by external than internal forces, is reduced to sand.

It is doubtless true that a part of the volcanic sand and dust results from the trituration of solid material in the process of violent eruption; but, at the same time, it is generally believed that by far the largest portion of the latter is produced directly by the distention and explosion of multitudinous vesicles in the amorphous, viscous portion of the magma, and is the extreme product of the same operation which produces pumice. Mr. I. C. Russell has recently described some interesting volcanic dust from the Great Basin of Nevada. It has been traced two hundred miles from its source, the Mono craters, and has about the same chemical composition as the glassy lava of that place. This can be readily understood when we consider, that, at the time of its eruption, the magma contained few, if any, well-developed crystals. The difference in chemical composition between volcanic sand or dust, and the lava to which it belongs, appears to be directly proportional to the amount of crystallization which has taken place in the magma before its effusion. The composition of the Unalashka sand is such as to indicate that before its eruption there were many crystals secreted in the magma, so that there would be a proportionally small amount of siliceous dust produced. While it is evident that the constitution of volcanic sand is very variable from place to place, yet it is such in this case as to clearly indicate that it came from a crater erupting hornblende andesite, and that its basic character may be explained by supposing that the siliceous portion of the magma was carried away in the form of dust. The unaltered condition of the minerals and groundmass indicates that the sand has not been exposed to atmospheric influences for any considerable length of time, and favors the opinion of Mr. Applegate, that the sand came from the new crater, near the Island of Bogosloff, about sixty miles to the westward.

The precipitation of volcanic dust has been reported from several places in the United States, but it is all of very questionable determination. Mr. G. P. Merrill, of the U.S. national museum, has recently investigated that which fell at Rome, N.Y., and proved it to be an ordinary dust, composed chiefly of minute fragments of quartz and iron-stained products of decomposition. All of the reported dusts, of which I have been able to obtain samples, have been found to be like that which is most common about dusty cities and plains. A little experience will readily enable one to distinguish the Pélé's-hair and glass globules, in the dust of blast-furnaces and other iron-works, from the glass particles in volcanic dust.

The origin and distribution of the uncommon forms of dust are beginning to receive the attention they deserve; and it is a matter of gratulation, that the signal-service of this country has already taken steps towards systematic observations upon this subject at several elevated stations, such as Mount Washington and Pike's Peak, as well as in Alaska.

U. S. geological survey. J. S. DILLER.

METEOROLOGICAL CHARTS OF THE NORTH ATLANTIC.

ONE cannot fail, in studying the progress of maritime meteorology, to be impressed with the value placed on the Maury charts, as evinced by the frequency with which they have been copied, or have served as the basis for more extended work in foreign countries. But it is also to be noticed, that in recent years the tendency has been towards more originality and independence in the work of the several nations that take part in this branch of physical investigation; and, further, that while Maury's principle of exhibiting as far as possible the separate observations on which averages are based is retained, his plan of dividing charts according to topics has been replaced by the much more practical division according to time. The master of a vessel, beginning a voyage in May, does not care to find on his chart information about the winds of all the year, but prefers information of all kinds about May, and especially about the winds, calms, gales, squalls, and fogs of that month.

Having considered, in a previous article, the development of maritime meteorology as shown in the wind-charts of the North Atlantic, published by various foreign governments since Maury's time, it is with satisfaction that we can now turn to a work on the Atlantic, executed in our own country, in which the advance from the earlier styles of charting is as well marked as in any of the examples given above.

On the charts whose title is given in the note,[1] we find the atmospheric conditions over a large area shown with greater detail, and based on a larger series of observations, than in any other charts yet published. The number of observations is extraordinary. The chart for March alone has wind-observations for 211,057 hours. That part of the chart which corresponds to the six of Toynbee's ten-degree squares north of the equator has 63,846 hours: the

[1] Meteorological charts of the North Atlantic Ocean for the months of March, April, and May. Published June, 1883, at the hydrographic office, Washington, D. C. J. C. P. Dekraft, commodore, U.S.N., hydrographer to the bureau of navigation. Prepared under the supervision of Lieut. JOHN H. MOORE, U.S.N. Charts for June and July were published in March and April, 1884. T. R. Bartlett, commander, U.S.N., hydrographer.

