



REPORT

OF THE

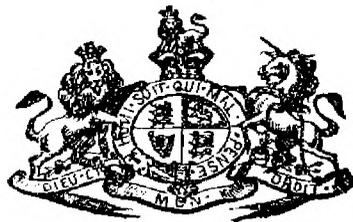
METEOROLOGICAL DEPARTMENT

OF

THE BOARD OF TRADE.

1857.

Presented to both Houses of Parliament by Command of Her Majesty.



LONDON :

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1857.

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R E P O R T.

MY LORD, Board of Trade, March 11, 1857.

IN submitting to your Lordship a Report of the state and progress of the Meteorological Department of the Board of Trade, I am enabled to write with rather less hesitation than hitherto, and to look forward with some degree of confidence to satisfactory results.

1. During so short a period as the existence of this office much productiveness could not reasonably be expected, as our time has been engrossed by collecting and preparing materials rather than by publishing them; but we are advancing, and in future shall be able to circulate results periodically.

2. As the subject of Meteorology, and the object of Her Majesty's Government in establishing an office for collecting and discussing observations made at sea, may not be known to many of the persons interested, although familiar to your Lordship, perhaps I may be excused for recapitulating a few points from former papers, before attempting to show the present state and progress of this recently formed department.

3. In the early part of this century, while Mr. Marsden was Secretary of the Admiralty, the want of collected and combined information respecting the ocean was so often felt by that able public servant that he suggested a plan for arranging, or grouping, all that could be obtained in certain convenient divisions of the seas. He then proposed the method of squares as suitable and convenient in practice. (*See Appendix.*)

4. In 1831 a systematic commencement of a collection and discussion of Meteorological observations made at sea was undertaken at the Hydrographical Office of the Admiralty, upon a similar principle; but pressure of other duties, and the limited extent of means then applicable, impeded a continuance of the collection, which was scarcely more than commenced.

5. The twelve large volumes (one for each month) prepared for the Indian ocean, as being less known than the

Atlantic, are now in this office, with their corresponding charts subdivided into numbered squares.

6. This useful arrangement, dividing the ocean into squares, which affords the means of grouping and averaging observations, as well as identifying spaces of sea like provinces of land, was thus originated at the Admiralty.

7. In the year 1838 a system of Meteorological observations on an extensive scale was strenuously advocated by the author of the "Law of Storms" (Sir William Reid), and chiefly in consequence of his arguments officers of the Royal Engineers at detached stations, and Consuls in foreign ports were requested to collect and transmit such observations.*

8. But probably the more immediate object in view at that time was the investigation of storms affecting the safety of ships rather than the duration of their passages; and it was not till Lieutenant Maury, of the United States, fully appreciating what had been previously done in the wide field of research which he was then contemplating, commenced those extensive undertakings, already so useful, which have earned deserved praise for their accumulation of facts, for their useful advice, and valuable results.

9. The maritime commerce of nations having been extended over the world to an unprecedented degree, and competition having reached such a point that the value of cargoes and the profits of enterprise depend more than ever on the duration and nature of voyages, it is obviously a question of the greatest importance to determine the very best tracks for ships to follow in order to make the quickest as well as the safest passages. The employment of steamers in such numbers, the prevalent endeavour to keep as near the *direct* line between two places (the arc of a great circle) as intervening obstacles, currents, and winds allow, and the general improvement in navigation,—cause a demand for more precise and readily available information respecting all frequented parts of the oceans.

10. Not only greater accuracy of detail, but more con-

* As it has been said that "we want observations in unknown, unfrequented places, rather than in the beaten tracks," it may here be remarked that we require to know all particulars about the most frequented localities, as a first necessity, besides what can be collected about other places generally. Mercantile navigation cannot be too much facilitated by information of the most complete description. The wants of inexperienced persons should be kept in view, not the fleeting acquirements of those who have passed their ordeal.

centration and arrangement of the existing though scattered information (so difficult to obtain speedily), are now required. Besides which instrumental errors have vitiated many results, and have prevented a considerable portion of the Meteorological observations made at sea from being considered better than rough approximations.

11. "It is one of the chief points of a seaman's duty to know where to find a fair wind, and where to fall in with a favourable current;"* but with means hitherto accessible the knowledge of such matters has only been acquired by individuals after years of trial and actual experience at sea; of which the results have not been conveyed adequately to their successors.

12. By the Wind and Current Charts published of late years, chiefly based on the great work of the United States Government, superintended by Lieutenant Maury, and by studying his sailing directions, navigators have been enabled to shorten their passages materially, in many cases as much as one-fourth, in some one-third, of the distance or time previously employed.

13. Although much had been collected and written about winds and currents by well-known authorities, attention had not been sufficiently devoted to the subject, however important to maritime countries, and especially to Great Britain.

14. In 1853, encouraged by the practical results already obtained, the principal maritime Powers authorized qualified persons to assist at a Conference, held at Brussels, on the subject of Meteorology at sea. The Report of that Conference was laid before Parliament, and the result was a vote of money for the purchase of instruments and the discussion of observations, under the superintendence of the Board of Trade.

15. Parliament having voted the necessary expenditure, arrangements were made, in accordance with the views of the Royal Society and the British Association for the Advancement of Science, for a supply of instruments so constructed and tested as to be strictly reliable and inter-comparable. A communication was made by Government, in consequence of which the Royal Society obtained the opinions and suggestions of many eminent Meteorologists in Europe and America, and then addressed an elaborate letter to the Board of Trade,† expressing their

* Basil Hall.

Appendix.

views of the principal objects sought for, and more especially desirable, in the investigations of Meteorological science, with the hope of ascertaining important laws.

16. A naval officer was appointed to execute the duties of this new department (assisted by other persons), and at the beginning of 1855 an office was established at the Board of Trade.

17. Agents were appointed at principal ports, through whom instruments, charts, and books might be furnished to a limited number of very carefully selected ships; and the supply commenced. Since that time more than 200 merchant ships and numerous men-of-war, in which officers have undertaken to make, record, and transmit observations, have been so supplied.

18. Many more ships might have been similarly provided with instruments, had the willingness of their captains alone affected the supply; but as only a certain number of good instruments can be purchased by Government annually, with due regard to the Parliamentary vote of money, and as each of the agents requires a set of instruments to be kept by him for the purpose of comparison with those sent or returned, besides those wanted for comparisons with the barometers at numerous lighthouses, the number must be limited discreetly.

19. Attention to preliminary arrangements, and the preparation of numerous books, forms, and registers, did not prevent an advance towards some practical results, even in the first year. An extensive digest of Maury's Pilot Charts was undertaken, by which their substance is rendered available to the seaman in a graphical instead of a numerical form. These conversions of Maury's wind-roses into diagrams showing his accumulated data in another manner, have been carried on as far as his charts supplied the materials; and from those sources alone have twelve wind charts been compiled and circulated by the Board of Trade, which afford valuable information to the navigator in each of the oceans—(except the South Pacific, from which we are now collecting materials for another chart). The Dutch are following our example, and with improvement, some may think by simplifying the diagrams.

20. These charts are prepared for the four calendar quarters, rather than for the four commonly received seasons of the year, because, in fact, the extreme variations of the atmosphere and of the ocean occur some time after the

equinoxes and solstices, so that February, May, August, and November approximate to the actual extremes nearer than those months which respectively precede them, and are usually considered the middle of each season.

21. This arrangement has been adopted for another reason also, which is, that all parts of the world—all varieties of climate and season—are to be considered, besides those most familiar to Europeans.

22. It is proposed, when sufficient materials are ready, to comprise the contents of such charts as have been described, within the pages of books (preserving the graphical illustration), numbered according to the squares of the world for every month of the year (each square being subdivided where requisite).

23. The effect of such compilations will be, that a person interested in a voyage or distant locality may at once ascertain the average and relative meteorological facts already known about the part of the world in question, including such information about the sea and its currents, as well as the atmosphere over it, as should influence the selection of courses to be steered, or the localities to be visited, therefore immediately affecting the great desideratum of voyagers—a safe and pleasant as well as a speedy passage.

24. It is obvious that by making a passage in less time, there is not only a saving of expense to the merchant, the shipowner, and the insurer, but a great diminution of the risk from fatal maladies,—as instead of losing time, if not lives, in unhealthy localities, heavy rains, or calms with oppressive heat, a ship properly navigated may be speeding on her way under favourable circumstances.

25. Such information, duly classified and rendered easy of access, may become invaluable. At present it exists to a much greater extent than is usually supposed; but being so diffused among a variety of books and documents, it is little better than an unworked mine—unproductive, however rich.

26. In this new office valuable meteorological facts, already collected at the Admiralty, or obtained elsewhere, may be tabulated and discussed, in addition to the continually accruing and more exact data to be furnished in future. A large number of ships are engaged in observations, aided by documents liberally furnished by the United States Government, or by the Board of Trade. Not only has that Government offered directions and

charts *gratis* to American ships, but also to those of other nations, in accordance with easy and just conditions. And in this country the Government, through the Board of Trade, has supplied a certain number of ships going on distant voyages, with charts, meteorological registers, and excellent instruments.

27. Changes in the atmosphere over the ocean, as well as on the land, being intimately connected with electrical or magnetic action, besides wind and weather, all seamen are interested by such matters, while the facts which they register become valuable to philosophers.

28. Meteorological information collected at the Board of Trade is therefore discussed with the twofold object in view—of aiding navigators, or making navigation easier, as well as more certain,—and amassing a collection of accurate and digested observations for the future use of men of science.

29. There is no insuperable reason why every part of the sea should not be known as well as the land; if not, indeed, better, generally speaking, because more accessible and less varied in character. And it is expected that in process of years every frequented square of ocean will have been investigated sufficiently to enable digests to be given, which will afford such guides to the inexperienced as much time and practice only could give them otherwise.

30. As it is desirable that observations of the wind and barometer should be made and recorded more frequently than those of other kinds, and as every vigilant commander requires them to be made regularly for his information, at least once in each watch, there can be no great additional trouble caused by the Meteorological Log or Register (“Abstract Log,” U.S.)—which perhaps may be called the Weather Book.

31. Regular attention to the barometer tends directly to the safety of the ship, as well as the comfort of all on board, and the economy of material; but to make such an inspection of full value the results should be recorded, in order that the movements of the mercurial column may be known during previous days as well as hours. These prolonged comparisons, and judicious inferences drawn from them, afford the means of foretelling wind and weather during the next following period of more or less time, and therefore have an immediately important as well as a future value.

32. Their record, compared subsequently with many other records, will assist the meteorologist in tracing and investigating atmospheric waves and circulating meteors, or cyclones, as well as ordinary gales—subjects by which every seafaring man is vitally interested.

33. A remark has often been made, to the effect that “the barometer was of no use” at a certain place, but such a remark indicated either superficial observation, or that there had been a conflict or concurrence of atmospheric influences or waves at the place in question, which masked, as it were, the coming changes. Such a masking may occur before a great storm, when the barometer is more affected by an *impending* long continuance of particular winds which *follow* the hurricane, than by the *brief*, however violent, storm; or when it is kept up by a concurrence of atmospheric waves.

34. The barometric column usually stands, on an average, higher with or before polar and easterly winds than it does with or before equatorial and westerly winds (of equal strength and dryness) in all parts of the world. This average difference ranges from one tenth to six tenths of an inch, according to the local barometric range.

35. Great improvement has taken place of late years in passages across the ocean, no doubt partly due to the improved construction of ships and eager competition of their owners and captains; but a large share of it must be attributed to publications by which the experience and acquirements of a few persons have been rendered available to many. By collecting and digesting observations already made, but not yet turned to account, and by means of more correct and extensive investigations in future, the “highway of nations” may yearly become more safe, and the intercourse between distant parts of the world remarkably facilitated.

36. To the well-informed and experienced seaman there may be comparatively little to offer; but property and life, to a great extent, must at times be entrusted to inexperienced men. Every commander of a ship must have a beginning.

37. During late years the great increase (by the wider diffusion) of nautical knowledge has not only much shortened sea passages, but has rendered them more secure and less liable to mistakes, as well as to such uncertain delays as occurred so often formerly.

38. The great advantages of making a quick passage are admitted, in a general way, no doubt, but we do not always realize to ourselves the shipowner's, the merchant's, or even the public interest in the question. If a frigate, with important despatches, is some days later in arriving at her destination than might be the case, the possible consequences may be disastrous, but the expense is not thought of because it does not affect individuals, and because the ship is maintained in continuous service for a considerable period, probably some years; but for every day that a merchant ship is delayed beyond the expected or an average time of passage, not only do passengers suffer more or less inconvenience, affecting health, it may be, if not life itself, but the merchant loses and the shipowner loses. The expense of pay, provisions, and wear and tear of a large ship full of cargo and passengers, is from 50% to 100% daily; besides which direct expense, there is the diminution of that ship's annual earnings, by the delay unnecessarily caused before she can commence another voyage. Thus the injurious effects of a long passage are compound, and though well known to the owners of clipper ships are not so clearly recognised by the public at large.

39. It may be, and often has been asked, what inducement has the captain of a ship to make and record meteorological observations, to embarrass himself with extra logs and delicate instruments? To which it may be replied that, irrespective of public acknowledgment, those very instruments, if used at reasonable intervals, become more and more interesting, as well as useful to himself at the time, and for others as well as himself in future.

40. With the assistance of his officers, he has the means of making good observations at least twice a day (probably oftener), as often as at an observatory, and therefore, generally speaking, sufficient, except for a special object or on particular occasions.

41. Undesirable as it undoubtedly is to countenance much less encourage any inaccuracy, a loose mode of observing or recording, or any indifference to minuteness of results, a line must be drawn somewhere, in order that time, attention, and pains may not be wasted, that exertion may not be fruitless, and that active interest may not be checked by a feeling of uncertainty and oppressiveness.

42. Attempts to attain an extreme degree of accuracy, by notations claiming more minute precision than the instruments themselves or even the ultimate exhibitions of results are capable of affording, only perplex and unnecessarily waste valuable time. On land, and in the calculation and discussion of meteorological observations, three places of decimals may be appropriately used, but in observing and recording at sea, two places are sufficient in reading and recording the barometer, and one place of decimals in marking the thermometer.

43. Attempts to ask for more may be inexpedient, and, like a demand for too frequent observations, not unlikely to discourage those who have many other claims on their time and thought. Observers at sea, in bad weather, in war time, or at other critical periods, find risk as well as difficulty in using instruments, their circumstances being so different from those of observers in convenient buildings on land.

44. In consequence of the assistance given by the Kew Committee of the British Association, the instruments offered by Government are not only more correct, but less liable to error, if not injury, than those hitherto used, and they are, generally speaking, *lent* gratuitously, though they may be purchased for a ship at their cost price, and this (considering their tested value) is a great advantage.

45. Those who undertake to keep the registers, or weather books (abstract logs), are supplied with them free of all expense, and they are asked to insert observations *only when taken* at such times among the numerous hours stated as may be most exact. It is not intended, by any means, that all the hours specified should be times of observation for each person, but that every observation carefully made shall be entered at the correct time and place in the book.

46. The importance of accumulating and discussing observations of wind, weather, climate, currents, temperature and density of sea water, and other matters usually included under the term Meteorology, having been fully recognised by Government in the department thus established in 1855 for the collection and discussion of Meteorological observations made at sea:—

47. In order to secure methodical reduction and tabulation of such observations, so arranged that the

philosopher may use them with confidence and facility, and that the navigator may acquire from them practical information without avoidable delay,—much consideration was given to the system of record adopted, which is now, briefly, the following:—

48. The surface of the globe being supposed to be divided into squares, which are numbered and lettered on maps for reference, numbers showing the principal squares, and letters their subdivisions:—(See Appendix.)

49. These separate spaces serve for grouping observations, and their respective centres are as points of particular reference for averages, or mean results, like Observatories.

50. Folio books, agreeing with each other in tabular arrangement, are numbered to correspond with the squares, and are so methodised that every individual entry made from any register or log of uncorrected observations, after being duly reduced, can be recorded in its appropriate table in such a way that it may be used singly or otherwise, and identified or traced at any future time.

51. When averages or means are required, of course these data are equally available; but the general principles of operation are to allow no details to be lost or confused, and to leave no doubt as to the special authority for any fact recorded.

52. At present there are in use about sixty collecting books of tabular forms, called Data Books, appropriated to the following subjects:—namely, Barometer, Thermometer, Hydrometer, Winds, Weather, Currents, Variation, Soundings, Crossings, Passages, Storms, Ice, Shooting Stars and Meteors, Aurora, and Electricity.

53. Entries are made in these tabular forms, as the logs, or meteorological registers are successively examined, the various data being extracted, reduced, and recorded by different persons, and remarkable passages of immediate interest being noted for publication.

54. To the present time about 700 months (equal to 58 years of one log) of good meteorological logs have been received from nearly 100 selected ships in the mercantile navy, and about a third of these registers have been already discussed and tabulated.

55. Before they were received, the 12 wind charts for the principal oceans, already mentioned as converted from those of Maury, were compiled and published.

56. There are now more than 180 merchantmen supplied with tested and reliable instruments, besides charts

and books, of which ships more than 100 have already returned logs.

57. The character of these ships and of their captains may be inferred from the annexed return of registers already received, and from the fact that, in accordance with this return, the following distinguishing marks are now authorized in the Mercantile Navy List by the President of the Board of Trade. (*See Appendix.*)

58. To those names included in the first list the letter A is affixed; to those in the second, B; in the third, C; and in the fourth, D. And in future years the same names may be further distinguished by numbers or additional letters.

59. Moreover, five captains* having sent in meteorological registers, not only superior to others, but exemplary in a high degree, the honorary reward of a valuable telescope is to be presented to each of those gentlemen, by order of the President.

60. In the Appendix to this Report are statements of the supply and expenditure on account of this department, with the number of instruments injured or become unserviceable out of the whole quantity purchased by Government.

61. Other documents also are appended, to which further reference will be made, especially those relating to the co-operation of Her Majesty's Navy.

62. Hitherto not many meteorological logs have been received from Her Majesty's ships, because the war with Russia caused unavoidable obstacles for a time, and because registers sent to foreign stations in 1855 have not yet been returned. But from some ships excellent documents have been already received, and their contents tabulated, among which the logs of the "Frolic," Captain Nolloth; "Hastings," Captain Caffin; "Impérieuse," Captain Watson (kept by Messrs. Scott† and Grigor‡); "Dauntless," Captain Ryder; "Duke of Wellington," Captain Caldwell, and others, are very praiseworthy.

