v.43F, no.2-11

THE NORMANDIE.[1]
THE CHARLOTTE WEBB.
O'SULLIVAN *ET AL. V.* COMPAGNIE GENERALE TRANSATLANTIQUE.
O'SULLIVAN *ET AL. V.* THE NORMANDIE.

District Court, S. D. New York. May 20, 1890.

1. COLLISION—STEAM AND SAIL—FOG—EXCESSIVE SPEED—DUTY TO REVERSE.

Collision occurred towards midnight of May 28, 1889, from five to eight miles east by south of Sandy Hook light-ship, in a dense fog, between the steam-ship Normandie and the pilot-boat Charlotte Webb, by reason of which the pilot-boat was sunk. The steam-ship, having left New York on one of her regular trips, had been put upon a course of east by south, on which course she continued until within a few moments of collision. The pilot-boat was cruising for vessels. She was sailing slowly on a course of about E. N. E., and crossing the steamer's course. When the steamer's whistles were first heard, which was from 15 to 80 minutes before the collision, the pilot-boat continued to sound her fog-horn, which was blown by mechanical means, at regular intervals, and as the Normandie's whistles continued to approach, bearing in the same direction, two bombs were fired by the pilot-boat, and a flash light was twice shown over the port side. She did not alter her course at any time. She was struck by the steamer on her port side, half cut through, carried along with the steamer for a short period, until she dropped off and, sank. The steamer's speed had been from 11 to 12 knots, her maximum speed being 16 knots. Soon after hearing the pilot-boat's horn ahead her engines were slowed. She continued on at this speed for about a minute, when the light of the sailing vessel came in sight, only a short distance ahead. By reversal before the collision her speed was reduced to four or five knots. The above facts being found on very conflicting evidence, *held,* that there was no fault in the pilot-boat, either in her signals or maneuvers; that the speed of the steam-ship was in excess of the moderate speed required in a fog by article 13 of the collision rules; that she was also to blame for not reversing, instead of slowing, when the horn was heard ahead and near; and that she alone was responsible for the collision.

2. SAME—TWO SUITS—COSTS—MANEUVERING AND STOPPING POWER.

Upon two suits *in personam* and *in rem,* successively brought for the same demand, ho security being obtained in the former, *held,* decree should be given in the suit *in rem* with one bill of costs only, but hot until after the lookout, a co-libelant and an available witness, had been produced and called therein.

In Admiralty. Actions for damages by collision.

Carter & Ledyard, for libelant.

Coudert Bros., for defendants.