same area in Toynbee's monograph has for March only 6,823 wind-observations. One of the five-degree squares (No. 676, latitude 0° to 5°, longitude 20° to 25°) into which the ocean is divided on our charts has 10,329 hours of record : this is practically equivalent to a continuous hourly record in this square for nearly fourteen Marches. If the other months maintain the same number of North Atlantic observations,

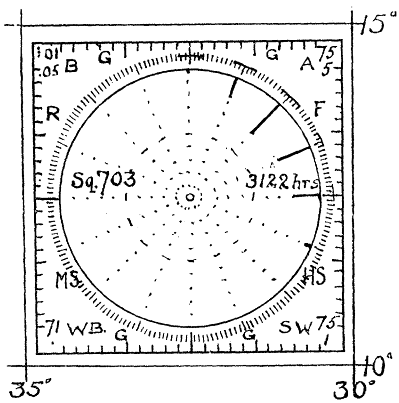


FIG. 1.

the year's average would be based on about 2,500,000 hours of record. On the other hand, many coast squares, and most of those off Newfoundland and Labrador, have insufficient observations. The wind-observations in this vast quantity of material come from the Maury records and from more recent logs in about equal number, but the data on the side of the squares rest on the recent logs alone.

Chief attention is given to classifying the wind in direction and force, as this is the factor of greatest use to the practical seaman. The percentage of the number of observation-hours during which the wind is recorded as having blown from every two points of the compass is shown by the fractional radius drawn inward from the appropriate part of the circle within the square. The average force for every wind-direction, in units of the U. S. navy (= Beaufort) wind-scale, is measured by the number of divisions, outside the circle (fig. 1), connected by a cross-line. The percentage of calms and variable winds is shown on the radial percentage scale by a ring and a cross at the centre of the circle. North-west and north-east gales (*G*) are shown in percentages on the top of the square; south-west and south-east, at the bottom. Moderate squalls (*M S*) and heavy squalls (*H S*) are placed on the lower half of the left and right sides of the square, rain (*R*) and fog (*F*) being above them. All these are given in percentages of their total hours,[1] and consequently, when taken together, give to the navigator a very close measure of the kind of weather he may expect for any part of the North Atlantic south of 50° latitude. The figures in the corners of the squares record the average stand and the average daily variation of the barometer (*B*), air-thermometer (*A*), wet-bulb thermometer (*W B*), and sea-thermometer (*S W*), thus completing the list of the more important and practically useful climatic elements. The most serious omission is the number of observations on which these side data depend.

The mechanical execution of the work is excellent. The charts, twenty-seven by thirty-four inches, are clearly and sharply engraved. The figures are, perhaps, rather fine, being smaller than in the accompanying cut, which does not fairly represent the clearness of the original, but they are not so fine as some in Toynbee's work; and some of the lines are too delicate for rapid reading, but they are perfectly distinct on a closer examination. Some ease of counting might be gained by emphasizing the fifty-per-cent divisions, as here marked. In comparing the graphic method of these new charts with the numerical and verbal form of record in the volume for the North Pacific,[1] issued by the hydrographic office a few years ago, it is difficult to make a choice, except as a matter of preference. The results shown are about the same in both. On the Pacific charts, from which a five-degree square is given in fig. 2, the number of observations, and average force of the wind for every two points, are given in the outer circle: the percentage that these observations make, of the total of winds, calms, and variables, is in the inner circle. The other data explain themselves. In the centre there is a verbal description of the characteristic local weather, for which there is no space in the Atlantic charts. But the frequency of gales from the four quadrants is not shown; and

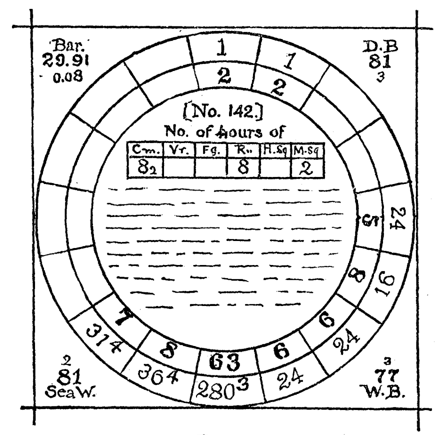


FIG. 2.

in making a comparison of winds from square to square, or even within a single square, the numbers have first to be read, and then compared; which is certainly more difficult than when the wind percentages and strengths are expressed in lines, whose

[1] The legend on the charts states that these side data rest on a smaller number of hours than is recorded for the general wind-observations.