63. The archives of the Admiralty contain almost inexhaustible mines of certain kinds of meteorological information, though not so valuable as that lately obtained,

* Boyd, Quirk, Toynbee, Trivett, and Wood.

† Master.

‡ Surgeon.

with the aid of more reliable instruments and better directed observers.

64. To these stores the Admiralty have authorized access, and only the narrow limit of our own number prevents more facts being extracted thence. Much might be culled that would tend to the benefit of navigation.

65. Besides some extracts from these Admiralty records (chiefly the logs of ships lately employed in the Black Sea and Indian Ocean), the Admiralty observations made during late years at Ascension, Bermuda, Halifax, Valparaiso, Trincomalee, Point de Galle, and Columbo, have been discussed and prepared for publication, in a form corresponding to that established in the Corps of Royal Engineers by Colonel James, authorized by Sir John Burgoyne.

66. Perhaps here reference may also be made to a result obtained from the comparison *at sea*, within the tropics, of a great many reliable Kew model barometers.

67. Within certain limits of latitude, near the equator, the barometer varies so little from a normal height now ascertained, that (allowing for its tidal change) any ship *between those parallels* may ascertain the error of her barometer, aneroid, or sympiesometer, to nearly three hundredths of an inch, and this without incurring risk by moving the instrument, and without any trouble, beyond making the usual observations.

68. By this fact, which could only have been proved by employing such instruments as those recommended by the Kew Committee, a value is given to all barometrical observations made by ships crossing the equator, equivalent to that derivable from comparisons with a standard instrument; and as this applies to past as well as to future observations, it will be the more appreciated.

69. Having shown what has been effected to the present time, and having given an outline of *some* future proceedings now contemplated, a reference to the Royal Society's letter, in the Appendix, may be requested as an exposition of the views of that learned body (in 1854) with respect to these subjects.

70. Instructions from the Admiralty are likewise appended, besides examples of various printed forms in use, which, with the copies of a few pages from the data books, serve to show much of the general nature and extent of the duties to be executed. There is a great deal of detail connected with the selection, purchase, charge, and dis-

tribution of instruments, which, however indispensable, interferes exceedingly with the time and thought required for calculations and the deduction of results.

71. At present the rooms allotted to the Meteorological Office are so filled that additional persons would be detrimental. Space is wanted for packing and storing instruments, as well as for keeping records accessibly: but, with more accommodation, and additional assistance, our fast accumulating materials may be overtaken, and their results promptly published.

72. At present the zealous assiduity of the four persons regularly employed does not suffice to keep pace with increasing current work, and therefore much lately recorded information lies untouched, unavoidably, which ought to be made available.

73. The *annual* expenditure on account of this department, authorized by Parliament, has been *3,200l.* for the Board of Trade, with *1,000l.* on account of the Admiralty: and it does not seem necessary to ask for more money, as there is now a stock of good Instruments on hand, but rather that a larger portion of the sums voted might be devoted to the Office, in order that more assistance might be obtained.

74. The special question, "What results should be periodically published?" demands and has had much consideration. Some persons who take the trouble to keep Meteorological registers say, "Publish them in full." But this would be as impracticable in general as unavailing. The *combined data* from many sources are wanted by the public who are interested in such matters, not isolated diaries or extracts, except in special cases. But what extent or kind of combination is advisable? Some scientific men require original observations, singly or in numbers, still preserving their individuality. Others prefer means or averages for certain periods, say "five-day," monthly, or yearly; and as each has special objects in view, perhaps of equal importance, it appears to be advisable to tabulate all data in such a manner as to be available for the advocates of either method, and on no account to diminish the value of any original observation by recording it (duly corrected or reduced) otherwise than individually. Examples of the methods adopted are given in the Appendix from the data books.

75. At present it is proposed to publish copies of the filled pages of these data books as frequently as may be practicable, and in a form as suitable for transmission by post as can be devised; because the expenses of postage, besides national diversities of language and measures or scales, and the want of full arrangement as to what results or data shall be interchanged, have hitherto much impeded due co-operation.

76. As one illustration of what might be speedily effected by combination, a portion of a plan is submitted in the Appendix, which, if fully executed, would throw a light on the atmospheric changes over the British Islands and their vicinity, which has been unattainable hitherto, though long desired.* I refer to ascertaining the simultaneous states of the atmosphere at certain times (for example, during this last winter), remarkable for their extreme and sudden changes, at very numerous stations on land as well as at sea within an area comprised between the parallels of 40 and 70 degrees north, and the meridians of 10 degrees east longitude and 30 west.

77. For each selected time (referred to one meridian) a chart should be compiled of the atmosphere within these limits: and from such charts a great amount of information, practically as well as scientifically useful, might be derived. Their intercomparison might tend to show the course, progress, and nature of those changes, which now seem so uncertain, and cause so much anxiety to farmers and travellers, as well as to those most interested, who are concerned in navigation or fishery. Scientific men would obtain facts immediately applicable to theories of wind and weather, and to a more distinct elucidation of the nature and progress of atmospheric waves. The meteorological history of three months of winter, and perhaps three of summer, by such a combination, would be the object aimed at if approved.

78. When Sir John Herschel proposed "term days" for general use in the great combination of magnetical and meteorological observers, which was instituted in 1838, that great philosopher recommended united efforts to be made at *definite limited times*. (Those meteorological observations being for purely scientific objects

* Besides nearly one hundred places of regular observation within the British Islands, registers are kept at the lighthouses—now very numerous.

rather than for those of navigation, however related to them, were not specially referred to at the commencement of this report.) The principle of observing at certain terms rather than constantly, if adopted generally, might induce many persons to co-operate who now cannot undertake to observe continuously,—besides being otherwise advantageous.

79. While Great Britain has been taking part in the system of international co-operation arranged at Brussels, it is natural to inquire what is in progress among other nations?

80. In the United States the Superintendent of the National Observatory, the celebrated Maury, has continued his labours indefatigably, as evidenced by new charts, valued books, and useful correspondence. In Holland the Meteorological Institute has published three volumes of nautical information, extracted from Dutch logs in the Indian seas as well as the Atlantic Ocean. In those volumes is also given a conversion of Maury's Pilot charts, reduced to a small scale, for every month, on a plan analogous to that of the Board of Trade. And at the Mauritius a volume has been published which is valuable for the Indian Ocean, especially to seamen. The materials for it were commenced by the zealous and much lamented meteorologist, Dr. Thom.

81. In the United States, the Medical Department of the Army takes charge of Meteorology on land, where their stations are numerous and widely scattered. In their Navy the captains are responsible (as in our own service), but one may express a hope, perhaps, that medical officers at sea may be willingly enlisted among efficient co-operators, if encouraged by the Authorities.

82. Unless some person is specially interested in the subject on board each ship, one cannot expect due consistency of observation, or such a degree of correctness as might be ensured by one person's even occasional supervision, in *addition* to that of the captain, who on board a ship of war has the superintendence of every thing, in a *general* way.

83. In conclusion I would say, that besides reporting briefly on the progress, the present state, and the require-

ments of the Meteorological Department, my object has been to give such an account of its origin and duties, as may serve for a record, and as a document to be referred to, in shaping future proceedings.*

I have the honour to be,
Your Lordship's obedient Servant,
ROBERT FITZROY.

The Lord Stanley of Alderley,
President of the Board of Trade.

* The Parliamentary Papers connected with Meteorological Observations at Sea were presented in February 1853 (No. 115) and in February 1854, the latter containing a Report of the Brussels Conference.

APPENDIX.

APPENDIX A.

LETTER from the ROYAL SOCIETY.

REPLY of the PRESIDENT and COUNCIL of the ROYAL SOCIETY
to a LETTER from the BOARD OF TRADE, dated January 15
1854.

Royal Society, Somerset House,
February 22, 1855.

SIR,

IN the month of June last, the Lords of the Committee of the Privy Council for Trade caused a letter to be addressed to the President and Council of the Royal Society, acquainting them that their Lordships were about to submit to Parliament an estimate for an office for the discussion of the observations on Meteorology to be made at sea in all parts of the globe, in conformity with the recommendation of a conference held at Brussels in 1853; and that they were about to construct a set of forms for the use of that office, in which they proposed to publish from time to time and to circulate such statistical results, obtained by means of the observations referred to, as might be considered most desirable by men learned in the science of Meteorology, in addition to such other information as might be required for the purposes of navigation.

Before doing so, however, their Lordships were desirous of having the opinion of the Royal Society, as to what were the great desiderata in meteorological science; and as to the forms which may be best calculated to exhibit the great atmospheric laws which it may be most desirable to develop.

Their Lordships further state, that as it may possibly happen that observations on land upon an extended scale may hereafter be made and discussed in the same office, it is desirable that the reply of the Royal Society should keep in view, and provide for, such a contingency.

Deeply impressed with a sense of the magnitude and importance of the work which has been thus undertaken by Her Majesty's Government, and confided to the Board of Trade, and fully appreciating the honour of being consulted, and the responsibility of the reply which they are called upon to make;—considering also that by including the contingency of *land* obser-

vations, the inquiry is, in fact, co-extensive with the requirements of meteorology over all accessible parts of the earth's surface,—the President and Council of the Royal Society deemed it advisable, before making their reply, to obtain the opinion of those amongst their foreign members who are known as distinguished cultivators of meteorological science, as well as of others in foreign countries, who either hold offices connected with the advancement of Meteorology, or have otherwise devoted themselves to this branch of science.

A circular was accordingly addressed to several gentlemen whose names were transmitted to the Board of Trade in June last, containing a copy of the communication from the Board of Trade, and a request to be favoured with any suggestions which might aid Her Majesty's Government in an undertaking which was obviously one of general concernment.

Replies in some degree of detail have been received from five of these gentlemen,* copies of which are herewith transmitted.

The President and Council are glad to avail themselves of this opportunity of expressing their acknowledgments to these gentlemen, and more particularly to Professor Dové, Director of the meteorological establishments and institutions in Prussia, whose zeal for the advancement of meteorology induced him to repair personally to England, and to join himself to the Committee by whom the present reply has been prepared. Those who are most familiar with the labours and writings of this eminent meteorologist will best be able to appreciate the value of his co-operation.

The President and Council have considered it as the most convenient course to divide their reply under the different heads into which the subject naturally branches. But before they proceed to treat of these, they wish to remark generally, that one of the chief impediments to the advancement of meteorology consists in the very slow progress which is made in the transmission from one country to another of the observations and discussions on which, under the fostering aid of different governments, so much labour is bestowed in Europe and America: and they would therefore recommend that such steps as may appear desirable should be taken by Her Majesty's Government to promote and facilitate the mutual interchange of meteorological publications emanating from the governments of different countries.

Barometer.

It is known that considerable differences, apparently of a permanent character, are found to exist in the mean barometric pressure in different places: and that the periodical variations in the pressure in different months and seasons at the same place are very different in different parts of the globe, both as respects period and amount; insomuch that in extreme cases, the variations have even opposite features in regard to period, in places

* Dr. Erman of Berlin; Dr. Heis of Münster; Prof. Kreil of Vienna; Lieut. Maury of Washington; and M. Quetelet of Brussels.

situated in the same hemisphere and at equal distances from the equator.

For the purpose of extending our knowledge of the facts of these departures from the state of equilibrium, and of more fully investigating the causes thereof, it is desirable to obtain, by means of barometric observations strictly comparable with each other, and extending over all parts of the globe accessible by land or sea, *tables*, showing the mean barometric pressure *in the year, in each month of the year, and in the four meteorological seasons*,—on land, at all stations of observation,—and at sea, corresponding to the middle points of spaces bounded by geographical latitudes and longitudes, not far distant from each other.

The manner of forming such tables from the marine observations which are now proposed to be made, by collecting together observations of the same month in separate ledgers, each of which should correspond to a *geographical space* comprised between specified meridians and parallels, and to a *particular month*, is too obvious to require to be further dwelt upon. The distances apart of the meridians and parallels will require to be varied in different parts of the globe, so that the magnitudes of the spaces which they enclose, and for each of which a table will be formed, may be more circumscribed, when the rapidity of the variation of the particular phenomena to be elucidated is greatest in regard to geographical space. Their magnitude will also necessarily vary with the number of observations which it may be possible to collect in each space, inasmuch as it is well known that there are extensive portions of the ocean which are scarcely ever traversed by ships, whilst other portions may be viewed as the highways of a constant traffic.

The strict comparability of observations made in different ships may perhaps be best assured, by limiting the examination of the instruments to comparisons which it is proposed to make at the Kew Observatory, before and after their employment in particular ships. From the nature of their construction, the barometers with which Her Majesty's navy and the mercantile marine are to be supplied are not very liable to derangement, except from such accidents as would destroy them altogether. Under present arrangements they will all be carefully compared at Kew before they are sent to the Admiralty or to the Board of Trade; and similar arrangements may easily be made by which they may be returned to Kew for re-examination at the expiration of each tour of service. The comparison of barometers, when embarked and in use, with standards, or supposed standards, at ports which the vessels may visit, entails many inconveniences, and is in many respects a far less satisfactory method. The limitation here recommended is not, however, to be understood as applicable in the case of other establishments than Kew, where a special provision may be made for an equally careful and correct examination.

At land stations, in addition to proper measures to assure the correctness of the barometer and consequent comparability of the

observations, care should be taken to ascertain by the best possible means (independently of the barometer itself) the height of the station above the level of the sea at some stated locality. For this purpose the extension of levels for the construction of railroads will often afford facilities.

It may be desirable to indicate some of the localities where the data, which tables such as those which have been spoken of would exhibit, are required for the solution of problems of immediate interest.

1°. It is known, that over the Atlantic Ocean a low mean annual pressure exists near the equator, and a high pressure at the north and south borders of the torrid zone (23° to 30° north and south latitudes); and it is probable that from similar causes similar phenomena exist over the corresponding latitudes in the Pacific Ocean: the few observations which we possess are in accord with this supposition; but the extent of space covered by the Pacific is large and the observations are few; they may be expected to be greatly increased by the means now contemplated. But it is particularly over the Indian Ocean, both at the equator and at the borders of the torrid zone, that the phenomena of the barometric pressure, not only annual but also monthly, require elucidation by observations. The trade winds, which would prevail generally round the globe if it were wholly covered by a surface of water, are interrupted by the large continental spaces in Asia and Australia, and give place to the phenomena of monsoons, which are the indirect results of the heating action of the sun's rays on those continental spaces. These are the causes of that displacement of the trade winds, and substitution of a current flowing in another direction, which occasion the atmospheric phenomena over the Indian Ocean, and on the north and south sides of that ocean, to be different from those in corresponding localities over and on either side of the equator in the Atlantic Ocean, and (probably generally also) in the Pacific Ocean.

It is important alike to navigation and to general science to know the limits where the phenomena of the trade winds give place to those of the monsoons; and whether any and what variations take place in those limits in different parts of the year. *The barometric variations are intimately connected with the causes of these variations, and require to be known for their more perfect elucidation.*

The importance, indeed, of a full and complete knowledge of the variations which take place in the limits of the trade winds, generally in both hemispheres, at different seasons of the year, has long been recognised. On this account, although the present section is headed "Barometer," it may be well to remark here, that it is desirable that the forms supplied to ships should contain headings, calling forth a special record of the latitude and longitude where the trade wind is first met with, and where it is first found to fail.

2°. The great extent of continental space in Northern Asia causes, by reason of the great heat of the summer and the ascend-

ing current produced thereby, a remarkable diminution of atmospheric pressure in the summer months, extending in the north to the Polar Sea, and on the European side as far as Moscow. Towards the east it is known to include the coast of China and Japan, but the extent of this great diminution of summer pressure beyond the coasts thus named is not known. A determination of the monthly variation of the pressure over the adjacent parts of the Pacific Ocean is therefore a desideratum; and for the same object it is desirable to have a more accurate knowledge than we now possess of the prevailing direction of the wind in different seasons in the vicinity of the coasts of China and Japan.

3°. With reference to regions or districts of increased or diminished *mean annual* pressure, it is known that in certain districts in the temperate and polar zones, such as in the vicinity of Cape Horn extending into the antarctic polar ocean, and in the vicinity of Iceland, the mean annual barometric pressure is *considerably* less than the average pressure on the surface of the globe generally; and that anomalous differences, also of considerable amount, exist in the mean pressure in different parts of the arctic ocean. These all require special attention, with a view to obtain a more perfect knowledge of the facts, in regard to their amount, geographical extension, and variation with the change of seasons, as well as to the elucidation of their causes.

Dry Air and Aqueous Vapour.

The apparently anomalous variations which have been noticed to exist in the mean annual barometric pressure, and in its distribution in the different seasons and months of the year, are also found to exist in each of the two constituent pressures which conjointly constitute the barometric pressure. In order to study the problems connected with these departures from a state of equilibrium under their most simple forms,—and generally for the true understanding of almost all the great laws of atmospheric change,—it is necessary to have a separate knowledge of the two constituents (*viz.*, the pressures of the dry air and of the aqueous vapour) which we are accustomed to measure together by the barometer. This separate knowledge is obtained by means of the hygrometer, which determines the elasticity of the vapour, and leads to the determination of that of the dry air, by enabling us to deduct the elasticity of the vapour from that of the whole barometric pressure. It is therefore extremely desirable that tables, similar to those recommended under the preceding head of the barometer, should be formed at every land station, and over the ocean at the centres of geographical spaces bounded by certain values of latitude and longitude, for the *annual*, *monthly*, and *season* pressures,—1. Of the aqueous vapour; and 2. Of the dry air; each considered separately. Each of the said geographical spaces will require its appropriate ledger for each of the twelve months.

It may be desirable to notice one or two of the problems connected with extensive and important atmospherical laws, which may be materially assisted by such tables.