BROWN, J. The above libels were filed to recover damages for the loss of the pilot-boat Charlotte Webb, with the personal effects of those on board, through collision with the French steam-ship La Normandie, in a dense fog at sea, from five to eight miles east by south from Sandy Hook light-ship, towards midnight of May 28, 1889. The first-named libel is against the owners of La Normandie *in personam*; the second, brought by the same libelant with one other libelant, who was a passenger on the pilot-boat, is against the ship *in rem.* The Normandie is a steam-ship of the first class, plying regularly between Havre and New York, about 464 feet long, 50 feet beam, 25 feet draft when loaded, displacement at 21½ feet draft, 8,392 tons, and between 7,000 and 8,000 tons burden. She has triple expansion engines, of 6,600 horse-power; a single right-hand propeller, about 22 feet in diameter, with a pitch of 9 meters and 80 centimeters, (about 32 feet,) giving under her ordinary full speed about 56 or 57 revolutions per minute, and a speed of 16 knots per hour. The Charlotte Webb was a two-masted schooner, 85 feet long, 23½ feet beam, and was in the service of licensed pilots. The Normandie left her dock at New York at 7 A. M. of the 28th of May. Encountering a dense fog at Sandy Hook, she came to anchor. A little before 10 P. M., the weather being still foggy, she resumed her voyage, passed a little to the northward of the Scotland light-ship and the Sandy Hook light-ship, both of which she made, the latter at 20 minutes past 11 P. M., and was then put upon a course of east by south, and so continued until her wheel was ported a few moments before collision. The Charlotte Webb left Stapleton, Staten island, between 11 and 12 o'clock of the same morning, on a cruise at sea in search of pilot service. She had on board four pilots, six seamen, and Green, who was a passenger or volunteer. The wind was light, about south-east by east, and she was sailing upon the starboard tack, with her booms to port, and her jib, foresail, and one reefed mainsail, all close-hauled, and a stay-sail hauled to the mast, with the sheet to starboard, making not over one or two knots per hour, upon a course E. N. E., or N. E. by E. and crossing, therefore, the steamer's course at an angle of from three to four points to port. The fog continued dense up to the moment of collision. The pilot-boat was struck near her fore rigging on the port side, by the stem of the steamer, at an angle variously estimated to be from 60 to 90 degrees. She was a little more than half cut through by the blow, carried along in the jaws of the steamer for a short period, until, as the steamer stopped by the backing of her engines, she dropped from the stem of the steamer and sank in 13 fathoms of water. Several of her men jumped overboard, or went down with the schooner; two of whom (Malcolm, the wheelsman, and Fitzgerald, the boat-keeper) were drowned; the rest had got into the yawl, which had been hove overboard before the collision, and, after being upset, they were rescued by the steamer. The libelants contend that the collision arose in consequence of the immoderate speed of the steamer, of her failure to heed the signals given by, the pilot-boat, and her neglect to stop and back in time. The respondents claim that the steamer was in ho fault in these respects, and that the collision arose through the failure of the pilot-boat to give proper signals, or to veer, as it is claimed she might and ought to have done, out of the line of the steamer's course when it was perceived that the steamer was coming directly upon her, and could not avoid her.

Damages for collision are given under our law only upon proof of fault, actual or presumptive. As between a steamer and a sail-vessel, upon proof that the latter has observed all the rules of navigation, fault in the steamer in case of collision is presumed, except on an issue of inevitable accident, *(The Florence P. Hall,* 14 Fed. Rep. 408–416, 418, and cases cited;) and the burden is upon her, if she would avoid liability, to satisfy the court that she has observed all the rules of navigation, and of careful seamanship. If this be proved to the satisfaction of the court, she is entitled to acquittal. The loss is ascribed to inevitable accident, or perils of the sea, and remains where it fell. *The Morning Light,* 2 Wall. 550–556; *The Marpesia,* L. R. 4 P. C. 212–219.

