords probable grounds for connecting the hurricane at Manilla, Oct. 23–24, with that of Oct. 31, at Balasore, on the shores of the Bay of Bengal.

*Extract from the private journal of Wm. F. Griswold, Esq., Master of the ship Panama, on a voyage to Canton, October, 1831.*

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\* From these and like statements of the changes of the monsoons at other points, some useful inductions might be obtained.



October 23d, (*Nautical time*,) *lat.*  $9^{\circ} 17' N.$ , *lon.*  $117^{\circ} 16' E.$  Wind came out at southward and continued until 10 p. m., then died away and commenced from the northward, with a heavy head sea.—Forenoon breeze from N. W. and clear weather. *Lat.*  $9^{\circ} 45' N.$ , *lon.*  $117^{\circ} 25' E.$

Oct. 24th.—Pleasant breezes from N. W. and hazy, steady weather. A sea rolling from the northward. I suppose there has been a gale in the China sea which has not yet reached us.—Evening wind rapidly increasing and barometer falling from 29.75 to 29.40. Midnight reefed topsails.—9. a. m. double reefed do.—*barometer* 29.20. Ends with tremendous gale from the westward and heavy sea—*barometer* 29.10. *Lat.*  $11^{\circ} 51' N.$  *lon.*  $118^{\circ} 20' E.$

Oct. 25th.—Heavy gale from W. S. W.—*barometer* 29.05. Gale hauling to the southward. Evening more moderate. Made a little sail. Wind at 7. p. m. from southwestward; at 11 p. m. from southward. In the morning at 5 o'clock the wind came out at S. E. (*barometer* at 29.10) and blew a perfect hurricane. Hove to under mizen staysail;—*barometer* at 1 p. m. 29.05—4 p. m. 29.00—7 a. m. 29.10—8 a. m. 29.20. I believe this fall of the barometer to be, in this latitude, very remarkable.

This gale was on the 24th and 25th October, civil time, and from its peculiar features and double fall of the barometer, there appears something like the falling in of two hurricanes on the same track. It was, doubtless, in whole or in part, the same hurricane that visited Manilla on the night of the 23d of October, and which is noticed by Col. Reid. The irregularities of the storm *may* have been caused by its passage over the Philippine Islands, the Panama being then off the Strait of Mindora, and about 210 miles from Manilla. I have deemed it not improbable, that this storm was the same that visited the Bay of Bengal on the 31st of the same month, and was so destructive at Balasore, and on the neighboring coast. The course from the Panama's position to Balasore is about N.  $73^{\circ} W.$ , and the distance, say 1920 miles, which would give a rate of progression of  $11\frac{1}{2}$  nautical miles per hour; which coincides with other storms which have formerly been examined. It is important to ascertain if this storm crossed the Burman Empire, immediately previous to its appearance in the Bay of Bengal.

#### *Panama's Hurricane in Indian Ocean, January, 1832.*

In order to add to the stock of available facts for tracing the storms of South Latitude, I add the following account of a hurricane in the Indian Ocean, on the 25th of January, 1832.

“*January 25th, (nautical time,) Lat.*  $20^{\circ} 14' S.$  *Lon.*  $80^{\circ} 36' E.$  Strong breezes and squally, with every appearance of a gale; *barometer* at noon 29.57, having fallen from 29.80. At 1 p. m. *barom.* 29.50;—



at 4 p. m. 29.45;—at 8 p. m. 29.50;—at midnight 29.30: reefed, &c. and brought the ship to. During the night, heavy and increasing gale from E. S. E. to E. At 4 a. m. barom. 29.00;—at 6 a. m. 28.90;—at 8 a. m. 28.80;—at 10 a. m. 28.70;—at noon 28.60.—Tremendous gale and dangerous sea. *Lat. 20° 14' S., Lon. 76° 47' E.*