1°. By the operation of causes which are too well known to require explanation here, the dry air should always have a minimum pressure in the hottest months of the year. But we know that there are places where the contrary prevails, namely, that the pressure of the dry air is greater in summer than in winter. We also know that when comparison is made between places in the same latitude, and having the same, or very nearly the same, differences of temperature in summer and in winter, the differences between the summer and winter pressures of the dry air are found to be subject to many remarkable anomalies. The variations in the pressure of the dry air do not therefore, as might be at first imagined, depend altogether on the differences between the summer and winter temperatures at the places where the variations themselves occur. The increased pressure in the hottest months appears rather to point to the existence of an overflow of air in the higher regions of the atmosphere from *lateral sources*; the statical pressure at the base of the column being increased by the augmentation of the superincumbent mass of air arising from an influx in the upper portion. Such lateral sources may well be supposed to be due to *excessive ascensional currents* caused by *excessive summer heats* in certain places of the globe (as, for example, in Central Asia). Now the lateral overflow from such sources, traversing in the shape of currents the higher regions of the atmosphere, and encountering the well-known general current flowing from the equator towards the pole, has been recently assigned with considerable probability (derived from its correspondence with many otherwise anomalous phenomena already known, and which all receive an explanation from such supposition) to be the original source or primary cause of the *rotating storms* or *cyclones*, so well known in the West Indies and in China under the names of hurricanes and typhoons. A single illustration may be desirable. Let it be supposed that such an excessive ascensional current exists over the greatly heated parts of Asia and Africa in the northern tropical zone,—giving rise, in the continuation of the same zone over the Atlantic Ocean, to a lateral current in the upper regions; this would then be a current prevailing in those regions from east to west; and it would encounter over the Atlantic Ocean the well-known upper current proceeding from the equator towards the pole, which is a current from the south-west. An easterly current impinging on a south-west current may give rise, by well-known laws, to a rotatory motion in the atmosphere, of which the direction may be the same as that which characterizes the cyclones of the northern hemisphere. To test the accuracy of this explanation, we desire to be acquainted with the variations which the *mean pressure of the dry air undergoes in the different seasons* in the part of the globe where, according to this explanation, considerable variations having particular characters ought to be found.

2°. We have named one of the explanations which have been recently offered of the primary cause of the northern cyclones. Another mode of explanation has been proposed, by assuming the condensation of large quantities of vapour, and the consequent influx of air to supply the place. In such case the phenomena are to be tested in considerable measure by the variations which the *other constituent* of the barometric pressure, namely, the *aqueous vapour* undergoes.

3°. The surface of sea in the southern hemisphere *much* exceeds that in the northern hemisphere. It is therefore probable that at the season when the sun is over the southern hemisphere, evaporation over the whole surface of the globe is more considerable than in the opposite season, when the sun is over the northern hemisphere. Supposing the pressure of the dry air to be a constant, the difference of evaporation in the two seasons may thus produce for the whole globe an *annual barometric variation*, the aggregate barometric pressure over the *whole* surface being highest during the northern winter. The separation of the barometric pressure into its two constituent pressures would give direct and conclusive evidence of the cause to which such a barometric variation should be ascribed. It would also follow that evaporation being greatest in the south, and condensation greatest in the north, the water which proceeds from south to north in a state of vapour would have to return to the south in a liquid state, and might possibly exert some discernible influence on the currents of the ocean. The tests by which the truth of the suppositions thus advanced may be determined are the variations of the meteorological elements in different seasons and months, determined by methods and instruments strictly comparable with each other, and arranged in such tables as have been suggested. A still more direct test would indeed be furnished by the fact (if it could be ascertained), that the quantity of rain which falls in the northern is greater than that which falls in the southern hemisphere, and by examining its distribution into the different months and seasons of its occurrence. Data for such conclusions are as yet very insufficient; they should always, however, form a part of the record at all land stations where registers are kept.

In order that all observations of the elasticity of the aqueous vapour may be strictly comparable, it is desirable that all should be computed by the same tables; those founded upon the experiments of MM. Regnault and Magnus may be most suitably recommended for this purpose, not only on their general merits, but also as being likely to be most generally adopted by observers in other countries.

Temperature of the Air.

Tables of the mean temperature of the air in the year, and in the different months and seasons of the year, at above 1,000 stations on the globe, have recently been computed by Professor Dove, and published under the auspices of the Royal Academy of

Sciences at Berlin. This work, which is a true model of the method in which a great body of meteorological facts, collected by different observers and at different times, should be brought together and co-ordinated, has conducted, as is well known, to conclusions of very considerable importance on their bearing on climatology, and on the general laws of the distribution of heat on the surface of the globe. These tables have, however, been formed exclusively from observations made *on land*. For the completion of this great work of physical geography, there is yet wanting a similar investigation for the *oceanic* portion: and this we may hopefully anticipate as likely to be now accomplished by means of the marine observations about to be undertaken. In the case of the temperature of the air, as in that of the atmospheric pressure previously adverted to, the centres of geographical spaces bounded by certain latitudes and longitudes will form points of concentration for observations which may be made within those spaces, not only by the same but also by different ships; provided that the system be steadily maintained of employing only instruments which shall have been examined, and their inter-comparability ascertained, by a competent and responsible authority; and provided that no observations be used but those in which careful attention shall have been given to the precautions which it will be necessary to adopt, for the purpose of obtaining the correct knowledge of the temperature of the external air, amidst the many disturbing influences from heat and moisture so difficult to escape on board ship. In this respect additional precautions must be used, if *night observations* are to be required, since the ordinary difficulties are necessarily much enhanced by the employment of artificial light. Amongst the instructions which will be required perhaps there will be none which will need to be more carefully drawn than those for obtaining the correct temperature of the external air under the continually varying circumstances that present themselves on board ship.

In regard to *land stations* Professor Dove's tables have shown that data are still pressingly required from the British North American possessions intermediate between the stations of the Arctic Expeditions and those of the United States; and that the deficiency extends across the whole North American Continent in those latitudes from the Atlantic to the Pacific. Professor Dove has also indicated as desiderata observations at the British Military stations in the Mediterranean (Gibraltar, Malta, and Corfu), and around the Coasts of Australia and New Zealand: also that *hourly* observations, continued for at least one year, are particularly required at some one station in the West Indies, to supply the diurnal corrections for existing observations.

Whilst the study of the distribution of heat at the surface of the globe has thus been making progress, in respect to the *mean annual temperature* in different places, and to its *periodical variations* in different parts of the year at the same place, the attention of physical geographers has recently been directed (and

with great promise of important results to the material interests of men as well as to general science) to the causes of those fluctuations in the temperature, or departures from its mean or normal state at the same place and at the same period of the year, which have received the name of "non-periodic variations." It is known that these frequently affect extensive portions of the globe at the same time; and are generally, if not always, accompanied by a fluctuation of an opposite character, prevailing at the same time in some adjoining but distant region; so that by the comparison of synchronous observations a progression is traceable, from a locality of maximum increased heat in one region, to one of maximum diminished heat in another region. For the elucidation of the non-periodic variations even *monthly* means are insufficient; and the necessity has been felt of computing the mean temperatures for periods of much shorter duration. The Meteorological Institutions of those of the European States which have taken the foremost part in the prosecution of meteorology, have in consequence adopted *five-day means*, as the most suitable intermediate gradation between daily and monthly means; and as an evidence of the conviction which is entertained of the value of the conclusions to which this investigation is likely to lead, it has been considered worth while to undertake the prodigious labour of calculating the five-day means of the most reliable existing observations during a century past. This work is already far advanced; and it cannot be too strongly recommended, that at all fixed stations, where observations shall hereafter be made with sufficient care to be worth recording, five-days means may invariably be added to the daily, monthly, and annual means into which the observations are usually collected. The five-day means should always commence with January 1, for the purpose of preserving the uniformity at different stations, which is essential for comparison: in leap years, the period which includes the 29th of February will be of six days.

In treating climatology as a *science*, it is desirable that some correct and convenient mode should be adopted for computing and expressing the *comparative variability* to which the temperature in different parts of the globe, and in different parts of the year in the same place, is subject from non-periodic causes. The *probable variability*, computed on the same principle as the *probable error* of each of a number of independent observations, has recently been suggested as furnishing an index "of the probable daily non periodic variation" at the different seasons of the year; and its use in this respect has been exemplified by calculations of the "index" from the five-day means of twelve years of observations at Toronto, in Canada (Phil. Trans. 1853, Art V.) An index of this description is of course of absolute and general application; supplying the means of comparing the probable variability of the temperature in different seasons at *different places* (where the same method of computation is adopted) as well as at the *same place*. It is desirable that this (or some

preferable method, if such can be devised for obtaining the same object) should be adopted by those who may desire to make their observations practically useful for sanitary or agricultural purposes, or for any of the great variety of objects for which climatic peculiarities are required to be known. Having these three data, viz., the mean annual temperature,—its periodical changes in respect to days, months, and seasons,—and the measure of its liability to non-periodic (or what would commonly be called irregular) variations,—we may consider that we possess as complete a representation of the climate of any particular place (so far as temperature is concerned) as the present state of our knowledge permits.

It is obvious that much of what has been said under this Article is more applicable to land than to sea observations; but the letter of the Board of Trade, to which this is a reply, requests that both should be contemplated.

Temperature of the Sea, and Investigations regarding Currents.

It is unnecessary to dwell on the practical importance to *navigation* of a correct knowledge of the currents of the ocean; their direction, extent, velocity, and the temperature of the surface water relatively to the ordinary ocean temperature in the same latitude; together with the variations in all these respects which currents experience in different parts of the year, and in different parts of their course. As the information on these points, which may be expected to follow from the measures adopted by the Board of Trade, must necessarily depend in great degree on the *intelligence*, as well as the *interest* taken in them by the observers, it is desirable that the instructions to be supplied with the meteorological instruments should contain a brief summary of what is already known in regard to the principal oceanic currents; accompanied by charts on which their supposed limits in different seasons, and the variations in those limits which may have been observed in particular years, may be indicated, with notices of the particularities of the temperature of the surface-water by which the presence of the current may be recognised. Forms will also be required for use in such localities, in which the surface temperatures may be recorded at hourly or half-hourly intervals, with the corresponding geographical positions of the ship, as they may be best inferred from observation and reckoning. For such localities also it will be necessary that the tables, into which the observations of different ships at different seasons are collected, should have their bounding lines of latitude and longitude brought nearer together than may be required for the ocean at large.

In looking forward to the results which are likely to be obtained by the contemplated marine observations, it is reasonable that those which may bear practically on the interests of navigation should occupy the first place; but, on the other hand, it

would not be easy to over-estimate the advantages to physical geography, of general tables of the surface temperature of the ocean in the different months of the year, exhibiting, as they would do, its normal and its abnormal states, the mean temperature of the different parallels, and the deviations therefrom, whether permanent, periodical, or occasional. The knowledge which such tables would convey is essentially required for the study of climatology *as a science*.

The degree in which climatic variations extending over large portions of the earth's service may be influenced by the variable phenomena of oceanic currents in different years, may perhaps be illustrated by circumstances of known occurrence in the vicinity of our own coasts. The admirable researches of Major Rennell have shown that in ordinary years the warm water of the great current known by the name of the Gulf-stream is not found to the east of the meridian of the Azores; the sea being of ordinary ocean temperature for its latitude at all seasons, and in every direction, in the great space comprised between the Azores and the coasts of Europe and North Africa: but Major Rennell has also shown that on two occasions, viz., in 1776 and in 1821-1822, the warm water by which the Gulf-stream is characterised throughout its whole course (*being several degrees* above the ordinary ocean temperature in the same latitude), was found to extend across this great expanse of ocean, and in 1776 (in particular) was traced (by Dr. Franklin) quite home to the coast of Europe. The presence of a body of unusually heated water, extending for several hundred miles both in latitude and in longitude, and continuing for several weeks, at a season of the year when the prevailing winds blow from that quarter on the coasts of England and France, can scarcely be imagined to be without a considerable influence on the relations of temperature and moisture in those countries. In accordance with this supposition, we find in the Meteorological Journals of the more recent period (which are more easily accessible), that the state of the weather in November and December 1821 and January 1822 was so unusual in the southern parts of Great Britain and in France, as to have excited general observation; we find it characterised as "most extraordinarily hot, damp, stormy, and oppressive," that "the gales from the W. and S.W. were almost without intermission," "the fall of rain was excessive," and "the barometer lower than it had ever been known for 35 years before."

There can be little doubt that Major Rennell was right in ascribing the unusual extension of the Gulf-stream in particular years to its greater initial velocity, occasioned by a more than ordinary difference in the levels of the Gulf of Mexico and of the Atlantic in the preceding summer. An unusual height of the Gulf of Mexico at the head of the stream, or an unusual velocity of the stream at its outset in the Strait of Florida, are facts which may admit of being recognised by properly directed attention; and as these must precede, by many weeks, the arrival of the

warm water of the stream at above 3,000 miles distant from its outset, and the climatic effects thence resulting, it might be possible to anticipate the occurrence of such unusual seasons upon our coasts.

Much, indeed, may undoubtedly be done towards the increase of our partial acquaintance with the phenomena of the Gulf-stream, and of its counter currents, by the collection and co-ordination of observations made by casual passages of ships in different years and different seasons across different parts of its course ; but for that full and complete knowledge of all its particulars, which should meet the maritime and scientific requirements of the period in which we live, we must await the disposition of Government to accede to the recommendation, so frequently made to them by the most eminent hydrographical authorities, of a specific survey of the stream by vessels employed for that special service. What has been recently accomplished by the Government of the United States in this respect shows both the importance of the inquiry and the great extent of the research, and lends great weight to the proposition which has been made to Her Majesty's Government on the part of the United States, for a joint survey of the whole stream by vessels of the two countries. The establishment of an office under the Board of Trade specially charged with the reduction and co-ordination of such data may materially facilitate such an undertaking.

Storms or Gales.

It is much to be desired, both for the purposes of navigation and for those of general science, that the captains of Her Majesty's ships and masters of merchant vessels should be correctly and thoroughly instructed in the methods of distinguishing *in all cases* between the rotatory storms or gales, which are properly called *Cyclones*, and gales of a more ordinary character, but which are frequently accompanied by a veering of the wind, which under certain circumstances might easily be confounded with the phenomena of *Cyclones*, though due to a very different cause. It is recommended, therefore, that the instructions proposed to be given to ships supplied with meteorological instruments should contain clear and simple directions for distinguishing *in all cases*, and *under all circumstances* between these two kinds of storms; and that the forms to be issued for recording the meteorological phenomena during great atmospheric disturbances should comprehend a notice of all the particulars which are required for forming a correct judgment in this respect.

Thunder-storms.

It is known that in the high latitudes of the northern and southern hemispheres thunder-storms are almost wholly unknown ; and it is believed that they are of very rare occurrence over the

ocean in the middle latitudes when distant from continents. By a suitable classification and arrangement of the documents which will be henceforward received by the Board of Trade, statistical tables may in process of time be formed, showing the comparative frequency of these phenomena in different parts of the ocean and in different months of the year.

It is known that there are localities on the globe where, during certain months of the year, thunder-storms may be considered as a periodical phenomenon of daily occurrence. In the Port Royal Mountains in Jamaica, for example, thunder-storms are said to take place *daily* about the hour of noon from the middle of November to the middle of April. It is much to be desired that a full and precise account of such thunder-storms, and of the circumstances in which they appear to originate, should be obtained.

In recording the phenomena of thunder and lightning, it is desirable to state the duration of the interval between the flashes of lightning and the thunder which follows. This may be done by means of a seconds-hand watch, by which the time of the apparition of the flash, and of the commencement (and of the conclusion also) of the thunder may be noted. The interval between the flash and the commencement of the thunder has been known to vary in different cases, from less than a single second to between 40 and 50 seconds, and even on very rare occasions to exceed 50 seconds. The two forms of ordinary lightning, viz., zigzag (or forked) lightning and sheet lightning, should always be distinguished apart; and particular attention should be given both to the observation and to the record, in the rare cases when zigzag lightning either bifurcates, or returns upwards. A special notice should not fail to be made when thunder and lightning, or either separately, occur in a perfectly cloudless sky. When globular lightning (balls of fire) are seen, a particular record should be made of all the attendant circumstances. These phenomena are known to be of the nature of lightning, from the injury they have occasioned in ships and buildings that have been struck by them; but they differ from ordinary lightning not only by their globular shape, but by the length of time they continue visible, and by their slow motion. They are said to occur sometimes without the usual accompaniments of a storm, and even with a perfectly serene sky. Conductors are now so universally employed in ships that it may seem almost superfluous to remark that should a ship be struck by lightning, the most circumstantial account will be desirable of the course which the lightning took, and of the injuries it occasioned; or to remind the seaman that it is always prudent, after such an accident has befallen a ship, to distrust her compasses until it has been ascertained that their direction has not been altered. Accidents occurring *on land* from lightning will, of course receive the fullest attention from meteorologists who may be within convenient distance of the spot.

Auroras and Falling Stars.

Auroras are of such rare occurrence in seas frequented by ships engaged in commerce, that it may seem superfluous to give any particular directions for their observation *at sea*; and land observatories are already abundantly furnished with such. It is, of course, desirable that the meteorological reports received from ships should always contain a notice of the time and place where Auroras may be seen, and of any remarkable features that may attract attention.

The letter from Professor Heis, which is one of the foreign communications annexed, indicates the principal points to be attended to in the instructions which it may be desirable to draw up for the observation of "Falling Stars." For directions concerning Halos and Parhelia, a paper by Monsieur Bravais in the 'Annuaire Météorologique de la France' for 1851, contains suggestions which will be found of much value.

Charts of the Magnetic Variation.

Although the variation of the compass does not belong in strictness to the domain of meteorology, it has been included, with great propriety, amongst the subjects treated of by the Brussels Conference, and should not therefore be omitted here. It is scarcely necessary to remark, that whatever may have been the practice in times past, when the phenomena of the earth's magnetism were less understood than at present, it should in future be regarded as indispensable, that variation-charts should always be constructed for a *particular epoch* and that *all parts* of the chart should show *the variation corresponding to the epoch for which it is constructed*. Such charts should also have, either engraved on the face or attached in some convenient manner, a table, showing the approximate annual rate of the secular change of the variation in the different latitudes and longitudes comprised: so that by means of this table, the variation taken from the chart for any particular latitude and longitude may be corrected to the year for which it is required, if that should happen to be different from the epoch for which the chart is constructed.

A valuable service would be rendered to this very important branch of hydrography if, under the authority of the new department of the Board of Trade, variation-charts for the North and South Atlantic Oceans, for the North and South Pacific Oceans, for the Indian Ocean, and for any other localities in which the requirements of navigation might call for them, were published at *stated intervals*, corrected for the secular change that had taken place since the preceding publication. Materials would be furnished for this purpose by the observations which are now intended to be made, supposing them to be collected and suitably arranged with proper references to date and to geographical position, and to the original reports in which the results and the data on which they were founded were communicated. By

means of these observations the tables of approximate correction for secular change might also be altered from time to time as occasion should require, since the rate of secular change itself is not constant.