The Pilot-Boat's Signals. On careful consideration of the testimony, and of all that has been urged in behalf of the claimant, I must find that fog signals, as required by law, were duly given by the pilot-boat, and that she is without fault in this respect. When the Normandie's whistles were first heard two persons only were on deck, Capt. Scott, who was at the wheel, and in charge of the watch after 10:40 P. M., and Olsen, who was the lookout, and blowing the fog-horn. The horn was blown by a mechanical appliance of approved form, giving blasts audible, as the testimony states, at three or four times the distance at which a horn blown from the mouth would be heard. Olsen went on the lookout at 10 P. M. He and Capt. Scott testify that the horn was sounded regularly at intervals of about a minute from that time to the collision; the signal being one blast, in conformity with the rules of navigation, the pilot-boat being on her starboard tack. The fog signals of the Normandie, as they testify, were beard a considerable time before collision, estimated at from 15 to 30 minutes. These signals, according to the claimant's testimony, were given at intervals of about one minute. Capt. Scott testifies that he located these signals as bearing by compass W. by N., or W. N. W., and that they continued on the same bearing until the collision; that, after hearing six or eight of those signals, he called up Pilot Hammer, who thereupon came up and remained some time standing in the companion way, and watching for the steamer. Both used glasses. Soon afterwards Hammer called up Pilot Hines. Hammer and Freeman testify to hearing the signals from the Normandie upon the same bearing, and that the pilot-boat replied thereto regularly for some time before the collision, and that they heard the pilot-boat's previous signals before they came on deck. Four other witnesses testify to hearing the horn blown while they were below. After Hammer came up Capt. Scott ordered a bomb to be fired, which was done, giving a report, it is said, louder than a cannon. To get, to fix, and to fire the bomb took "about a minute." After the bomb, a flash light was shown over the port side for about a minute. After that, another bomb was fired, and then the flash light was again shown on the port side. Meantime the boat-keeper and all hands had been called from below. The steamer's lights were first seen about the time, or soon after, the second bomb was fired. She was then probably not over a quarter of a mile distant. It was then, or very soon afterwards, that the yawl was hove over, before all the men below had got on deck. Scott and Hammer jumped into the yawl at once. Two others below, roused by the calls and the noise above, came up, saw the steamer's lights, and got into the yawl; they did not pull away before they were upset by the collision. Larsen estimated that the yawl was launched eight minutes before collision; Anderson, three or four minutes. Freeman thinks the second bomb fired was a half hour before collision. These estimates carry no weight. Capt. Scott, the other pilots, and Olsen say the boat was thrown over just before the collision, and of that I have no doubt. The whole testimony on both sides bristles with discrepancies as regards the estimates of time and distance. Little weight is to be attached to such estimates, unsubstantiated or uncorrected by other facts. The acts done, and all the circumstances of time, place, and navigation, afford a better means of judging of such particulars. *Kennedy* v. *The Sarmatian,* 2 Fed. Rep. 914. Several blasts of the Normandie's siren were heard between the two bombs; Scott thinks, two or three blasts; Hammer, three or four. Taking all the evidence and the circumstances into account, I think it most probable that the Normandie's whistles were first heard about 15 minutes before collision; that the interval between the bombs was probably from one to three minutes; that the last bomb was fired about two minutes before collision, and the steamer's lights first seen a few moments after the last bomb was fired; and that the yawl was hove over about that time. The steamer's witnesses testify that only one bomb was heard by them, and, before the bomb, only one blast of the horn, which was immediately before the bomb; that, after the bomb, the pilot's horn was heard often, and was soon blown almost continuously. For the defense it is urged that Olsen's testimony that he assisted in exhibiting the torchlights, and also in heaving the lead once after the steamer's whistles were first heard, as well as in launching the yawl, proves that other duties were imposed upon him incompatible with his duty to keep a proper lookout, and to give the proper signals. Capt. Scott, however, testifies that he himself threw the lead, and took the observation of 13 fathoms; and that Olsen merely hauled in the line, a matter of a few seconds only. Both Scott and Hammer testify that the torch-lights were shown by them, and not by Olsen, and the latter so stated on his original examination. The fact, also, testified to by five of the claimant's witnesses, that the horn was heard just before the bomb, confirms the testimony of Scott and Hammer that Olsen was not called off from his duty to fire the bomb. The other circumstances on which Olsen's alleged neglect to sound the horn regularly is based are too slight to have any weight against the mass of direct evidence, as well as the probabilities of the case, that the proper signals were given. The event shows that Capt. Scott had accurately located the bearing of the steamer by her whistles as west by north. The whistles continued, he says, to bear in the same direction; showing, therefore, that the steamer was coming directly for the pilot-boat; and he was fully alive to that fact. It is extremely improbable that, under such circumstances, the use of the ordinary fog signals, which had been given all along, should be neglected then. Many witnesses testify that these signals were given, and given oftener than is required by the rules; and the firing of the two bombs was an additional precaution that was employed because they knew the steamer was coming towards them. It is not credible that such added precaution, should have been adopted, and the simple and usual precaution of blowing the horn neglected. That it was not neglected is proved by all the direct testimony that the case makes possible; and it is confirmed, as I have said, to some extent, by the steamer‘s evidence that the fog-horn was heard before the bomb. Such a mass of testimony I cannot discredit, merely because the horn was not heard earlier on board of the Normandie. Her witnesses say that only one bomb was heard, yet two were certainly fired. The first bomb was probably within a few minutes of the second; at all events, it was some time after the first signal from the Normandie was heard on the pilot-boat; and the first bomb should ordinarily have been heard on the Normandie. If not heard, the failure to hear the first bomb, as well as earlier fog-horns, should be set down to abnormal conditions of the atmosphere, or to inattention. *Bradley* v. *The John Pridgeon,* 38 Fed. Rep. 261, 267; *McCabe* v. *Steam-Ship Co.,* 31 Fed. Rep. 238; *The Lepanto,* 21 Fed. Rep. 651, 656–658; *The Zadok,* 9 Prob. Div. 114. The theory that the yawl was launched some eight minutes before collision, for the purpose of sending a pilot to the steamer, and that the crew were occupied about that business, encounters too many opposing circumstances and too much opposing testimony to be adopted. Nor could the pilot-boat safely depart from her course, before the steamer could be distinguished. No rule required that; and, had she done so, it would have been at her own risk. There was nothing by which she could determine whether to turn to the right or the left; and, after the steamer was seen, there was nothing, I think, which she could have safely done. She could not tell what change the steamer might be making. It requires a very clear case to condemn a sailing vessel for observing the general rule to hold her course, instead of departing from it. This is not such a case.