“Jan. 26. Blowing a tremendous hurricane. Lost the fore-topsail and foresail and scud under the fore-topmast stay-sail, which split, and the ship broached to, lying on her beam-ends in the trough of the sea. Night came on gloomy and dark, the hurricane increasing. At 10 p. m. the wind began to abate, hauling eastward, and finally to E. N. E.: ended with pleasant weather. *Barometer at 1 p. m. 28.55;—at 2 p. m. 28.50;—at 4 p. m. 28.45, (lowest);—at 8 p. m. 28.50;—at 9 p. m. 28.60;—at 10 p. m. 28.70;—at 11 p. m. 28.80;—at midnight 28.90;—at 1 a. m. 29.00;—at 2 a. m. 29.10;—at 3 a. m. 29.20;—at 4 a. m. 29.30;—at 6 a. m. 29.40;—at 8 a. m. 29.50;—at 10 a. m. 29.55;—at noon 29.60: Lat. 21° 46' S., lon. 75° 59' E.*”—*Journal of Wm. Frederick Griswold, Esq., Master of Ship Panama, from Canton, bound to New York.*

As no change of wind is specified at the commencement of this storm, it would appear to have begun in the direction of the south-east trade, the latter being a fair wind for the ship, which appears to have been under the southern semi-circle of the storm; and the progress of the storm towards the southwest, nearly in the course of the ship, doubtless protracted its duration. The direction and veering of the wind in this storm, is in perfect accordance with the facts and inductions adduced by Col. Reid, relating to the Culloden's storm of March, 1809; the direction of rotation being *towards the right*, as in other storms in south latitude. This hurricane of the Panama, is one of the storms on which my own inductions for southern latitudes had been founded.

### *Natural System of Winds and Storms.*

It will be found difficult to reconcile with the received theory of winds, the facts which have claimed our attention while pursuing this inquiry. To me it appears, that the courses of the great storms may be considered to indicate with entire certainty, the great law of circulation in our atmosphere; and that the long cherished theory which is founded upon calorific rarefaction, must give place to a more natural system of winds and storms; founded, mainly, upon the more simple conditions of the great law of gravitation.

### *Storms of Europe.*

The courses and developments of the storms which pass over the island of Great Britain, are believed to be more complex than on the shores of the United States. It is not improbable, that the



course of many European storms is in a southeastern direction. A comparison of marine reports has shown me, that while a storm was blowing at W., or W. S. W., in the English channel, it was blowing S. E. at Elsineur; at N. E. on the east coast of Scotland; and at N. and N. W. in the Irish channel; thus exhibiting, plainly, a rotation to the left. The great storm of Nov. 29, 1836, appeared in the north of Germany after it left the shores of England, and other British storms have also exhibited an easterly progress. But it is on careful investigations, hereafter to be made, that we must rely for a proper development of the system of European storms.

New York, October 20, 1838.

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ART. II.—*On the Meteor of May 18th, 1838, and on Shooting Stars in general*; by ELIAS LOOMIS, Professor of Mathematics and Natural Philosophy in Western Reserve College, Ohio.

ON the evening of May 18th, 1838, a very remarkable meteor was seen throughout most of the northern part of the United States, and a considerable district of Upper Canada. It attracted general attention from its size, brilliancy, train, length of path, and slowness of apparent motion. Observers, almost without exception, pronounced it the most remarkable meteor they ever saw. Having obtained observations at four or five different places, and learned the general phenomena of the meteor, I inserted a brief notice of it in the Cleveland papers, and concluded with requesting information from any one who observed it. Above twenty letters were received in answer to this invitation; and as considerable information has been obtained through other channels, the observations are as numerous as could be desired. Their accuracy will be considered hereafter. The result is, that the meteor was noticed throughout all the north of Ohio; at Detroit and Ann Arbor, in Michigan; at various places in the State of New York; at two stations in New Hampshire; and in various parts of Canada. The evidence that all saw the *same* meteor is as follows: 1. All saw a meteor at the same instant. Throughout Ohio, the time was that of early candle-lighting. The brightest stars were just becoming visible. In New Hampshire, the time was a little after eight o'clock. The phenomenon, as