All observed variations, communicated or employed as data upon which variation-charts may be either constructed or corrected, should be accompanied by other observational data (the nature of which ought now to be well understood) for correcting the observed variation for the error of the compass occasioned by the ship's iron. It is also strongly recommended that no observations be received as data for the formation or correction of variation-charts, but such as are accompanied by a detailed statement of the principal elements both of observation and of calculation. Proper forms should be supplied for this purpose ; or, what is still better, books of blank forms may be supplied, in which the observations themselves may be entered, and the calculation performed by which the results are obtained. Such books of blank forms would be found extremely useful both for the variation of the needle, and for the chronometrical longitude (as well as for lunar observations, if the practice of lunar observations be not, as there is too much reason to fear it is, almost wholly discontinued). By preparing and issuing books of blank forms suitable for these purposes, and by requesting their return in accompaniment with the other reports to be transmitted to the Board of Trade at the conclusion of a voyage, the groundwork would be laid for the attainment of greatly improved habits of accuracy in practical navigation in the British mercantile marine.

The President and Council are aware that they have not exhausted the subject of this reply in what they have thus directed me to address to you ; but they think that perhaps they have noticed as many points as may be desirable for *present* attention ; and they desire me to add, that they will be at all times ready to resume the consideration if required, and to supply any further suggestions which may appear likely to be useful.

I have the honour to be, Sir,

Your obedient Servant,

W. SHARPEY, *Sec.*

*To the Secretary of the Lords of the
Committee of Privy Council for Trade.*

A subsequent correspondence passed, in May and June 1856, from which the following extract may be here given, being the only part of that correspondence which related to the meteorological desiderata referred to in the communication from the Board of Trade.

EXTRACT.

“It cannot be doubted that one of the most important objects of the Meteorological Department, both in a practical and a theoretical view

is the procurement of the statistics of the direction and force of the wind in different seasons of the year over those parts of the Atlantic Ocean which are most usually traversed by ships. The records kept by the vessels themselves, suitably co-ordinated, may be expected in the course of time to do much towards this very important purpose; but the Committee are desirous of bringing under the consideration of the Board of Trade the advisability of aiding and expediting the inquiry by establishing, as far as may be found convenient, self-recording anemometrical instruments on some of the islands of the Atlantic. Detached observations of the wind, taken at intervals on board ship, may be most valuable in filling up the spaces between fixed and unerring self-recording instruments, but are scarcely sufficient to procure such exact knowledge of the variations as is required not less for the purposes and improvement of navigation than for the complete theory of the laws which regulate these variations. The Azores, Madeira, Bermuda, Ascension, and St. Helena are all stations where continuous and exact anemometrical records might be obtained, probably with very little inconvenience and at a comparatively small cost, and would be most valuable in the relation above stated. A self-recording anemometer quite suitable for this purpose is now under construction at the Kew Observatory; and instruments on the same model might be procured complete, it is believed, at a cost of less than 50*l.*, requiring no other alteration than the change, once in twenty-four hours, of the paper on which the instrument itself records the direction and force of the wind."

DIAGRAMS.

SQUARE 375.

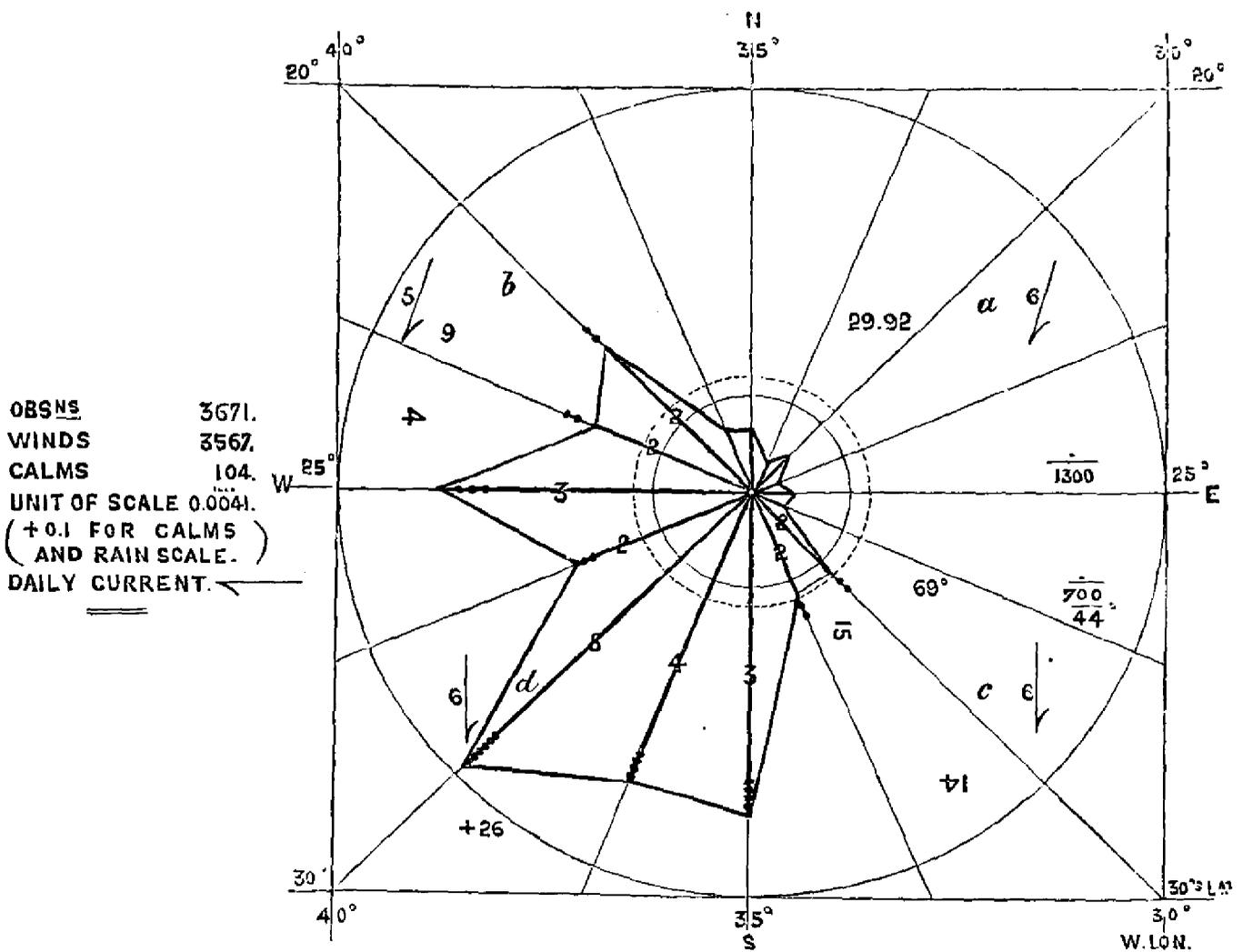
Sub-divided into *a, b, c, d*, which sub-division may be continued by quartering and lettering *a, b, c, d*, as *e, f, g, h*, &c.

SOUTH ATLANTIC.

Brazilian Coast (near Rio de Janeiro).
For Three Months,—January, February, March.

Four of Maury's Wind roses are condensed into this Diagram ; namely, those for

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
Lats.	20° + 25° S.	20° + 25° S.	25° + 30° S.	25° + 30° S.
and				
Longs.	30 + 35 W.	35 + 40 W.	30 + 35 W.	35 + 40 W.



OBSNS 3671.
WINDS 3567.
CALMS 104.
UNIT OF SCALE 0.0041.
(+0.1 FOR CALMS
AND RAIN SCALE.)
DAILY CURRENT. ←

Scale of Wind. Beaufort - 1-12 and Land - 1-6	{ 1=2=Light. 2=4=Moderate. 3=6=Fresh. 4=8=Strong. 5=10=Heavy. 6=12=Violent.	Temp. sea surf. 69°	Var. (¼ turn).
		Depth - - 1,500	Dip (½ turn).
		No ground at 1300	Sp. Gr. + 26.
		Temp. at - 15.00 / 44°	(1,000 + ?)
		Variation - - 4	
		Dip - - 11	

Converted from Maury's Pilot Charts of South

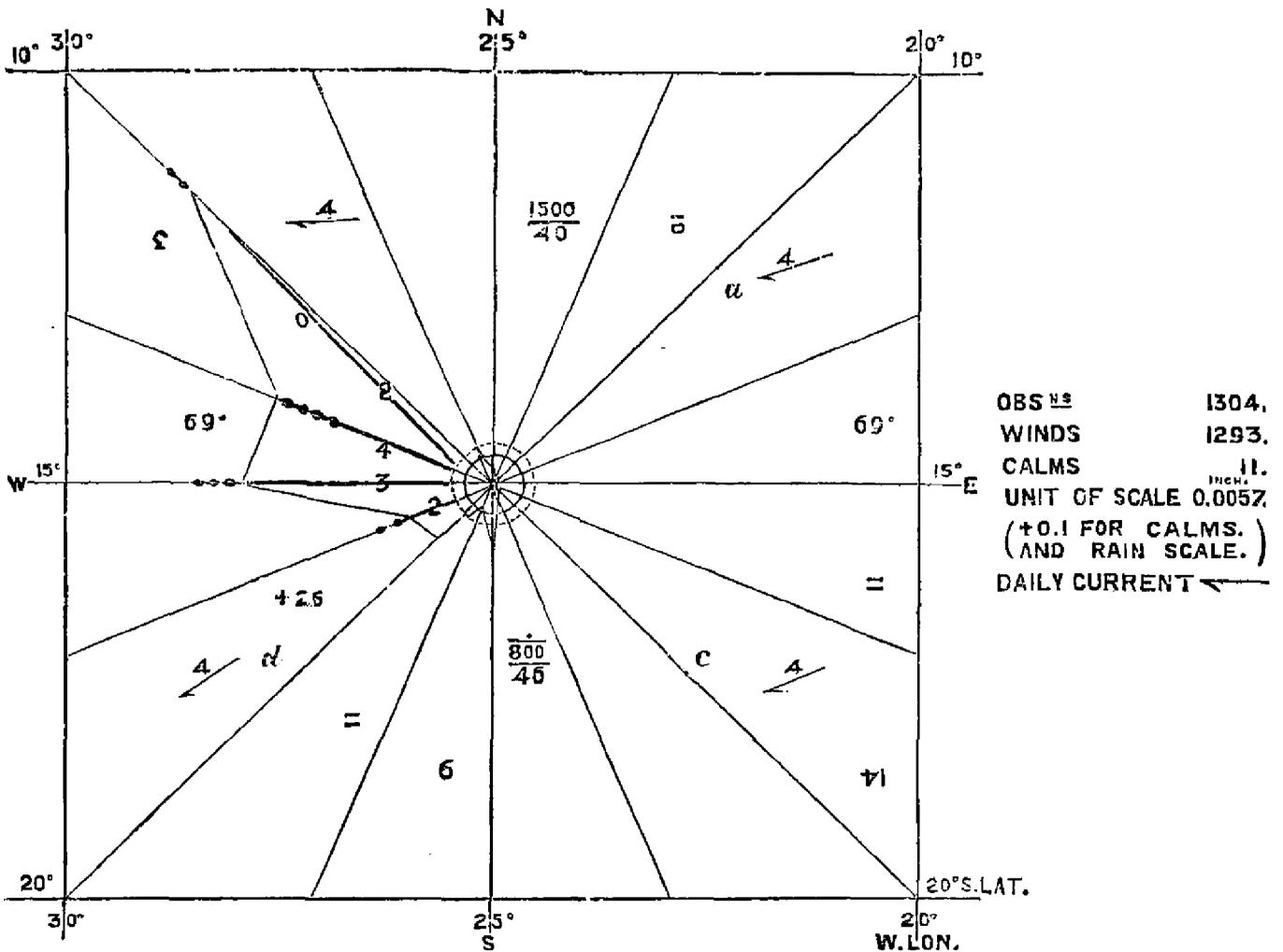
SQUARE 338.

SOUTH ATLANTIC.

Brazilian Coast (near Bahia).

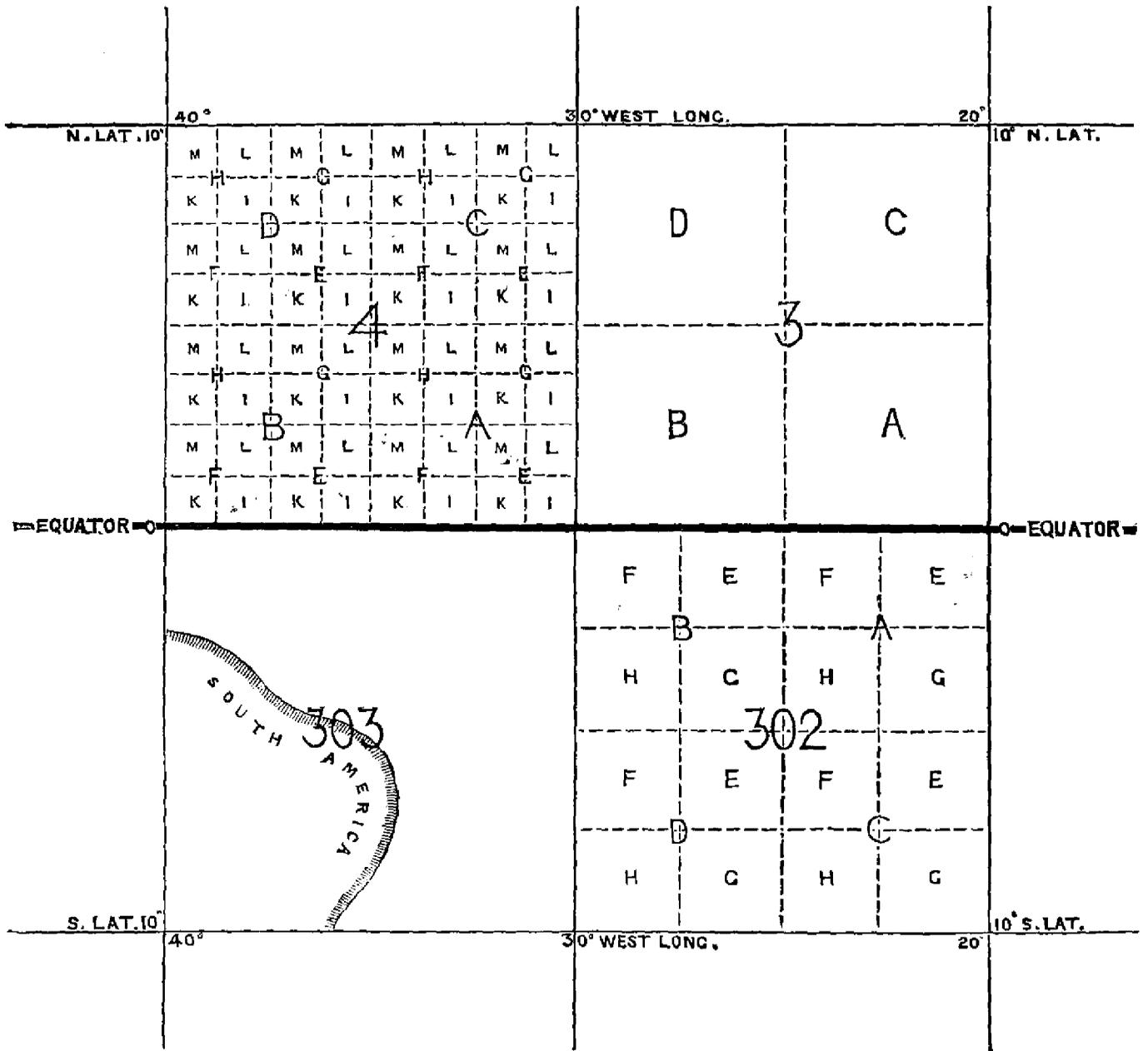
For Three Months,—January, February, March.

Five-inch Square : half one side (=radius of inscribed circle) has 2,500-thousandths of an inch, in which measure the *unit for scale* is taken.



Let. n = number of parts in <i>radius</i> (=2,500)	Log. n (2500)	= 3.3979
" n' = " longest point (<i>radius</i>)	Log. l (·001)	= 3.0000
" l = length of <i>one</i> part of radius = (·001)		0.3979
" l' = length of unit of scale.		2.6425
then $n' : n :: l : l'$	Log. $n' = (439)$	3.7554
$\therefore \frac{n \times l}{n'} = l' = \text{unit of scale}$	Unit of Scale = $l' = \cdot 0057 = \bar{3} \cdot 7554$	

SPECIMEN of the METHOD ADOPTED in the SUBDIVISION of the SQUARES of TEN DEGREES into which the SURFACE of the GLOBE is supposed to be DIVIDED.



N.B.—The letters in the above diagram may be of any character.

APPENDIX B.

 DIVISIONS of the GLOBE and CONSTRUCTION of WIND CHARTS, &c.

DIVISIONS OF THE GLOBE.

THE mode of exhibiting barometrical and thermometrical oscillations by diagrams is familiar to most persons ; but, as the method here adopted to show the results of observations of wind, weather, and some other matters graphically, is new, it may require explanation.

The surface of the globe is supposed to be divided into squares of ten degrees each. Beginning at the meridian of Greenwich, on the Equator, the numbers go westward until the same meridian is regained ; then, on the next circle, northwards, between the parallels of 10 and 20 degrees of latitude, and so on, omitting the 10 degrees space of latitude around the pole.

From the first meridian the squares south of the Equator are numbered from 300 in a similar manner, but southwards to the eightieth southern parallel. Thus distinguished by numbers not exceeding 600, all those below 300 being north of the Equator, the locality of each frequented square may soon become fixed in the memory of a navigator, and serve (like provinces on land) to recal spaces to the mind, rather than points indicated only by latitude and longitude.

Observations made in any square may be referred to the centre of that square, as to an observatory at which observations are made daily.

In such spaces it is supposed that meteorological occurrences will not generally be very dissimilar ; and that, if all are referred to the centre of that square, or subdivision of it, in which they occur, the mean result of a great number of observations will give a reliable and approximately correct general average for practical use.

If between each time of observation eight hours elapse, three winds (or calms) may be noted for one day.

During a certain interval of weeks, months, seasons, or years, a number of observations are collected. These are classified and totalled under points of the compass. A circle being inscribed in a square of so many degrees, the greatest number of observations under any point governs the scale of equal parts according to which the numbers of winds under each point are laid down from the centre of the circle leewardly towards its circumference, the longest point being always equal to the radius. Through the extremities of these lines, on points or alternate points of the

compass, a line is drawn, as a curve is drawn through ordinates, and the resulting diagram (sometimes called a wind star) shows the proportion of winds.