The Normandie‘s Speed. The Normandie‘s speed before slowing is estimated by her officers at from 10 to 11 knots, but no reason appears for estimating it at much less than 12 knots. For more than half an hour she had been making 42 revolutions per minute. The general conditions for speed were favorable. Her loading was not deeper than usual. Fifty-six or 57 revolutions give her 16 knots, and 42 revolutions should therefore give 12. Computed from the pitch of the propeller of over 31 feet, with 10 per cent, slip, 42 revolutions should give nearly 12 knots. It is not very material, however, whether her speed was 12 knots or 11. Either is considerably in excess of what has been adjudged in many cases in the courts of this country an excessive rate of speed in a dense fog, and therefore a violation of the thirteenth article of navigation. I am not at liberty to depart from these adjudications, notwithstanding the opinions of witnesses and the argument of counsel that her speed was moderate, and was the safest for herself and for other vessels.

No doubt the question of what is "moderate speed" is largely a question of circumstances, having reference to the density of the fog; the place of navigation; the probable presence of other vessels likely to be met; the state of the weather as affecting the ability to hear the fog signals of other vessels at a reasonable distance; the full speed of the ship herself, her appliances for rapid maneuvering, and the amount of her steam-power kept in reserve, as affecting her ability to stop quickly after hearing fog signals. No doubt, also, that, in the absence of circumstances of special danger, navigation is not required to be suspended on the high seas on account of dense fog. Neither the rules nor the ordinary practice of seamen require that. The rules intend that signals shall be given which are expected to be heard in time to enable vessels to avoid each other; and no speed is sufficiently "moderate," under given conditions of wind, sea, and weather, unless it is so reduced as to enable the vessel to perform her duty to keep out of the way from the time when she has a right to expect that the other vessel's signals, under the existing conditions, will be heard. For the Normandie it is contended that her speed in this case, considering all the circumstances, was moderate speed, because her speed was reduced, and was such as, considering the utility and necessity of rapid evolutions, was most effective to enable her successfully to avoid collision with other vessels that observe the rules of navigation. The recent case of *The Champagne* and *The City of Rio Janeiro* in the French courts has been cited in support of this contention. There the Champagne was running in foggy weather at a speed of 14½ knots an hour. She heard the whistle of the Rio Janeiro ahead, or a little on her port bow, and thereupon ported, and reduced her speed to 10 knots. The Rio Janeiro heard and erroneously located the whistles of the Champagne on her starboard bow, and accordingly veered to port, which brought the two vessels into collision. The vessels had in fact been approaching very nearly head and head. The erroneous location of the Champagne's whistle by the City of Rio Janeiro was ascribed to inexplicable fatality, or the reverberations of the sound of the whistles from strata of fog of different density. The court of appeal at Rouen adopted the finding of the tribunal of Havre, that the reduction of speed from 14½ to 10 knots was in keeping with the circumstances, and proper for making the necessary evolutions that are required to execute maneuvers as quickly as possible in order to avoid collisions. Both courts, however, found the further fact that the speed of the Champagne did not contribute to the collision in that case, nor have any direct relation to it, and therefore released the Champagne. International Mar. Rev. 1887–88, pp. 500–543. The court of cassation, in affirming the judgment, did not consider the question