[1] Meteorological charts of the North Pacific Ocean fror. the equator to latitude 45° north, and from the American coast to the 180th meridian. Washington, 1878. (Prepared under the direction of Lieut. T. A. Lyons.)

relative length is quickly seized by the eye. When the subdivisions go down to one-degree squares, then tabulation is necessary to save space, if a variety of data is to be shown; but, on five-degree squares, we believe the general preference would be for graphic representation, unless, what would be still better, both methods were combined, somewhat as in Toynbee's charts; but this would increase the size of the sheets. After all, the choice between the two methods must be made, not so much by the reviewer, as by the practical seaman, for whom the charts are especially constructed.

Currents are not attempted on these charts: it is the intention of the hydrographic office to give them special study as soon as possible, with particular attention to the temporary and local winds at the time of every observation. It may thus be possible to explain the rather discordant results shown on many current-charts. Before this, however, it is the desire of the office to complete the meteorological charts for the other oceans, on the plan now so well carried out for the North Atlantic. All who are interested in the success of this long piece of work will join in the wish that every aid and opportunity may be given to its progress.

The accompanying figure (fig. 3) is inserted for comparison of these new charts with those of Toynbee's squares that they cover, for the month of March. The full lines are isobars, the fainter ones being Toynbee's. Their agreement in general attitude is good, but there appears to be a persistent difference of reading of one or two hundredths of an inch between the two. The broken and dotted lines are sea-water isotherms, with satisfactory coincidence. The arrows show the average winds: the only notable divergences are in the region of variables and calms. On attempting to draw out the isobars for the whole of our March chart, smooth curves can be traced up to latitude 30° or 35° by admitting corrections of two or three hundredths of an inch. Farther north, where observations are fewer, and barometric variations are known to be greater, corrections of five-hundredths or more are sometimes needed. This is probably due to the great difficulty of finding closely checked barometer records, especially in the older logs. Although all defective records have been thrown out whenever detected, it is evident that some still remain; as, for example, in square 786, on the March sheet. We may therefore infer that the next improvement in the study of oceanic meteorology will come rather through increased accuracy than through increased number of observations.