The greater area of the figure being to leeward of the centre indicates, at a glance, the *relative* prevalence of wind from particular points, and its relative duration.

As a circle is said to be generated by the revolution of its radius, so a wind star may be said to result from the motion of a vane ; and persistence in any direction may be supposed to increase the length of the corresponding line or point (like the growth of crystals).

The average strength of wind may be shown by parallel lines, or numerically, or by dots ; the per-centage of calms, by a circle of which the radius equals their number (according to the scale of the diagram) ; the per-centage of rain by a dotted circle, on a similar principle ; and oceanic currents by the usual arrows and numbers. In addition may be given, without overloading the paper, confusing the eye, or using colours,* the per-centage of gales or storms (by marks on the point lines), deep-sea soundings, temperature, atmospheric pressure, and the specific gravity of sea water ; besides variation of the magnetic needle, and perhaps other data.

Twelve wind charts for the principal oceans have been published, which show part only of what may be given at a future time.

* Colours increase the expense of printing.

MAURY CONVERSION—WINDS AND CALMS.

375 a. b. c. d.

POINTS OF THE COMPASS.

Sq.	Mo.	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
375 a	1	74	76	35	89	41	58	13	7	4	1	2	3	2	7	21	70
	2	50	50	43	49	49	19	5	6	2	4	1	2	1	13	18	47
	3	32	40	30	48	42	39	8	10	2	10		4		13	19	71
b	1	53	84	17	18	10	10	1	1		2				6	8	32
	2	32	66	15	24	19	22	14	10	1	4	5	4	2	15	9	20
	3	44	75	26	46	30	31	25	21	13	16	3	11	4	21	12	65
c	1	43	33	23	31	11	22		2	2	5	4	5	13	13	11	29
	2	29	39	15	29	9	17	2	6	4	1	1	2	4	31	27	54
	3	18	22	27	33	11	34	9	8	3	13	4	10	2	8	8	10
d	1	23	41	14	12	6	14	6	4		1	3	5		18	9	39
	2	34	60	11	20	6	12	8	4	1	2	3	4		3	6	12
	3	36	29	12	30	13	16	5	13	2	18	9	18	3	21	11	36
Total	-	468	615	268	429	247	294	96	92	34	77	35	68	31	169	159	485
<p>Winds..... = 3567</p> <p>Calms..... = 104</p>																	
Mo.	a	1	2	3	b	1	2	3	c	1	2	3	d	1	2	3	13 = 104 Total Observations... = 3671
		13	7	18	4	1	14	24	10	14	24	10	13	7	18		

MAURY CONVERSION--WINDS AND CALMS.

POINTS OF THE COMPASS.

338 a. b. c. d.

Sq.	Mo.	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
338 <i>a</i>	1			2	2	2	12	5	2								
	2			1	5	5	28	7	4								
	3				19	15	53										
<i>b</i>	1		4	3	21	38	73										4
	2			12	24	43	95	6	1					1	1		2
	3	2	9	5	24	17	55	3	1								10
<i>c</i>	1				7	7	1										
	2	1	7	14	12	3	7										
	3																
<i>d</i>	1		14	28	53	45	18	2						1	1	1	10
	2	11	20	33	67	39	48	8	3						4	7	12
	3	9	23	11	29	22	49	6		1	3		1				34
Total -		23	77	109	263	236	439	37	11	1	3		1	4	6	11	72
<p>Winds..... = 1293 Calms..... = 11</p>																	
Mo.		<i>a</i>	1 2 3	<i>b</i>	1 2 3	<i>c</i>	1 2 3	<i>d</i>	1 2 3	2 2 5 = 11	Total Observations.. = 1304						
			1		1		1		1								

APPENDIX C.
EXAMPLES of ENTRIES in DATA BOOKS.

BAROMETRICAL OBSERVATIONS.—NORTH ATLANTIC.

Ship or Number.	Date. y. m. d.			BAROMETER CORRECTED AND REDUCED.													
				N. A.		Latitude, 0°—5° Longitude, 25°—20°											
				3 a.		6	8	9	10	12	2	3	4	6	8	10	12
302	55 VII.	7	..	29·76	..	..	29·79	..	29·77	..	29·84	..	..	29·87	..	..
302 a	56 III.	7	..	·70	..	..	·72	..	·68	..	·62	..	..	·68	..	..
"	" "	8	..	·62	..	..	·72	..	·67	..	·62	..	..	·67	..	..
291 b	56 IV.	9	..	·69	..	..	·72	..	·69	..	·66	..	..	·69	..	..
"	" "	10	..	·95	..	..	·96	..	·95	..	·92	..	..	·98	..	..
"	" "	11	..	·95	..	..	30·00	..	·99	..	·95	..	..	30·00	..	..
"	" "	12	..	30·00	..	..	..	..	..	..	·93	..	..	29·99	..	..
283 a	56 III.	8	..	29·96	..	..	29·99	..	29·96	..	·92	..	..	·98	..	..
"	" "	8	..	·92	..	..	·92	..	·79	..	·79	..	..	·83	..	..
220	55 V.	9	..	·89	..	..	·90	..	·88	..	·83	..	..	·87	..	..
"	" "	18	..	·85	..	..	·94	..	·90	..	·90	..	..	·80	..	..
"	" "	19	..	·91	..	..	..	..	·91	..	·89	..	..	·89	..	..
220 a	55 XII.	30	..	·82	..	..	29·89	..	·85	..	·79	..	..	·88	..	..
"	" "	31	..	·84	..	..	·89	..	·82	..	·79	..	..	..	..	..
"	56 I.	1	..	·85	..	..	·90	..	·84	..	·80	..	..	29·89	..	..
300	55 II.	7	..	·87	..	..	·97	..	·96	..	·94	..	..	·97	..	..
"	" "	8	..	·93	..	..	·97	..	·97	..	·22	..	..	·94	..	..
"	" "	9	..	·92	..	..	·98	..	·94	..	·91	..	..	·96	..	..
202	55 IV.	17	..	·92	..	..	·93	..	·93	..	·89	..	..	·89	..	..
"	" "	22	..	·90	..	..	·94	..	·94	..	·92	..	..	·92	..	..
203	55 XI.	9	..	·93	..	..	·92	..	·95	..	·91	..	..	·93	..	..
"	" "	10	..	·92	..	..	·94	..	·91	..	·85	..	..	·95	..	..
"	" "	11	..	·92	..	..	·95	..	·95	..	·89	..	..	·97	..	..
289	56 III.	17	..	·93	..	..	·97	..	·95	..	·89	..	..	·96	..	..
"	" "	19	..	·96	..	..	30·01	..	·96	..	·91	..	..	·94	..	..
"	" "	20	..	·92	..	..	·01	..	·98	..	·92	..	..	·95	..	..
"	" "	21	..	·92	..	..	29·96	..	·94	..	·85	..	..	·87	..	..
286	55 VIII.	11	30·01	30·00	30·01	30·03	30·04	30·05	30·04	30·00	..	29·97	30·01	30·05	30·09	30·07	
"	" "	12	·00	·00	·02	·06	·07	·08	·03	·00	29·99	30·00	·00	·02	·04	·03	
286 a	56 III.	4	·00	29·98	29·98	·02	·03	·03	·00	29·97	·95	29·94	29·96	29·99	·01	29·99	
213	55 VIII.	7	29·97	·91	·96	·01	·03	·04	·02	·97	·95	·94	·96	·99	·02	30·02	
"	" "	8	..	·98	..	..	29·98	..	29·97	..	30·03	..	..	30·06	..	·08
268	55 VII.	6	..	30·08	..	..	30·11	..	30·06	..	·03	..	..	·03	..	·07
"	" "	7	..	29·87	..	..	29·89	..	29·91	..	29·94	..	..	29·96	..	..
"	" "	7	..	·96	..	..	·94	..	·91	..	·89	..	..	·91	..	..
268 a	56 II.	27	..	·87	..	..	·87	..	·89	..	·85	..	..	·81	..	29·81
"	" "	28	..	..	..	..	·88	..	·86	..	·86	..	..	·86	..	·86

EXPLANATION.

The figures in the first column (headed Ship or Number) have reference to the documents from which the observations have been respectively obtained.

The second column supplies the date, the year, month, and day.

The letters N. A., with 3 a. beneath, refer to the *locality*—e. g., all the observations on this page were made in the subdivision a of that particular square of ten degrees in the North Atlantic, to which the number 3 has been assigned—i. e., between the Equator and 5° North Latitude, and between 20° and 25° West Longitude.

The figures at the top of the columns containing the observations represent the hours of the day (civil time).

Ex.—Taking the first entry, 29·76 is the corrected reading of the barometer of the ship "Storm Cloud," at 4 a. m. 7th July, 1855, 29·79 at 9 A. M. on same day, 29·77 at noon, and so on.

The observations are reduced as follows:—

Ex.—The first entry, 29·76, was recorded in the log as +29·880
 Correction to scale reading..... + ·002
 To reduce to sea-level (10 feet)..... + ·011 nearly
 To reduce to 32° Fahrenheit (temperature 79°) .. — ·134

29·759 = 29·76 nearly.

THERMOMETRICAL OBSERVATIONS—SOUTH ATLANTIC.

Ship or No. and Date.	Upper A.M. Lower P.M.		S.A.		DRY AND WET THERMOMETERS—IN AIR (corrected).												
			339 c.		Latitude, 15°—20°.						Longitude, 35°—30°.						
	d	w	d	w	d	w	d	w	d	w	d	w	d	w	d	w	
300 17.2.55			78·3	73·3					78·	72·1	77·8	72·9			79·1	73·1	
18.,, "			78·2	72·4	77·	71·9			77·8	73·1	77·6	72·2			78·1	72·6	
300 a 18.1.56			78·2	75·3	76·3	74·6			77·5	75·1	78·2	75·3			79·	76·1	
19.,, "			80·	76·1	77·5	75·1			78·8	75·9	78·5	75·1			79·3	74·9	
286 22.8.55	73·1	68·			73·	67·9	72·2	66·8	72·2	66·3	72·5	66·8	73·	66·6	73·2	67·2	
	73·	66·9	73·	66·8	72·8	66·8	72·1	66·2	72·	67·			72·	66·6	72·	66·6	
23.,, "	71·5	66·			71·	65·2			72·2	66·3	73·	66·8	73·	66·9	73·8	66·8	
	73·2	66·8	73·	66·6	72·7	66·4	71·8	66·	71·6	66·4			71·4	66·8	71·2	67·1	
268 17.7.55					73·8	75·8					74·8	75·8			75·8	74·8	
			74·8	74·8					73·3	75·3							
213 19.8.55					73·8	72·8					75·8	73·8			74·8	75·8	
			74·8	72·8					72·8	72·8					71·8	70·8	
213 a 16.12.55					74·8	74·8					76·8	74·8			77·8	75·8	
			77·8	75·8					75·8	74·8					76·8	75·8	
17.,, "					76·8	75·8					78·8	76·8			78·8	77·8	
			79·8	78·8					78·8	77·8					77·8	75·8	
221 26.5.55					74·3	70·6					75·9	71·			76·1	70·4	
			76·7	71·					75·9	70·3							
27.,, "					74·1	68·6					74·7	70·			74·5	71·2	
			74·7	71·					73·7	71·8							
264 21.8.55					73·	69·1					73·	68·9	73·2	69·3		73·	69·3
			72·8	69·1													

EXPLANATION.

The columns headed d and w contain the readings, when corrected for index errors, of the dry and wet bulb thermometers respectively.

The upper row of figures in each division are the A.M., the lower the P.M. observations.

In other respects the tabulation is similar to that of the barometrical observations.

Ex.—Taking the observations in the first division, we find that, in the subdivision c of the square 339 in the South Atlantic (S.A. 339 c), or between 15° and 20° South Latitude, and between 30° and 35° West Longitude, on 17th February 1855, the temperature of the air was found by the ship "Cambridge" (300) to be 77°·8 at 9 A.M., the wet bulb thermometer showing at the same time 72°·9. At noon on the same day we have, dry bulb, 79°·1; wet bulb, 73°·1; at 3 P.M., 78°·3 and 73°·3 respectively; and so on for the other observations.

In some few instances the temperatures of the wetted thermometer are found to be noted as higher than those of the dry-bulb thermometer.

When this is the case a mistake has probably been made in the entry, but it is possible that the bulb may in some cases have been wetted with water rather warmer than the air, and for a time may have actually raised the temperature of the mercury, instead of lowering it as usually by the effect of evaporation.

WINDS AND WEATHER—CHINA SEA.

East.		WINDS AND WEATHER.											
26 a.		Latitude 0°—5°. Longitude 105°—110°.											
Ship.	Year.	Month.	Day.	Weather.	Cloud.	North.	N.N.E.	N.E.	E.N.E.	East.	E.S.E.	S.E.	S.S.E.
239	54	10	12	bc	::	::	::	::	::	::	::	2	::
"	"	"	13	b c c	::	0	::	::	::	::	::	::	::
"	"	"	17	o c	::	2' 0'	::	::	::	::	::	::	::
"	"	"	"	p c q	::	0'	::	::	::	::	::	2	::
"	"	"	27	c m q	::	0	::	::	::	::	::	3	::
"	"	"	"	b c c	::		::	::	::	::	::		::
"	"	"	28	bc	cir.								3
"	"	"	29	bc	::	1' 0'	::	::	::	::	::		::
"	"	"	"	bc	::	2	::	::	::	::	::		::
"	"	"	30	bc	::			2					
"	"	"	31	c	::							3	
"	"	11	5	bc	::	1							
"	"	"	9	o c m	::		2	3'					
"	"	"	10	o c m	cir. str.	2' 0'							
"	"	"	"	bc	::	3							
"	"	"	13	bc	::	2							
"	"	"	14	bc q	::		6						
"	"	"	"	b c q o	::		4	2					
"	"	"	15	b c m o	nim.			5					
"	"	"	"	bc q									
"	"	"	16	b c r	nim.	1	3						
"	"	"	17	o c d			3						
"	"	"	"	bc									
"	"	"	18	bc		3							
"	"	"	"	b c m			3						
"	"	"	19	c m p			3						
"	"	"	20	b			3						
"	"	"	21	bc			4						
"	"	"	22	bc			3						
"	"	"	"	bc				2					
"	"	"	"	bc				4					
268	55	9	13	c	cremstr							4	

EXPLANATION.

This page contains a record of Winds (from the eastern half of the compass) and Weather, in square 26a, China Sea, i.e. between the Equator and 5° N. lat. and 105° and 110° E. long. The figures represent the average force of the wind for a period of eight hours, the Beaufort notation (1—12) being used. A cypher represents a calm.

A mark close under any entry signifies that that entry refers to only half a full period, or to an interval of four hours.

Ex. 1.—The first entry is a note by H.M. Ship "Lily," of a very light breeze from S.E., on 12th October 1854, the weather being fine, blue sky with detached clouds.

N.B. Three observations (periods of eight hours) in each space.

Ex. 2.—The third entry is a report, by the same ship, on the 17th of the same month, of overcast weather with detached clouds, a very light N. breeze for four hours, followed by a calm of same duration, then a very light S.E. breeze for eight hours, with passing showers, detached clouds, and squally weather. The remaining period of eight hours was divided between a calm and a light breeze from S.E. with detached clouds, misty atmosphere, and squally weather.

WINDS AND WEATHER - CHINA SEA.

West.		WINDS AND WEATHER.											
26 a		Latitude 0°—5°						Longitude 105°—110°.					
Ship.	Year.	Month.	Day.	Weather.	Cloud.	South.	S.S.W.	S.W.	W.S.W.	West.	W.N.W.	N.W.	N.N.W.
253	54	9	11	bc	cum.	4	..	..	..	..	..	..	..
"	"	"	13	bem	..	2	..	..	..	..	..	..	..
"	"	"	14	bc	cm. str.	..	..	1	..	..	..	..	..
"	"	"	14	bc	..	..	..	..	..	1	..	..	..
"	"	"	"	cl	nim.	0	..	..	..	..	..	..	..
"	"	"	15	bc	..	..	..	..	..	2	..	..	..
"	"	10	9	bc	..	..	..	..	..	..	..	1	..
"	"	"	10	orq	..	..	..	4	..	..	..	..	..
"	"	"	"	bc	nim.	..	..	..	..	..	..	2	..
"	"	"	"	bc	..	..	..	..	..	..	..	..	3
"	"	"	11	c	..	..	..	..	..	..	..	..	1
"	"	"	"	cgup	nim.	..	..	..	..	3	..	..	..
"	"	"	12	bc	—	..	..	..	..	..	..	..	..
"	"	"	"	c	—	..	..	..	..	..	..	..	1
"	"	"	13	bc	—	..	2	..	..	..	..	..	..
"	"	"	15	bc	cir.cum.	0'	..	..	..	..	..	1'	..
"	"	12	7	bc	..	..	..	..	..	..	..	2	..
"	"	"	"	c	..	..	..	..	..	..	..	..	1
"	"	"	8	bem	..	..	..	..	..	..	..	..	2
"	"	"	"	bc	..	..	..	..	..	..	..	..	3
"	"	"	9	bc	..	..	..	..	..	..	1	..	..
"	"	"	10	bc	..	..	..	..	..	1	..	..	..
"	"	"	11	c	..	..	2	..	..	..	..	..	..
"	"	"	"	bc	..	..	..	..	..	..	2	..	..
"	"	"	12	cpqr	..	0'	..	..	..	3	..	..	..
"	"	"	"	bc	..	..	..	..	..	..	1'	..	..
"	"	"	30	bc	cir.	..	..	..	..	2	..	..	..
"	"	"	"	bc	..	0' 1'	..	..	..	..	..	..	..
239	54	4	19	bep	..	..	..	..	..	..	3	..	..
"	"	"	"	bc	..	..	..	..	..	2	..	..	..
"	"	"	20	bc	..	..	..	..	..	1	..	..	..
"	"	"	"	bc	cir. str.	..	2	..	..	..	..	..	..
"	"	"	"	bc	..	..	..	..	1	..	..	..	..

EXPLANATION.

This page contains a record of Winds, from the western half of the compass—Weather and Cloud tabulated in a manner precisely similar to the preceding.—(Three entries in each space) (each line=8* (or 4) hours.)

Ex.—In the third division H. M. S. "Rapid" reports on 10th Oct. 1854 a fresh breeze from S. W., overcast weather, rain, and squalls; middle part, light N. W. breeze, blue sky, and detached clouds (nimbi); latter part, moderate breeze from N. N. W., blue sky, with detached clouds.

* First part=8; middle part=8; last part=8=24 hours.

TEMPERATURE of SEA at SURFACE and DEPTH, and SPECIFIC GRAVITY,
SOUTH ATLANTIC.

S. A.		SEA-WATER.												
409		Latitude, 30°—40°.						Longitude, 20°—10°.						
Ship.	Year.	Month.	Day.	Latitude.		Longitude.		Current.		Temperature.	Specific Gravity.	Depth.	Temperature.	
				°	'	°	'							
76	38	9	18	30	35	19	18			59·1				
	"	"	19	32	06	18	31			58·1				
	"	"	20	33	02	16	29			59·2				
	"	"	21	32	02	13	19			56·8				
	"	"	22	32	15	10	07			59·0				
	"	"	23	31	20	16	58			62·0				
80	"	"	24	32	54	13	31			62·0				
	"	"	25	34	07	13	23			59·0				
	"	"	26	34	17	11	46			58·0				
	"	"	"	"	"	"	"							
I.	54	4	14	36	37	10	11	N.E. b. N.	17	63·1	28·2			
	"	"	"	"	"	"	"			64·7				
	"	"	"	"	"	"	"			63·4				
	"	"	15	36	29	12	20	N.W. $\frac{1}{2}$ W.	55	62·2	27·9	300	52·0	
	"	"	"	"	"	"	"			64·3				
	"	"	"	"	"	"	"			64·6				
	"	"	16	36	24	16	30	N.E. b. E.	25	65·2	27·6			
	"	"	"	"	"	"	"			66·0				
	"	"	"	"	"	"	"			65·2				
	"	"	3	30	31	38	19	12			70·5	29·4		
	"	"	"	"	"	"	"	"			69·7			
	"	"	"	"	"	"	"	"			69·6			
	"	"	31	31	52	17	28	N. b. E.	15	69·6	29·2	300	49·5	
	"	"	"	"	"	"	"	"			70·7			
	"	"	"	"	"	"	"	"			69·8			
"	"	4	33	27	17	4	West	7	68·5					
"	"	"	"	"	"	"	"			67·8				
"	"	"	"	"	"	"	"			66·8				
"	"	2	35	2	15	15	East	19	65·8					
"	"	"	"	"	"	"	"			65·7				
"	"	"	"	"	"	"	"			64·6				
"	"	3	35	47	13	36				64·1	28			
"	"	"	"	"	"	"	"			64·0				
"	"	"	"	"	"	"	"			64·2				

EXPLANATION.

The sea-water observations for each square of 10° are kept distinct. All on this page were, as shown by the heading (S. A. 409), taken in square 409 in the South Atlantic, i.e. between 30° and 40° S. latitude, and between 10° and 20° W. longitude.

The first of the columns headed "Temperature" contains the "temperature" of the sea at surface, given three times per day; the last column is for temperature at certain depths whenever obtained.

The mode of notation is obvious:—

Ex.—In the fifth division from the top, on the 15th April 1854, in latitude 36° 29' S. and longitude 12° 20' W., the "Saracen" (I.) reports a current N.W. $\frac{1}{2}$ W., setting 55 miles in 24 hours, temperature at surface varying from 62°·2 to 64°·6. Specific gravity at surface 1027·9, and temperature of water at a depth of 300 fathoms, without finding bottom, 52°.

MISCELLANEA.

Authority and Date.				ICE.			Temperature of	
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Air.	Water.
84	55	VI.	30	North. 45° 17'	Large berg, about 180 feet high.	West. 47° 47'	49°	48°

Authority and Date.				AURORA BOREALIS.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Time.
205	55	XII.	3	49° N.	Forming an arch extending from N.E. by E. to N.W.; streams of light occasionally shooting up to 15° or 20° above the arch; most brilliant about 9 P.M.; of a dull yellow colour.	42° W.	5 P.M. to 11 P.M.

Authority and Date.				METEORIC APPEARANCES.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Time.
202	55	VI.	20	5° S.	A large meteor to northward fell with a noise like a rocket.	59° E.	10 P.M.
204	55	XII.	6	3° N.	Many shooting stars in N.E. falling perpendicularly.	26° W.	About 9 P.M.

GALES OR STORMS (IN NOVEMBER.)							Barometer.	
Ship.	Date.	Wind.	Force.	Latitude.	General Nature.	Longitude.	Greatest Depression.	Time.
82*	20th 54	S.S.E. to S.W.	12	North. 23° 52'	Hurricane from 11 A.M. to 5 P.M., when more moderate.	East. 143° 17'	28.48	2 P.M.

Authority and Date.				THUNDER, LIGHTNING, OR HAIL.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Time.
202	55	V.	23	South. 36° 32'	Heavy shower of hail; lightning to N.W.	East. 31° 40'	About noon.

* Ship's log or document 82 contains many further details.

MISCELLANEA.

Authority and Date.				DANGERS (VIGIA), &c.		
Ship.	Year.	Month.	Day.	Latitude.	Remarks.	Longitude.
4	54	V.	1	North. 4° 29'	Being near the spot marked "French Shoal" on chart, tried for soundings, with 100 and 160 fathoms, without bottom. Sea showed two distinct swells from N. and S. respectively. Many birds about, principally "Portuguese Mon-of-War."	West. 20° 34'

Authority and Date.				WHALES OBSERVED.			No. seen.	Temperature of water.
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.		
205	55	IX.	18	52° N.	"Greenland," also "Fin-backs" in hundreds.	54° W.	10 or 12	37°

Authority and Date.				BIRDS, FISH, &c.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Remarks.
1	54	II.	26	14° N.	Flying fish in great numbers.	21° W.	Flying towards South.
4	54	IV.	15	34° N.	Turtles seen. Swallows about the ship.	12° W.	The swallows all flew eastward.

Authority and Date.				DRIFT-WOOD, SEA-WEED, TIDE-RIPPLES, &c. &c.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Remarks.
205	55	IX.	2	North. 51° 22'	Colour of water changed from blue to green.	West. 24° 40'	Temperature of water fell from 60° to 57°.
205	55	IX.	17	North. 52° 14'	Drift-wood—boughs of pine trees.	West. 53° 30'	Wood recently drifted; no weeds on it.

FROM the CHANNEL to

In April.		CROSSINGS OF PARALLELS.											
		North Latitude.						West Longitude.					
Ship.	Date.	45°		40°		35°		30°		25°		20°	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
221	22/55	2	15	5	19	2½	20	1½	22	2	23	1½	24
227	20/55	2	15	2	18	2	19	3	21	3	24	2½	25

FROM the FIFTH SOUTHERN DEGREE

In October.		CROSSINGS OF PARALLELS.											
		South Latitude to North.						West Longitude.					
Ship.	Year.	5°		0°		5°		10°		15°		20°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
201	55	3rd	29	1½	29	1½	28	4	29	1½	33	1½	34
221	55	22d	17	3	20	4	21	5	21	5	29	2	31

FROM the FIFTH NORTHERN DEGREE

In July.		CROSSINGS OF PARALLELS.											
		North Latitude to South.						West Longitude.					
Ship.	Year.	5°		0°		5°		10		15°		20°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
219	55	8th	30	2	33	4	33	3	35	2	36	2	38
302	55	6th	23	2	27	1½	30	3½	32	3	34	1½	33

FROM the FORTY-FIFTH SOUTHERN DEGREE

In December.		CROSSINGS OF PARALLELS.											
		South Latitude.											
Ship.	Year.	45°		40°		35°		30°		25°		20°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
216	55	1st	39	2	34	3	27	2	27	2	27	4	29
219	55	26th Nov.	40	3	33	3	28	4	27	2	26	4	26

the FIFTH SOUTHERN DEGREE.

In April.		CROSSINGS OF PARALLELS.											
		North Latitude to South.						West Longitude.					
Ship.	Date.	15°		10°		5°		0		Days		5° South.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Channel.	From First Trade.	Days.	Long.
221	22/55	1	0	1½	0	4	0	4	0	25	0	2	0
227	20/55	1½	25	2	24	3	22	5	25	26	15	3	29

to the CHANNEL.

In October.		CROSSINGS OF PARALLELS.										Days to Channel.	
		North Latitude.					West Longitude.						
Ship.	Date.	25°		30°		35°		40°		45°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 5° S.
201	3/55	2½	0	1	0	1½	0	1½	0	2½	0	20½	22
221	22/55	3	35	9	36	4	35°	5	25	5	23	52	55

to the FORTY-FIFTH SOUTHERN—ATLANTIC.

In July.		CROSSINGS OF PARALLELS.											
		South Latitude.											
Ship.	Date.	25°		30°		35°		40°		45°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 5° N.
219	8/55	2	0	4	0	3	0	3	0	3	0	26	28
302	6/55	3½	41	2	44	3	48	5	52 W.	3	59	23	25

to the FIFTH NORTHERN—ATLANTIC.

In December.		CROSSINGS OF PARALLELS.											
		South Latitude to North.						West Longitude.					
Ship.	Date.	15°		10°		5°		0		Days.		5°	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From 45° S.	From 1st Trade.	Days.	Long.
216	1/55	6	0	2	0	1½	0	2	0	24½	10	3½	0
219	26/11/55	5	30	3	31	2	32	2	31	28	9	4	34

FROM the FORTY-FIFTH SOUTHERN DEGREE

In December.		CROSSINGS OF PARALLELS.											
		South Latitude.											
Ship.	Year.	45°		40°		35°		30°		25°		20°	
No.	1800	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
355	55	25th.	82 W.	2	81	3	82	3	78	4	78	3	84

FROM the FIFTH NORTHERN DEGREE

In May.		CROSSINGS OF PARALLELS.											
		North Latitude to South.											
Ship.	Year.	5°		0°		5°		10°		15°		20°	
No.	1800	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
355	66	8th.	103 W.	3	109	3	112	2½	115	1½	117	2	118

FROM the FIFTH SOUTHERN DEGREE

In January.		CROSSINGS OF PARALLELS.											
		South Latitude to North.											
Ship.	Year.	5°		0		5°		10°		15°		20°	
No.	1800	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
355	56	17th	94 W.	3	98	4	101	5	105	3	110	6½	108

FROM the FORTY-FIFTH NORTHERN DEGREE

In April.		CROSSINGS OF PARALLELS.											
		North Latitude.											
Ship.	Year.	45°		40°		35°		30°		25°		20°	
No.	1800	Day.	Long.	Days.	Long.								
55	56											21st	109 W.

to the FIFTH NORTHERN—in the PACIFIC.

In December.		CROSSINGS OF PARALLELS.											
		South Latitude to North.											
Ship.	Date.	15°		10°		5°		0°		Days.		5° North.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From 45° S.	From First Trade.	Days.	Long.
355	25/55	2½	87 W.	3	91	2½	93	3	97	26	14	4	101

to the FORTY-FIFTH SOUTHERN—in the PACIFIC.

In May.		CROSSINGS OF PARALLELS.											
		South Latitude.											
Ship.	Date.	25°		30°		35°		40°		45°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 5° N.
355	56	4	121	2½	118	2½	112	2	106	3	101	23	28

to the FORTY-FIFTH NORTHERN—PACIFIC.

In January.		CROSSINGS OF PARALLELS.											
		North Latitude.											
Ship.	Date.	25°		30°		35°		40°		45°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 5° S.
355	17/56	2½	108 W.									21	24

to the FIFTH SOUTHERN—PACIFIC.

In April.		CROSSINGS OF PARALLELS.											
		North Latitude to South.											
Ship.	Date.	15°		10°		5°		0		Days.		5°	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From highest Latitude.	From First Trade.	Days.	Long.
335	56	3	108 W.	5	106	7	103	5	109	20	17	3	112

FROM THE TENTH NORTHERN DEGREE TO

In January.		CROSSINGS OF PARALLELS.											
		North Latitude to South.						East Longitude.					
Ship.	Year.	10°		5°		0°		Days.		5° South.		10°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	From 10° N.	Out.	Days.	Long.	Days.	Long.
302	56	13th	85	1½	85	3½	82	5	12 from Calcutta.	3	83	2½	82
286	56	24th	59	3½	54	3½	50	7	16 from Bombay.	3	47	3	48

FROM THE THIRTY-FIFTH SOUTHERN DEGREE

In October.		CROSSINGS OF PARALLELS.											
		South Latitude.						East Longitude.					
Ship.	Year.	35°		30°		25°		20°		15°		10°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
286	55	4th	55	6	60	2½	61	2	61	1½	61	2	61
302	55	13th	113	2½	106	4½	100	3	95	2	91	2	89

LIMITS OF TRADE WINDS.

In July.		TRADE WINDS—ATLANTIC OCEAN.											
		North East.				Equatorial Calms.				South East.			
Ship.	Year.	North Limit.		South Limit.		North Limit.		South Limit.		North Limit.		South Limit.	
No.	1800.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
302	55	27 N.	22	12	25	10	26	6 N.	25	5 N.	25	22 S.	32

In May.		TRADE WINDS—PACIFIC OCEAN.											
		North East.				Equatorial Calms.				South East.			
Ship.	Year.	North Limit.		South Limit.		North Limit.		South Limit.		North Limit.		South Limit.	
No.	1800.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
355	56	16 N.	108 W.	11 N.	107	11	107	7 N.	105	6 N.	104	24 S.	121

the THIRTY-FIFTH SOUTHERN—INDIAN OCEAN.

In January.		CROSSINGS OF PARALLELS.											
		South Latitude.						East Longitude.					
Ship.	Date.	15°		20°		25°		30°		35°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 10° N.
302	13/56	2	76	1½	72	3	62	7	40	6	26	25	30
286	24/56	3	42	7	41	5	36	3	34	4	25	28	35

to the TENTH NORTHERN—INDIAN OCEAN.

In October.		CROSSINGS OF PARALLELS.											
		South Latitude to North.						East Longitude.					
Ship.	Date.	5°		0°		Days.		5°		10°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	From 35° S.	From 1st Trade.	Days.	Long.	Days.	Long.	From Equator.	From 35° S.
286	4/55	3	62	5	65	22	14	5	66	8	67	13	35
302	13 55	2	88	3	89	19	11	3	90	3	89	6	25

LIMITS of TRADES and MONSOONS.

In uary.		TRADE WINDS and MONSOONS—INDIAN OCEAN.											
		North East or South West.				Equatorial Calms.				South East.			
Ship.	Year.	North Limit.		South Limit.		North Limit.		South Limit.		North Limit.		South Limit.	
No.	1800.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
302	56	18 N.	89	2 N.	82	1 N.	82	S.	83	6 S.	83	30 S.	39

In September.		MONSOONS—CHINA SEA.											
		North Latitude. East Longitude.											
Ship.	Year.	N.E. or S.W.	Meridians.										
No.	1800.		100°	103°	106°	109°	112°	115°	118°	121°	124°	127°	130°
288	55	S.W.			2 N.		15 N.						

APPENDIX D.

LIST OF SHIPS.

FIRST LIST.

The Observations made with Instruments and the Remarks in these Meteorological Registers are *excellent*.

Captain's Name.	Months of Register.	Ship.	Tons.	Port.	Owner.
Boyd, A. McNeil -	8	Sir R. Abercrombie -	799	Alloa -	Tod.
English, G. W. -	8	Madras - - -	1,000	London -	Avery.
Fitzsimons, W. R. -	8	Fulwood - - -	1,160	Liverpool -	J. Palmer & Co.
Gales, J. - - -	8	Florence Nightingale	500	Liverpool -	R. Girvan.
Lidbetter, Thos. -	8	Swarthmore -	923	Liverpool -	J. Thompson.
Quirk, W. - - -	8	Mencius - - -	510	Liverpool -	Atkin & Co.
Toynbee, H. - - -	10	Gloriana - - -	1,056	London -	Smith & Co.
Trivett, J. J. - -	8	Statesman - - -	874	London -	Marshall & Co.
Wood, A. D. - - -	8	Queen's Hill - -	612	Liverpool -	J. Alexander.

SECOND LIST.

The Observations made with Instruments and the Remarks in these Meteorological Registers are *very good*.

Captain's Name.	Months of Register.	Ship.	Tons.	Port.	Owner.
Barnes, H. D. - -	6	Patriarch - - -	1,066	Liverpool -	J. R. Wilson.
Richard, P. - - -	8	Leopard - - -	300	Jersey - -	J. Richard & Co.
Bowlby, C. H. - -	8	Charles Holmes - -	886	Liverpool -	Thos. Chilton, Jun.
Browse, E. - - -	8	Seringapatam - - -	774	Liverpool -	Cotesworth & Co.
Campbell, J. - - -	8	Storm Cloud - - -	1,012	Glasgow -	Stephen & Sons.
Carlyle, J. - - -	8	Startled Pawn - - -	1,330	Liverpool -	G. H. Fletcher & Co.
Cass, J. - - -	8	Caduceus - - -	1,200	Plymouth -	J. B. Wilcocks.
Cornforth, Jos. -	8	Tippoo Saib - - -	1,022	Liverpool -	Jones, Palmer, & Co.
Cowell, J. - - -	8	Anna - - -	485	Liverpool -	Jones, Palmer, & Co.
Crowdie, W. - - -	2	White Eagle - - -	1,100	Glasgow -	Stephen & Sons.
Dallas, J. - - -	8	Fiery Cross - - -	686	Glasgow -	J. Campbell.
Deas, E. - - -	16	Conflict - - -	1,326	Liverpool -	J. Smith, Jun.
Evans, R. W. - - -	4	Alma - - -	2,500	Liverpool -	P. & O. S. N. Comp.
Enright, A. - - -	10	Lightning - - -	2,093	Liverpool -	J. Baines & Co.
Fairlem, H. - - -	8	Evangeline - - -	953	Liverpool -	Clint & Co.
Faulkner, J. H. -	8	Typhoon - - -	1,316	Liverpool -	Richardson & Co.
Fowler, J. - - -	8	Joshua - - -	804	Liverpool -	Prowse & Co.
Gilkinson, R. B. -	8	Alma - - -	591	Port Glasgow	R. Gilkinson.
Heddle, J. - - -	6	Calliance - - -	822	Sunderland	J. Hay.
Herron, J. - - -	8	Lord Raglan - - -	1,962	Liverpool -	J. B. Carrol.
Hewitt, H. W. - -	8	Cambridge - - -	1,225	Liverpool -	Jones, Palmer, & Co.
Heyler, A. - - -	12	Cossipore - - -	834	London -	Lindsay & Co.
Hinds, C. - - -	8	Collingsburgh - -	474	Newcastle -	D. Cowan.
Johnston, T. - - -	8	United Kingdom - -	1,267	Belfast -	Corry & Co.
Kennedy, J. B. - -	8	Medway - - -	850	London -	Marshall & Co.
Liddle, R. R. - - -	12	Bride - - -	565	London -	Temperley & Son.
Lidston, J. - - -	8	Fanny Forsyth - - -	1,342	Liverpool -	E. Bates.
Morris, H. - - -	8	Earl Balcarras - -	1,488	London -	McLeod & Co.
Paige, H. W. - - -	8	Cambodia - - -	1,000	London -	W. Mann.
Pole, W. W. - - -	8	Thomas Hamlin - - -	1,200	London -	G. Hamlin & Co.
Saabye, L. - - -	8	Benjamin Howard - -	721	Copenhagen	G. O'Hara Taaffe.
Samson, J. - - -	8	Try - - -	774	Bristol -	Whitnell & Co.
Simson, G. - - -	8	Stuart Wortley - - -	873	London -	Sir G. E. Hodgkinson.
Smith, G. - - -	8	Tinto - - -	779	Bridgewater	Burstall & Co.
Spence - - -	4	Columbine - - -	420	Hull -	T. Thompson & Co.
Steel, J. - - -	8	Crest of the Wave - -	856	Liverpool -	Brice, Friend, & Co.
Vinnis, F. - - -	6	Cornelia - - -	1,282	Liverpool -	Johnstone & Sons.
Warner, H. - - -	4	Donald McKay - - -	2,565	Liverpool -	J. Baines & Co.