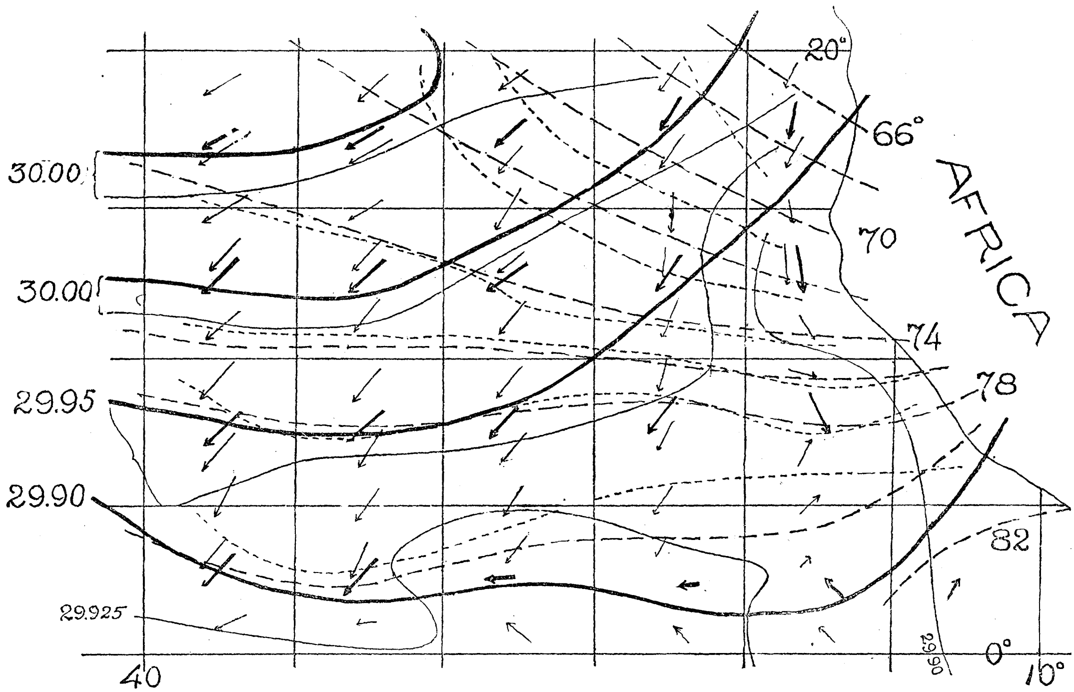


FIG. 3.

Another style of work undertaken by the hydrographic office is seen in the monthly Pilot charts of the North Atlantic, begun last December, of which mention has already been made in the columns of *Science*. These are designed to answer a double purpose, — first, to give a general representation of the prevailing winds for every month, based on the materials from which the more detailed meteorological charts above described are constructed; and, second, to serve as a ready means of publishing the

PILOT CHART OF THE NORTH ATLANT

NOTICES ISSUED DURING THE MONTH OF APRIL, 1884.

All bearings are true, and, in the case of lights, from seaward.

NOTICES TO MARINERS.

114 refers to the geographical position of Namorik (Baring) island, of the Marshall group.

115 refers to shoals, &c., on the west coast of Madagascar

116. England—E. coast.—1. A green buoy marked WRECK lies in 12 fathoms at low water, 30 yards to the eastward of a sunken wreck off Cromer.

2. A spherical buoy, painted red and white in horizontal bands, and surmounted by a staff and triangle, has been substituted for the present NW. Shingles buoy, in Alexandra channel, Thames river entrance. The W Shingles, Shingles Elbow, SW. Shingles, and S. Shingles buoys have been altered from red can to red conical buoys

117. Norway.—A rock, with seven feet of water over it, (marked by staff,) lies near the fairway of approach to Donnaso from the southward. Position: Lat., 65° 42′ 30″ N.; Long., 12° 19′ 30″ E.

118. England—Bristol channel.—On or about February 12, 1884, the illuminated arc of the light at Bideford (or Braunton) low light-house was extended so that it will show one point more to eastward and three points more to westward. The full intensity of the light will show between the bearings N. 70° 15′ E. and S. 50° 40′ E Variation 19° 45′ W

119. England—Isle of Man.—1. A length of about 600 feet of the outer end of the breakwater at port Erin has been partially destroyed by the sea, and is covered at high water ordinary spring tides. Mariners are therefore cautioned to keep well on the northern side of the bay. The light on the extremity of the breakwater has been discontinued until further notice.

120. Ireland—Ballynakill harbor.—1. Two small beacon buoys have been placed in the channel approaching Ross point. Black rock kept midway between these buoys bearing N. 8° E. leads to the anchorage off Ross point Variation 14° 30′ W.

2. **Sligo bar.**—Two large triangular-shaped beacons have been erected on Lower Rosses point. Kept in line bearing N. 72° 5′ E. they lead over the bar in deepest water. Variation 23° 30′ W.

121. West Indies—Jamaica.—A beacon, about 20 feet above high water, consisting of an iron tripod surmounted by a cap colored red and white in horizontal bands, has been placed on the NE. part of Alligator reef, S. coast of Jamaica.

122 gives information concerning localities in Magellan straits and on the W. coast of S. America.

123 refers to the time-signal at Colombo, Ceylon.

124 gives information concerning shoals, &c., in the Java and Celebes seas.

125 contains general information concerning the coasts of Corea and the Goto islands.

126. British Guiana—Demerara.—The buoy marking the wreck of the *San Carlos* has been removed. Pilotage is compulsary, but small vessels of 35 tons and under, from the neighboring colonies, and vessels coming to try the market without making an entry, are exempted unless they take a pilot.