THIRD LIST.

The Observations made with Instruments and the Remarks in these Meteorological Registers are *good*.

Captain's Name.	Months of Register.	Ship.	Tons.	Port.	Owner.
Armitage, G. B.	8	William Hutt	283	London	Betts, Peto, & Co.
Black, A.	8	Hercyna	857	Liverpool	Holderness & Co.
Black, A.	6	Rival	260	London	Young & Co.
Boyce, F.	8	Royal Charter	2,160	Liverpool	Gibbs, Bright, & Co.
Brown, A.	8	Chimera	761	Liverpool	H. Moore & Co.
Brownrigg, E. L.	4	James Carthy	—	Liverpool	Derbshire and Co.
Carmichael, J.	14	Fusilier	503	Liverpool	Cotesworth & Co.
Clarke, J.	8	Marco Polo	1,625	Liverpool	Baines & Co.
Dalison, F. S.	6	Advance	612	Liverpool	Moore & Co.
Fox, John	6	Anne Royden	1,140	Liverpool	Thos. Royden.
Fox, Thos.	2	War Cloud	1,250	Liverpool	Oxley & Co.
Gales, J.	4	Florence Nightingale	500	Liverpool	R. Girvan.
Geerkin, L.	4	Hansa	2,500	Bremen	W. A. Tritze & Co.
Hamm, H. P.	6	Joseph Tarratt	992	Liverpool	J. Baines & Co.
Henry, J.	8	Livingston	467	Liverpool	Hatton & Co.
Jobson, D. F.	4	Indian Queen	1,050	Liverpool	J. Baines & Co.
Jones, H.	8	Ballarat	743	London	W. O. Young.
Jones, Thos.	4	Indian	1,800	Glasgow	Allan & Gillespie.
Jopp, J.	10	Glenray	1,220	Glasgow	P. and T. Aikman.
M'Donnell, Chas.	6	James Baines	2,515	Liverpool	J. Baines & Co.
M'Kirdy, J.	10	Champion of the Seas	2,237	Liverpool	J. Baines & Co.
Morgan, R.	4	Arundel	868	Bridgewater	Burstall & Co.
Murphy, M.	6	Eagle	1,050	Liverpool	Gibbs, Bright, & Co.
Noakes, E.	8	Malabar	647	London	R. Green.
Orkney	4	Spectre	434	Glasgow	Handysides & Co.
Pearson, A.	8	Glenalva	1,051	Greenock	A. Adams.
Pirrie, W.	4	America	1,670	Liverpool	H. D. Sinclair.
Pope, W. H.	8	Alfred	1,400	London	Green & Co.
Powell, Chas.	2	Khersonese	1,704	Liverpool	J. Alexander.
Rea, J. W.	8	Ingleborough	401	Liverpool	Hornby & Co.
Reid	4	Sarah Palmer	1,440	Liverpool	J. Palmer & Co.
Rooke, J.	4	Harvest Home	677	Liverpool	Blythe & Troughton.
Rudolph, L. E.	8	Tasmania	1,217	Glasgow	P. & T. Aikman.
Samson, T.	10	Try	774	Bristol	Whitnell & Co.
Smith, Thos.	6	Robert Pulsford	551	Liverpool	J. Brocklebank.
Taylor, H. G.	4	Mona	395	Liverpool	J. Aikin.
Thomson, J.	8	Bucephalus	1,340	Liverpool	Johnstone & Sous.
Tobin, J. J.	4	Ocean Chief	1,092	Liverpool	J. Baines & Co.
Turpin, W. H.	8	Rapido	299	Liverpool	J. Mondell.
Warner, H.	2	Donald M'Kay	2,565	Liverpool	J. Baines & Co.
Wherland, F.	4	Star	727	Liverpool	J. B. Graves.
Wilkinson, W.	6	Utopia	947	Liverpool	W. Sharp.
Wilson, W.	12	Lady Hodgkinson	946	London	Sir G. E. Hodgkinson.

FOURTH LIST.

The Observations made with Instruments and the Remarks in the Meteorological Registers are *ordinary*.

Captain's Name.	Months of Register.	Ship.	Tons.	Port.	Owner.
Haliday, A.	6	Valdivia	473	Liverpool	Nicholson & Co.
Noble, John	6	Earl of Sefton	1,126	Liverpool	C. Moore.
Pickernell, J.	4	Beemah	887	Liverpool	Willis & Co.
Pollock	12	African	888	Belfast	J. C. Gregg.
Verrill, B.	8	Howden	1,200	Liverpool	Holderness & Co.

APPENDIX E.

INSTRUCTIONS AND LETTERS.

Office of Committee of Privy Council for Trade,
SIR, Marine Department, Sept. 1854.

I AM directed by the Lords of the Committee of Privy Council for Trade to invite the attention of the

* * * *

to the accompanying Report of the Conference which, on the suggestion of Lieutenant Maury, of the United States navy, was held at Brussels, on the subject of establishing an uniform system of meteorological observations at sea, and concurring in a general plan of observations on the winds and currents of the ocean, with a view to the acquirement of a more correct knowledge of the laws which govern the motion of those elements, and to the improvement of navigation.

In consequence of the suggestions contained in that Report, Her Majesty's Government has submitted, and Parliament has sanctioned, a vote for instruments, and for the tabulation of logs, and other meteorological records; and Captain Fitzroy, of the Royal Navy, has been appointed to assist this Board in the discussion of the observations.

The object of the arrangements will be to attain, if possible, to such an improved knowledge of the currents of the ocean, and of the direction of the prevailing winds, as may materially diminish the risk and labour of navigation, and shorten the duration of voyages.

As an acknowledgment for the pains and attention of such captains of foreign-going ships as are willing to co-operate with Her Majesty's Government in this undertaking, and as are competent to fulfil the conditions required of them, it is proposed to place a distinguishing mark against their names in the Mercantile Navy List, and to give copies of the charts and books, which will be printed from time to time from their own and their brother officers' observations, during the time they continue to contribute. These books and charts will contain information as to the prevailing winds and currents in the part of the ocean of which they treat, and of the most desirable tracks to follow, in order to make the surest and quickest passages, and how to avoid or mitigate the violence of hurricanes, &c.

And further, to such captains as will undertake to fill up the columns of the abstract logs, and to make observations, at the

hours denoted by the principal figures, for their successive voyages, the United States Government have directed to be furnished, gratis, a set of charts and sailing directions of Lieutenant Maury, of the United States navy, for the part of the ocean they are navigating.

In order to facilitate the desired co-operation, standard instruments have been prepared, and may be obtained at a diminished cost, for the use of the Merchant Navy.

My Lords are in hopes that the object of this undertaking, and the inducements held out to those who are willing to co-operate in it, will be considered by the more wealthy shipping companies and private shipowners of sufficient importance to induce them to encourage the officers in command of their ships to undertake these observations, and to furnish some, at least, of their captains with the requisite instruments; but in other cases, in order to render the experiment as extensive as possible, instruments will be furnished by the Marine Department of this Board to captains desiring to have them, and giving sufficient proof of their attainments. The extent to which their Lordships may be able to do this will, however, be limited to the means placed by Parliament at their Lordships' disposal, and my Lords are not prepared to pledge themselves to continue it in future years.

I am to add that it is very desirable that any captains of foreign-going ships who may be willing to avail themselves of the privileges mentioned above should communicate with as little delay as possible with this department, either directly, or through the agents appointed for this purpose at the outports.

I am, Sir,

Your obedient servant,

JAMES BOOTH.

INSTRUCTIONS for the AGENTS of the BOARD OF TRADE for METEOROLOGICAL PURPOSES.

1. The agent will take charge of, examine, and compare, issue and receive back the instruments and register books supplied by the Board of Trade.

2. He will keep accounts of all transactions on behalf of the Board of Trade, and will correspond with the secretary on all official matters.

3. It will be an essential object to ascertain that the captains who undertake to make meteorological observations are sufficiently qualified, and that their ships are destined to perform suitable voyages; but to do this in a proper manner without direct interference, which will not be expected of the agent, will require discretion and tact on his part in making his inquiries.

4. The agent will inspect damage done to instruments by carriage, or by casualty at sea, and will send such as are broken to be repaired.

5. He will, when applied to by the captain of a ship, either rate and compare his chronometers,* or he will advise him respecting the best local means of having them rated and compared.

6. The agent will satisfy himself, on the part of the Board of Trade, either by personal investigation (by permission of the captain), or by the report to himself made by a competent person, that the compasses of ships undertaking to make meteorological observations are good, that she has an azimuth compass on board, and that it has been duly placed and properly examined for deviation, and that it is wholly uncorrected by magnets or other means.

7. The agent will always be on the look out for, and duly report, the names of such ships and captains as it may be desirable to invite to take part in meteorological observations.

8. The agent will endeavour to guard against the waste of instruments lent for a time by the Board of Trade, by removing them from the ship on her return from abroad. If such ships are going out again on suitable voyages, they are to make fresh application for instruments.

9. He will send a list of all instruments received, describing their condition, to the Board of Trade.

10. With the standard instruments supplied to him, the agent will compare all others that are referred to him for examination.

11. Every ship supplied with instruments, or a meteorological register, will be reported to the Board of Trade; and from time to time lists of such ships will be forwarded to all the agents.

12. All instruments when supplied are to be entered in the 5th page of the Meteorological Register; a duplicate list of them is to be kept by the agent, and a triplicate forwarded to the Board of Trade.

13. In each case of supply the agent will obtain the authority of the Board of Trade, for whose satisfaction he will state briefly in his letter of application the chief reasons for proposing the supply.

14. As it is desirable to spread meteorological observations as widely as possible, the agent is to report the destination of each vessel applying for instruments, in order that a selection may be made, if necessary.

15. Any owner of a British ship going foreign, and commanded by a captain approved by the Board, will be supplied, on his application to the agent, with instruments at the low prices fixed by the Board, and with a Meteorological Register gratis, provided that the captain will undertake to make and record the required observations, and compare the instruments with an agent's standard on his return to port in the United Kingdom, and to return the register properly kept. Or, instead of purchasing *all* the necessary instruments, he may be supplied with only one or more,

* For which payment will be made by special agreement.

provided his own instruments on board are approved and duly compared with a standard.

16. Such ships will be furnished with Lieutenant Maury's charts of the winds, currents, &c., of the parts of the world to be traversed by them, and also with a copy of his sailing directions, provided that the owner or captain will undertake to comply with the annexed conditions.

17. Instruments will be *lent* to such ships as the Board of Trade may select, on the captain or owner undertaking that the necessary observations shall be made, and that the register shall be properly kept, and with the instruments, returned to their agent on the return of the ship to a British port, at which the Board of Trade has established a meteorological agency. Also, that if they are not so returned or accounted for satisfactorily, the captain or the owner will be answerable for their value; and that, if broken, the damaged instrument shall be returned. Ships so provided will likewise be entitled to a copy of Lieutenant Maury's sailing directions and some charts.

18. Every vessel engaged in these observations is to be provided, either by the owner or captain, with at least one good chronometer, duly rated and compared; with a sextant, and with an azimuth compass fixed in a proper place, and which has its deviation determined before the ship proceeds to sea; and the captain of every ship so provided will undertake further to observe azimuths and amplitudes at sea, to record the variation observed in its proper column, with the direction of the ship's head at the same time; and always to set his course by the standard compass corrected for the observed variation.

19. These azimuth compasses may be either lent or sold to the owners or captains of ships, at reduced prices, like the other instruments, in cases where the ships have been duly selected and approved by the Board of Trade.

20. Captains offering to take charge of the instruments and to keep a Meteorological Register, will be required to satisfy the Board of Trade that they are competent to make the observations required, and to deduce the currents from them and the "dead reckoning."

21. On any affairs connected with the meteorological business undertaken by an agent, he will address his official correspondence to the Secretary of the Board of Trade.

22. The remuneration to the agent for such services will be at the rate of fifty shillings (2*l.* 10*s.*) for each vessel approved and supplied with instruments by the Board of Trade; which sum is to include the payment for any assistance that may be required by the agent.

23. The issue and return of instruments is to be considered as one complete transaction, whether the return be made by the same ship or by any other.

24. All captains receiving instruments, or undertaking to keep the Meteorological Register, will be expected to comply with the

conditions, and to be guided by the instructions which they contain.

CONDITIONS referred to in AGENTS' INSTRUCTIONS.—Par. 16.

To entitle the navigator to copies of such sheets of Maury's charts as relate to his intended voyage, and to a copy of Maury's Sailing Directions, he should be able to show that he is prepared to make the observations required of him, and is provided with necessary instruments ; which should be, at least, a good compass, sextant, and chronometer ; a mercurial barometer, and three air and water thermometers.

The United States government offers these charts and directions gratis to all navigators, on condition that they will continue to keep and forward abstract logs of their voyages.

The navigator who receives a copy of these charts and sailing directions is expected to give his co-operation by keeping an abstract log, not only for the voyage then intended, but for his subsequent voyages, unless informed that no further co-operation is desired.

Every navigator, who, after receiving a copy of these charts and sailing directions, fails to comply with the conditions, namely, to keep abstracts of his voyages in the prescribed form, and on his return to his own country, to transmit them to the person appointed to receive them, forfeits his claim to future publications.*

Meteorological Agency,

SIR,

IN accordance with instructions from the Board of Trade, I am to acquaint you that a set of the under-mentioned instruments, or any less number of them, may be lent, or sold, to you, on the following conditions :

If lent, they are to be carefully used, and restored, in as good condition as may be practicable, to an Agent of the Board of Trade, at the return of your ship to a Port in Great Britain ; unless, after communication with such Agent, and after his comparisons, you should be duly authorized to retain them.

Enclosed are letters, which you will have the goodness to sign, and return to me, upon receiving instruments, registers, charts, or books from the Board of Trade.

I am, Sir,

Your obedient servant,

Agent.

Captain _____

* Maury's Sailing Directions, 6th edition.

LIST of PRICES (being the Cost Price, *average* Expense of Carriage, and Charge for Verification).

	£	s.	d.
Marine Barometer - - - -	3	10	0
Thermometer - - - -	0	7	0
Thermometer Stand or Screen - - -	0	10	0
Hydrometer (Glass) - - - -	0	5	0
Azimuth Compass - - - -	6	10	0

One Set of Instruments consists of

- 1 Marine Barometer.
- 6 Thermometers.
- 1 Thermometer Stand or Screen.
- 4 Hydrometers (Glass).
- 1 Azimuth Compass.

CONDITIONS.

To entitle the navigator to copies of such sheets of Maury's charts, as relate to his intended voyage, and to a copy of Maury's Sailing Directions, if in store, and to copies of such Board of Trade publications as may be available and suited to his objects, he should be able to show that he is prepared to make the observations required of him, and is provided with necessary instruments, which should be (at least) a good compass, sextant, and chronometer, a mercurial barometer, and three thermometers.

The navigator who receives a copy of such charts and directions is expected to give his assistance by keeping an abstract of his log, not only for the voyage then intended, but for subsequent voyages.

And a navigator who fails to comply with the conditions, namely, to keep abstracts of his voyages, in the prescribed form, and on his return to his own country to transmit them to the person appointed to receive them, will forfeit his claim to future publications, as well as to the loan of instruments.

Ship _____

SIR,

I ACKNOWLEDGE the receipt of the _____

enumerated below, and I promise to comply with the conditions stated in your letter of the _____

I am, Sir,
Your obedient servant,

To _____

Agent for Meteorological Purposes. Ship _____

Articles supplied.	No. supplied.	Maker's Name.	Mark and Number of Instrument.	Condition.
Compasses - Barometers - Thermometers - Hydrometers -				
Registers - - Charts - - Books - -				

ADMIRALTY INSTRUCTIONS.

SIR,

Board of Trade, January 6, 1855.

I AM requested by my Lords of the Privy Council for Trade to acknowledge the receipt of your letter of the 29th ult., transmitting for their consideration and suggestion a draft of the proposed instructions to Captain Fitzroy, as Chief of the Meteorological Department, and in reply I am to request you to inform the Lords Commissioners of the Admiralty that it appears to my Lords that some inconvenience might arise were Captain Fitzroy to receive separate Instructions for his guidance from two distinct departments, and they desire me to suggest for the consideration of the Lords Commissioners whether this object would not be answered equally well if their wishes with respect to his proceedings were addressed officially to my Lords, in order that they might be communicated by and through them to Captain Fitzroy.

(Signed) T. H. FARRER.

To the Secretary to the Admiralty.

SIR,

Admiralty, January 11, 1855.

I AM commanded by my Lords Commissioners of the Admiralty to transmit to you the enclosed copy of their instructions to Captain Fitzroy, with reference to meteorological observations to be made on board Her Majesty's ships, and I am to request that the President of the Board of Trade will be pleased to communicate them to that officer in the manner he may deem most convenient.

I am, Sir,

Your obedient Servant,

(Signed) W. A. B. HAMILTON.

James Booth, Esq.,
Board of Trade.