Curaçao—Santa Ana harbor.—A *white* mooring buoy has been placed at the entrance, close off the SW. angle of Fort Amsterdam, on the eastern side of the channel.

127 refers to lights on Perim island, in the Red sea.

128 refers to buoys, beacons, &c., on the coasts of Greece and Asia Minor.

129. England—Yarmouth.—1. A *green* buoy, marked WRECK, lies in eight fathoms at low water spring tides, 30 yards eastward of the brig *Sovereign*, sunk in Yarmouth road

2. **Thames river.**—Two *green* buoys, marked WRECK, are moored in 6½ fathoms at low water spring tides, 40 yards to NE'd and SW'd of the steamer *Kinnaird Castle*, sunk in Knob channel. A wreck marking light-vessel has been placed 140 yards S. 26° W. from the wreck. The light-vessel should be passed on that side on which two balls or two lights are shown. Variation 17° W.

130. West Indies—Cuba.—1. The light at Santiago de Cuba has been plainly seen, on two occasions, when 21 miles distant. Its period of revolution, frequently noted, is about 50 seconds, the period of greatest brilliancy being about 10 seconds.

2. The Diamante reef buoy, the Gorda bank buoy and the Gorda point beacon have all disappeared.

3. **Jamaica—Port Royal.**—The buoy on New Shoal is conical, *white*, with a horizontal *red* band.

131 refers to dredging operations at Leghorn and Civita Vecchia, Italy.

132 refers to reefs, &c., at Angra Pequena, W. coast of Africa.

133 refers to a light and a shoal in Sunda strait.

134 refers to a light on Pulo Bodjo, W. coast of Sumatra.

135 refers to lights, &c., in the Indian Archipelago.

136 refers to beacons in Wide bay, Australia.

137. United States—Vineyard Sound.—Several dangerous shoals exist in Monomoy passage between Shovelful and Pollock Rip light-vessels. They consist of patches with a least depth of 13½ feet near the northern extremity, and form an extension of Stone Horse shoal, in a northerly direction, to the 18 feet spot shown on Coast Survey chart No. 344, N. 59° E., ¼ mile from Shovelful light vessel. The patch, on a line between the two light vessels, has a least depth of 15 feet. Vessels of deep draught should keep to westward of a line joining the Handkerchief and Shovelful light vessels until on a line between the southern extremity of Monomoy point and Pollock Rip light-vessel.

138. United States—New Jersey.—On or about May 10, 1884, light-ship No. 44, moored on NE. end of Five Fathom bank, will be removed for repairs, and the RELIEF light-ship No. 24 will be substituted. The fog-signal while No. 24 is on this station will be a bell and a horn. No. 44 will be replaced as soon as the repairs are completed.

139 refers to a light in Frazier river, British Columbia.

140 refers to buoys, light-vessels, &c., on the China coast.

141 refers to a shoal off the coast of Chile.

142 refers to lights on the south coast of Australia.

143 refers to a light at Kobe, Japan.

144. France—N. Coast—Langrune.—1 A wreck, with the stump of the lower mast and the jib-boom protruding from the water lies in 6½ fathoms 1675 yards S. 22° E. from Essarts buoy. Variation 17° 30′ W.

2. **Dunkerque.**—A wreck lies near Dunkerque on the following bearings: Dunkerque light-house, S by E. Ruytingen light-ship, S. ½ W. Variation 16° 55′ W.

145 refers to a light in Kalmar sound, Baltic sea.

146 refers to light and buoys on the coast of Austro-Hungary

147. Ireland—Copeland islands.—About October 1, 1884, a flashing light, consisting of a group of four flashes at intervals of one minute, will be exhibited on Mew island, half a mile eastward of Copeland light-house island. During thick or foggy weather a fog-siren will give two blasts in quick succession at intervals of one minute. When this light is exhibited the light and fog bell at Copeland island will be discontinued

148 refers to a light at Malaga, Spain.

149 refers to the time-ball at Cape Town.

150. United States—New York.—1. The spar buoys marking the various channels in the lower bay during the winter, have been taken up and the proper can and nun-buoys have been replaced.

2. **New Jersey.**—The wreck of the schooner Mary Matheson having disappeared, the wreck buoy has been removed.

151. United States—New Jersey.—A sunken wreck with the topmast about 40 feet out of water lies off the coast of New Jersey, with Tucker island light-house bearing N NW., ½ W. 1½ miles. Variation 6° 15′ W.

152. United States—Virginia.—A bell-buoy has been moored near red buoy No. 2, off the SE. end of the middle ground, entrance to Chesapeake bay.

153. West Indies—Orchilla island.—A rock with 18½ feet of water over it lies in the entrance to Orchilla harbor, with the north point of NE. key bearing S. 85° 30′ E., and the outside line of breakers, which extend to the northward ¼ of a mile from Storm key, bearing S. 63° 55′ W Variation 2° E.

154 refers to beacons in Kirpon harbor, N. coast of Newfoundland.

155. Cape de Verde islands—Porto Praya.—A shoal with depths of from six to seven fathoms lies to SSE'd of the city on the line joining the two points of Porto Praya

156. France—Turbal.—A second *fixed white* light has been exhibited from an iron standard erected 40 yards S. 56° W. from the old light at Turbal, Croisic roads. The two in line indicate the entrance Variation 18° W

157 refers to the withdrawal of wreck light-vessel at the entrance to the Belts, Denmark.

158 refers to reef in the vicinity of Falkland islands.

159 refers to a change in False point light, Bay of Bengal.

160 refers to lights, &c., in the Mediterranean.

EXPLANATION.

100 Fathom Curve

Lines of Magnetic Variation for 1884

Information received during APRIL.

Storm Tracks

Ice reported Berg Field

Wrecks Floating, Rig and Position: Sunk:

Water Spouts

Prevailing Winds and Currents for MAY.

Limits of Gulf Stream and other Ocean Currents

Limits of Trades

Direction and Force of Wind

Light variable Winds

Calms

Limits of Ice

Note.

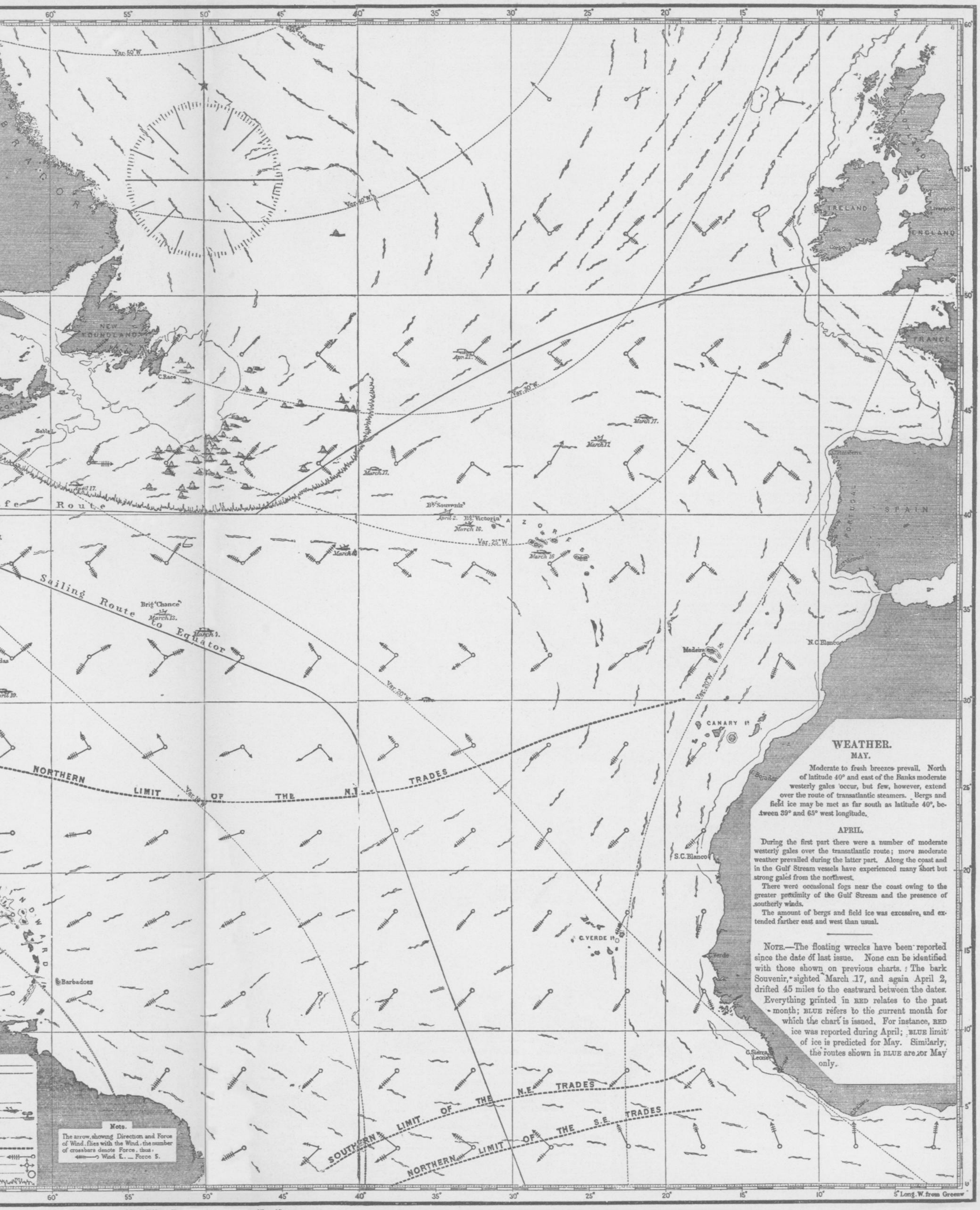
The arrow, showing Direction and Force of Wind, flies with the Wind, the number of crossbars denote Force, thus, Wind E. — Force 5.