SIR,

Admiralty, Dec. 24, 1854.

THE Lords Commissioners of the Admiralty having, on the representation of the Royal Society, decided that Her Majesty's ships shall take a part in the extended series of meteorological observations to be made chiefly at sea, and it having been arranged between the President of the Board of Trade and the First Lord of the Admiralty that you should take charge of measures necessary to carry the above-mentioned observations into effect, both on board ships of war and merchant ships, I am commanded to acquaint you that you have been appointed by their Lordships to that duty, as far as relates to Her Majesty's ships, and that your appointment is to date from the 1st of August last.

War having, unhappily, broken out since the original proposal for such observations was made, it will not for the present be practicable to carry out the measure so extensively as was at first intended, but there are still many cases in which it may be effected, as on board the ships on the North American and West India station, the Brazils, the Coast of Africa, India, Australia, and the Pacific. You will therefore place yourself in communication with the Hydrographer to the Admiralty, and in conjunction with him, order the requisite standard instruments to be prepared, and when properly tested, to be sent out by any convenient and safe opportunity to those stations for distribution among the ships.

A copy of the form of register which was sanctioned in April last is sent herewith for your information; but it is the wish of their Lordships to act in concert as much as possible with the Board of Trade, so that the observations may be uniform throughout the Royal Navy and Mercantile Marine, so far as is consistent with the established regulations and the usual routine of duties in Her Majesty's Service.

A sufficient supply of the blank forms of register is to be sent to all ships and stations to which instruments are sent; and it may be desirable that they should be accompanied by explicit and detailed instructions for making observations, should it be considered that those already issued in the Admiralty Manual are not sufficiently comprehensive.

When the instruments, registers, and instructions are ready, their Lordships will issue the necessary orders to the fleet for the observations being regularly carried out whenever the more immediate duties of the public service admit of it. Meteorological observations are now being made, and have been made for some years past under the orders of the Admiralty, at Halifax, Bermuda, Valparaiso, Ascension, and at Trincomalee, Columbo, and Point de Galle in Ceylon, and the records are periodically transmitted to England: these registers you can have access to on application to the Hydrographer. It will be for you to consider

whether it is desirable to continue observations at those places, and if so, to ascertain whether the instruments by which they are made are equal to the standard barometers and thermometers which it is understood have been lately perfected, and if not, to exchange them, as opportunities may arise, for the improved instruments.

All registers received will in future be sent to you for examination and discussion. It will be a part of your duty also to examine all the "Remark Books" periodically transmitted to the Admiralty, and on all occasions that you obtain information which can be useful to the navigator, as with reference to winds, currents, soundings, &c., you will at once acquaint the Hydrographer, in order that it may be inserted in the charts and sailing directions issued by the Admiralty for the public benefit.

The vote sanctioned by Parliament in the Admiralty estimates for these purposes is 1,000*l.* a year, which is considered will be ample for all the requirements of the service, and you will be careful that the whole expenses connected with carrying out this measure shall not exceed that sum in any single year, without their Lordships' express sanction.

Captain Fitz-Roy, R.N., F.R.S.

LETTER to AUTHORITIES at HER MAJESTY'S DOCKYARDS.

Admiralty and Board of Trade,
Meteorological Office,

IN obedience to the orders of my Lords Commissioners of the Admiralty, (referring to their Lordships' Circular, No. 258, July 25, 1856,) I have the honour to send to you the articles specified on the other side.

I am,

Your obedient servant,

To

LIST.

Registers or Weather-books - - - -	
Barometers : Nos.	
Aneroid barometers : Nos.	
Thermometers : Nos.	
Hydrometers : Nos.	

CIRCULAR, No. 258.

Admiralty, July 25th, 1856.

Meteorological Observations.

HER Majesty's Government having undertaken to promote and take part in an extended system of meteorological observations at sea, and having caused the requisite instruments, forms of register, and instructions to be provided and placed at the principal sea ports of the United Kingdom for the use of the Mercantile Marine, the Lords Commissioners of the Admiralty direct that all captains and commanding officers of Her Majesty's ships will co-operate in this undertaking, whenever and as far as their respective opportunities and means will admit.

Standard barometers, tested thermometers, and registers, with the necessary instructions, will be supplied from Her Majesty's dockyards, in the usual manner, on demand. The observations are to be carefully made, and recorded in the mode pointed out in the instructions; and the registers, when filled up, are to be transmitted to the Admiralty through the same channels as the ship's log-books.

Stationary ships, or ships fitting out or re-fitting in a home port, where a regular series of meteorological observations is established, will not be required to make the above observations while remaining at such port.

This order does not affect Art. I., Sect IX., Chapter V., of the Admiralty printed Instructions, which still remains in force.

By command of their Lordships,

R. OSBORNE.

To all Commanders-in-Chief, Captains, Commanders, and Commanding Officers of Her Majesty's Ships and Vessels.

N.B.—Screens or stands for thermometers may be obtained by application at the dockyards, or can be made on board according to the patterns at each depositary of instruments.

APPENDIX F.

OFFICE RETURNS AND LISTS.

RETURN showing the NUMBER of BOOKS, CHARTS, and INSTRUMENTS, &c. received at and issued from the METEOROLOGICAL DEPARTMENT up to the 1st March 1857.

Received.				Articles.	Issued.			
1854-5.	1856.	1857 to March 1.	Total.		1854-5.	1856.	1857 to March 1.	Total.
11,022	300	200	11,522	Maury's Charts - -	3,696	905	136	4,737
300	—	—	300	Maury's Sailing Directions.	143	147	2	292
450	1,000	—	1,450	Board of Trade Meteorological Registers.	450	641	121	1,212
6,800	24,700	—	31,500	Board of Trade Wind Charts.	1,404	10,754	24	12,182
1,000	1,000	2,000	4,000	Blank Returns - -	400	300	200	900
(Contracted for.)								
102	80	—	132	Compasses - - -	102	20	10	132
210	260	20	490	Barometers - - -	206	126	24	356
1,340	1,320	240	2,900	Thermometers - - -	1,290	498	174	1,962
1,340	600	160	2,100	Hydrometers - - -	698	610	161	1,468
—	20	—	20	Aneroids - - -	—	20	—	20

RETURN showing the NUMBER and DISPOSAL of INSTRUMENTS purchased by the METEOROLOGICAL DEPARTMENT of the BOARD of TRADE, with the number ordered, not yet delivered.

Board of Trade.				How disposed of.	Admiralty.			
Compasses.	Barometers.	Thermometers.	Hydrometers.		Aneroids.	Barometers.	Thermometers.	Hydrometers.
79	114	684	424	Sent afloat - - - - -	7	91	336	193
49	68	554	443	Ready at Stations (including 30 Barometers repaired and re-issued).	13	46	180	251
1	13	—	—	Repairable - - - - -	—	17	—	—
—	—	113	69	Condemned - - - - -	—	—	13	7
2	6	57	11	Sold - - - - -	—	—	—	—
1	1	25	65	Lost, or unaccounted for by Captains of Ships.	—	—	—	—
132	202	1,433	1,012	Total number disposed of - - -	20	154	529	456
(to the 1st January.)					(to the 1st March.)			
132	240	1,760	1,240	Total number contracted for to the 1st March.	20	250	1,140	860

LIST of METEOROLOGICAL AGENTS.

Place.	Name.	Address.
ENGLAND.		
Bristol - -	J. M. Hyde - - -	1, Broad Quay.
Hull - - -	Z. Scaping - - -	Trinity House.
Liverpool -	J. Hartnup - - -	Observatory.
London - - -	E. Hughes - - -	Sailor's Home, Well Street.
Newcastle -	T. Gray - - - -	Trinity House.
Plymouth -	Captain W. Walker, R.N. -	Shipping Office.
Southampton -	J. R. Stebbing - - -	47, High Street.
SCOTLAND.		
Aberdeen -	Rev. P. Robertson - -	7, Huntly Street.
Dundee - -	P. A. Feathers - - -	26, Dock Street.
Glasgow -	Captain A. Small - - -	Local Marine Board.
Greenock -	J. Gardner - - - -	Greenock (Optician).
Leith - - -	J. Davidson - - - -	Local Marine Board.
IRELAND.		
Belfast - -	F. M. Moore - - - -	114, High Street.
Cork - - -	Commander T. Stuart, R.N.	Local Marine Board.
Dublin - - -	Commander MacLean, R.N.	Local Marine Board.

BAROMETERS SUPPLIED TO H. M. SHIPS.

128 Standard Barometers have been supplied to H. M. Ships, or Stations, since 1854.

37 Standard Barometers have been returned from Ships paid off.

91 Standard Barometers are now in use on board H. M. Ships in commission.

Of the old Barometers (not standards, nor reliable) about one hundred have been withdrawn from H. M. Ships, and 58 of this number have been sold to opticians for the use of an inferior class of Ships, chiefly coasters. The rest will be similarly disposed of to the best bidders, their value being applied in payment for new instruments, of the authorized construction.

STATEMENT of SUMS voted by PARLIAMENT and ESTIMATE of the EXPENDITURE on account of the METEOROLOGICAL DEPARTMENT of the BOARD OF TRADE and ADMIRALTY, for "METEOROLOGICAL OBSERVATIONS AT SEA."

	1854-5.	1855-6.	1856-7.	Estimated 1857-8.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Amount of Vote for Board of Trade - - -	3,200 0 0	3,200 0 0	3,200 0 0	3,200 0 0
EXPENDITURE.				
Salaries :				
Rear-Admiral FitzRoy - - - -	199 14 6	300 0 0	300 0 0	300 0 0
Mr. W. Patrickson } <i>Salaries charged</i>	—	180 0 0	190 0 0	200 0 0
Mr. T. H. Babington } <i>to, and paid</i>	—	81 0 7	88 15 0	100 0 0
Mr. F. R. Townsend } <i>out of, Board</i>	—	81 0 1	90 0 0	110 0 0
				<i>of Trade Gene-</i>
				<i>ral Vote.</i>
Extra assistance in office - - - -	—	124 5 8	64 1 0	—
Port agencies and contingencies - - -	51 2 1	383 8 4	568 15 6	500 0 0
Instruments, carriage, and repairs - -	682 0 0	1,411 18 0	653 1 9	1,600 0 0
Lithography (special) - - - -	—	503 18 0	466 7 0	800 0 0
Verification of instruments at Kew - -	—	113 10 0	46 2 0	190 0 0
Total amount expended - - -	932 16 7	2,837 0 0*	2,098 7 3*	3,200 0 0
Amount of Vote for Admiralty - - -	1,000 0 0	1,000 0 0	1,000 0 0	1,000 0 0
EXPENDITURE.				
Salary (Rear-Admiral FitzRoy) - - -	200 0 0	300 0 0	300 0 0	300 0 0
Instruments, carriage, and repairs - -	—	670 19 2	625 15 1	580 0 0
Verification of instruments at Kew - -	—	79 10 0	50 15 0	70 0 0
Extra assistance in office - - - -	—	50 14 0	46 4 0	50 0 0
Total amount expended - - -	200 0 0	1,101 3 2	1,022 14 1	1,000 0 0

* Exclusive of Salaries charged to Board of Trade general vote.

LIST of OFFICE BOOKS.

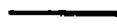
Contracts for instruments.

General registers of articles supplied.

Registers of Barometers.

”	Thermometers	”
”	Hydrometers	”
”	Compasses	”
”	Books, Charts, &c.	”
”	Ships	”
”	Ships authorized to be supplied.	
”	Documents received.	
”	Letters received.	
”	Letters written.	
”	Requisitions to Admiralty.	
”	Deviations of compass.	
”	Instruments sold or returned.	
”	Orders or memoranda.	
”	Daily progress.	

APPENDIX G.



PRINTED FORMS.

Meteorological Register kept on board

DATE 18 —		Latitude.		Longitude.		Currents and Temperature of Sea Surface.		Magnetic Variation.		Winds.		Barometer.	
Month, Day, and Moon.	Hours.	Observed.	D.R.	Observed.	D.R.	Direction.	Rate Daily.	Observed z. or m.*	Ship's Head.	Direction.	Force.	Height.	Attached Therm.
						Temperature by No. —.							
	2												
	4												
	6												
	8												
	9												
	10												
	NOON												
	2												
	3												
	4												
	6												
	8												
	10												
	MIDT.												
	2												
	4												
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	9												
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	6												
	8												
	9												
	10												
	NOON												
	2												
	3												
	4												
	6												
	8												
	10												
	MIDT.												
1	2	3	4	5	6	7 and 20	8	9	9a	10	11	12	13

*z=azimuth, m=amplitude.

Captain _____

from _____

to _____

Hours.	Thermometer.		Clouds.			Weather.	REMARKS ; including 19. State of the Sea.—21. Specific Gra- vity of Water.—22. Temperatures at depths :—and Deep Soundings (to be inserted at the nearest hour lines).
	Dry Bulb No. —.	Wet Bulb No. —.	Form or Character.	Amount 0—10.	Direction of Upper.	Fog, Rain, Snow, Hail, Thunder, Lightning, &c.	
2							
4							
6							
8							
9							
10							
NOON							
2							
3							
4							
6							
8							
10							
MIDT.							
2							
4							
6							
8							
9							
10							
NOON							
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MIDT.							
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4							
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8							
9							
10							
NOON							
2							
3							
4							
6							
8							
10							
MIDT.							
2 a	14	15	16	17	17 a	18 and 2	19 21 22 24*

* NOTE.—These numbers show columns of Brussels Conference Form.

METEOROLOGICAL AGENCY at _____
 SHIPS proposed to be supplied by _____

Date.	Ship's Name.	Tons.	Description.	Of what Port.	Owner.	Captain.	Certificate Number.	Destination.

METEOROLOGICAL _____
 Supplied by _____

Date.	To.	Conveyance.	No.	Distinguishing Mark, Number, &c.	Remarks.

METEOROLOGICAL AGENCY

Instruments, Charts, and Books

at _____

Supplied by _____

Date.	To what Ship.	Compasses.	Barometers.	Thermometers.	Hydrometers.	Charts.	Registers.	Directions, &c.

N.B.—The maker's name and mark, and the distinguishing numbers of the instruments supplied, are to be inserted on the Captain's Receipt, which is to accompany this Return

METEOROLOGICAL AGENCY

Ships supplied

at _____

by _____

Date.	Ship's Name.	Tons.	Description.	Of what Port.	Owner.	Captain.	Certificate Number.	Destination.

RETURN of METEOROLOGICAL INSTRUMENTS and BOOKS at _____ dated _____ 18____.

(Transmitted the first day of each month.)

Maker's Name.	Mark and Number.	Received.			BAROMETERS.			Issued.		
		Date.	Whence.	Condition and Remarks.	Date.	Ship.	Captain.	Date.	Ship.	Captain.

N.B.—The serviceable Barometers should stand first in the list.

Initials _____

Maker's Name.	Mark and Number.	Received.			ANEROIDS.			Issued.		
		Date.	Whence.	Condition and Remarks.	Date.	Ship.	Captain.	Date.	Ship.	Captain.

The serviceable Aneroids should stand first in the list.

THERMOMETER SCREENS or STANDS.

--	--	--	--	--	--

Initials _____

Received.				THERMOMETERS.				Issued.			
Maker.	Mark.	Numbers.	Date.	Whence.	Condition.	Maker.	Mark.	Numbers.	Date.	Ship.	

N.B.—The serviceable Thermometers should stand first in the list,—the sets having been completed, and corrections inserted from the boxes whence taken. *Initials*

Received.				HYDROMETERS.				Issued.			
Maker.	Mark.	Numbers.	Date.	Whence.	Condition.	Maker.	Mark.	Numbers.	Date.	Ship.	

N.B.—The serviceable Hydrometers should stand first in the list,—the sets having been completed and corrections inserted from the boxes whence taken.

Received.				METEOROLOGICAL REGISTERS.				Issued.	
Number.	Date.	Whence.	Number.	Date.	Ship.	Commander.	Signed		
							Dated		
METEOROLOGICAL INSTRUMENTS, &c. OF RETURN (A.)									

APPENDIX H.

SIMULTANEOUS OBSERVATIONS.

It has been desired that a great many observations should be compared throughout the British Islands (with their neighbouring coasts and seas), at certain remarkable periods, to obtain the means of delineating or mapping the atmosphere at successive times; and thence to deduce the order of those changes of wind and weather which affect navigation and fisheries especially, besides agriculture, health, and all outdoor occupations.

Such maps or charts might show the various horizontal or other currents of wind (existing within such an area) at one time, to which all other corresponding times should be reduced by allowing for the difference of longitude.

They might show the pressure and temperature of those currents and other facts, such as the presence of clouds, rain, lightning, &c. at their respective localities.

A sequence of such maps, compiled for special periods when changes have been most marked, would enable meteorologists to trace atmospheric waves as well as currents, both in plan and section, and would throw much light on meteorology.

Means might be taken, by circular letters, or otherwise, to request copies of such particular observations made between certain limits and dates, as might be specified in a general manner, and accompanied by a form for details.

CIRCULAR.*

Probably all persons who are interested in meteorology as a science, or in changes of wind and weather as practical matters affecting every-day life, have more or less noticed the remarkable changes of the last winter season.

The meteorological department of the Board of Trade is collecting facts in connection with such changes of weather and violent winds, with the view of ascertaining exactly where and when they occurred throughout a considerable area, including the British islands and adjacent localities.

This last winter has been selected as a portion of time within which certain sequences of simultaneous observations at a great many places may be collected, and their results arranged for publication, with particular advantage.

The direction and force of wind, nature and changes of weather, height of barometer, temperature of air, and moisture, are particularly desired, at whatever time actually observed, at sea or on land, between the meridians of thirty degrees west and thirty of east longitude, and between the parallels of forty degrees and sixty-seven of north latitude.

* Suggested, as suitable, in substance.

Such information is requested relating to any time between November last and the end of February.

The meteorological daily notices in "The Times" might be referred to as a suitable and general form: which might be amplified.

In all cases, the peculiarities and errors or corrections of instruments should be given, with the known or estimated height (saying which) of the barometer above the mean level of the sea, besides expressing whether the observations are given exactly as made or whether any and what corrections have been applied towards their reduction.

In addition to data corresponding to those in the daily tabular returns given by "The Times," the more numerous the exact observations and details that may be transmitted, the more valuable will be the communication.

Captains of ships within the specified area, during the months selected, are particularly requested to send in as many observations as their logs or registers contain, for comparison made with those at lighthouses, and with the numerous records now kept by private gentlemen, besides those of established observatories.

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