HYDROGRAPHIC OFFICE U.S. NAVY

Prepared by order of the Bureau of Navigation.
Commander J.R. Bartlett, U.S.N.
Hydrographer.

U.S. Hydrographic Office, Bureau of Navigation, Navy Department.
Washington D.C.

RT OF THE NORTH ATLANTIC OCEAN.



WEATHER.

MAY.

Moderate to fresh breezes prevail. North of latitude 40° and east of the Banks moderate westerly gales occur, but few, however, extend over the route of transatlantic steamers. Bergs and field ice may be met as far south as latitude 40°, between 39° and 65° west longitude.

APRIL.

During the first part there were a number of moderate westerly gales over the transatlantic route; more moderate weather prevailed during the latter part. Along the coast and in the Gulf Stream vessels have experienced many short but strong gales from the northwest.

There were occasional fogs near the coast owing to the greater proximity of the Gulf Stream and the presence of southerly winds.

The amount of bergs and field ice was excessive, and extended farther east and west than usual.

NOTE.—The floating wrecks have been reported since the date of last issue. None can be identified with those shown on previous charts. The bark Souvenir, sighted March 17, and again April 2, drifted 45 miles to the eastward between the dates.

Everything printed in RED relates to the past month; BLUE refers to the current month for which the chart is issued. For instance, RED ice was reported during April; BLUE limit of ice is predicted for May. Similarly, the routes shown in BLUE are for May only.

U.S. Hydrographic Office. Bureau of Navigation, Navy Department. Washington D.C.

information concerning wrecks, ice, etc., gained during the preceding month. Through the kindness of Commander Bartlett, we are enabled to present a copy of the chart for May, reduced to two-fifths of the original, from a special print in black. As stated in the legend, every thing concerning the current month (in this case, May) is printed in blue in the regular issue; thus the direction and force of the winds are given, with the probable limits of the trades and of floating ice. On the May chart, the sailing-route to the equator, and the safe route to England, are added. On the other hand, information received concerning floating wrecks, ice, and notable storms or fogs, is printed in red. Only the geographic outline, the currents, and the permanent wording, appear in black on the original charts. The first four numbers, December to March, were accompanied by a few pages of letter-press, giving information concerning wrecks, storms, etc.; but it has later been found possible to present sufficient detail on the chart itself. Although the publication of these charts was duly authorized, no special appropriation was made for the collection of the information that they are designed to show. The co-operation of seafaring men, and those interested in the weather of the ocean, is therefore solicited. The distribution of the charts from the branches of the hydrographic office lately established in New York, Philadelphia, Baltimore, and Boston, as well as from the central office in Washington, will, doubtless, prove a strong incentive to a more complete reporting of the desired observation.

Having thus considered what has been already accomplished for the North Atlantic, we may give a few lines to studies now in progress in different parts of the world. Germany, England, and Holland have entered into a kind of co-operative agreement by which each party is to take charge of a relatively small part of certain oceans, and examine all the observations, furnished from all the parties, with the utmost detail; this plan being the outcome of several meteorological congresses. So far as I can learn, the German government, through Dr. Neumayer of the Deutsche seewarte at Hamburg, is at work on the North Atlantic between latitudes 20° and 50°, from shore to shore, the results to be tabulated in one-degree squares. About one-eighth of this work has been published.[1] The British meteorological council, of which Gen. R. Strachey is chairman, and Mr. R. H. Scott, secretary, has about completed a series of sea-surface temperature charts of the three great oceans for the cardinal months, February, May, August, and November, and have on hand a similar set of barometrical charts. A more original undertaking is the preparation of daily synoptic charts of the North Atlantic, in charge of Capt. H. Toynbee, for the thirteen months beginning Aug. 1, 1882, and ending Aug. 31, 1883; this being the period covered by the international circumpolar observations. It is estimated that there will be at least four hundred observations for each day; and from these it may at last be discovered what becomes of our Atlantic gales. The Indian meteorological service, in charge of Mr. H. F. Blanford, is studying the Indian Ocean north of the equator, lapping to the eastward over the area taken by the Dutch. The Dutch government, represented by Dr. Buys-Ballot of the Meteorological institute at Utrecht, has undertaken the investigation of the China seas (0°–30° north latitude, 100°–150° east longitude), but the results have not yet appeared. The former work of this office on the surface temperatures of the Atlantic, although of much importance, has, perforce, been omitted in this review; nor has there been space to consider various essays on ocean surface temperatures by Petermann, Cornelissen, and Koldeway, which might well be compared with the results on our hydrographic charts. The winds furnish material enough for examination in one essay.

It is surely fitting that our government should bear its share in these invaluable studies, and we trust the work now approaching completion for the North Atlantic may be speedily followed by similar studies of the rich material in our possession from the other oceans. W. M. DAVIS.

[1] *Deutsche seewarte. Resultate meteorologische beobachtungen von deutschen und holländischen schiffen für eingradfelder des nordatlantischen Oceans.* (*Quadraten* 146 *und* 147.) Hamburg, 1880, 1881. These include the area between 40° and 50° north latitude, and 10° to 30° west longitude.

INVERTEBRATES OF THE TALISMAN EXPEDITION.

IN a communication to the French academy, Dr. Paul Fischer observes, that, during the voyage, attention was directed especially to determining whether the deep-sea fauna of the tropical seas is peculiar to the geographical region, or derived by emigration from arctic seas. By dredging in a north and south direction in the eastern Atlantic, and comparing the results from different latitudes with those obtained by others in northern seas, it was hoped to arrive at a satisfactory solution of the problem. The line upon which work was done extended from the mouth of the Charente, over thirty degrees of latitude, to Senegal.

It is known that the superficial and abyssal faunae of the seas of tropical Africa differ greatly. The genera are not the same: their respective assemblages have no parallel relations. If the remains of these two contemporaneous faunae were fossilized, it might be supposed that they belonged to two different epochs, or represented the population of two uncommunicating seas. The abyssal fauna of the coasts of the Sahara, Senegal, and islands of Cape de Verde, contains a number of mollusks common to the arctic seas which have an immensely wide distribution. Such are Troschelia berniciensis, Chrysodomus islandicus, Scaphander puncto-striatus, Lima excavata, Malletia obtusa, Limopsis minuta, Syndosmya longicallis, Neaera arctica, N. cuspidata, Pecten vitreus, and P. septemradiatus. These range from Iceland and Finmark, or northern European seas, in comparatively shallow water, southward to various