whether her speed was moderate within the rule, but affirmed the judgment on the finding of fact below that the rate of speed was in that instance immaterial, having no direct connection with the collision. Id. 1889–90, p. 7. In a still later case the court of appeals at Montpelier held the steamer Tonkin in fault for going in fog at a speed of 10 knots instead of 5. Id. 1889–90, pp. 204–207. Very similar arguments in favor of higher speed were addressed to the supreme court in the case of *The Pennsylvania,* 19 Wall. 125, and overruled; and I am not at liberty to treat the question as an open one in this court. The maximum speed of the steamer in that case was 13½ knots; and, under circumstances very similar to the present, a speed of 7 knots was held excessive. With improvements in steam-engines, and increased facilities for handling, it is not impossible that one-half the maximum speed, when full power is held in reserve for immediate use in emergencies, may come to be held a moderate speed, even in dense fog, in those parts of the high seas where other vessels are not specially liable to be met. But the speed of the Normandie in this case was more than half of her maximum speed. There is no case in the courts of this country where a speed of two-thirds of the maximum speed, under such circumstances as the present, has been held to be moderate speed within article 13. No doubt certain evolutions could be effected more rapidly with a speed of 10 to 12 knots than with a speed of 6. But a speed of 10 or 12 knots was not more necessary to the Normandie's safe navigation in this case than was 7 knots in the case of The Pennsylvania. Besides, the question is not whether certain evolutions can be executed in less time, but whether the Normandie, when meeting a vessel suddenly in a fog, could, as a rule, more effectively avoid her under a speed of 10 or 12 knots than when under a speed of only 6 or 7 knots. The experiments with the Normandie, testified to by Lieut. Chambers, do not favor the higher rate of speed, because they show that the ship stops in less space, and turns more within a given area, under a speed of 8 knots than under a speed of 12 knots. See White, Nav. Arch. 631–635.[1]

There was nothing to prevent the Normandie from proceeding at a much slower rate. The evidence shows that soon after the fog-horn was heard, her revolutions were brought down to 16 or 17 per minute, equal to about 5 knots speed. The testimony of the engineer in charge and of the first officer shows that this continued about a minute, whereupon her engines were reversed; and the commander testifies that this reversal was ordered at the time when the pilot-boat's light first came in sight, distant less than half the steamer's length. Upon other adjudged cases I also think the Normandie is to blame for not reversing at the time she slowed, because at that time the signals were heard nearly ahead, and must have been perceived to be near; and, considering that she was then at a speed of from 10 to 12 knots, on hearing such a signal near and ahead, she was bound to check her speed as soon as possible by instant reversal. *Leonard* v. *Whitwill,* 10 Ben. 638, 647; *The Frankland,* L. R. 4 P. C. 529; *The Martello, 34 Fed. Rep. 71, 74*; *The City of Atlanta, 26 Fed. Rep. 456, 462*; *The Britannic,* 39 Fed. Rep. 395, 399, and cases there cited; *The Wyanoke,* 40 Fed. Rep. 702, 704. From the fact that the pilot-boat was not cut through, it is not probable that at the moment of collision the steamer was going at the rate of more than 4 or 5 knots, and such is the master‘s estimate. The testimony Of Pilot Hines tends to-confirm this. He says he went down with the pilot-boat, and that on rising to the surface he saw the lights of the steamer, and kept them in view all the time until he was picked up. Had not her speed been reduced very much below 10 or 12 knots, the pilot-boat would have been cut through, and the Normandie would have gone out of sight before stopping. Mr. De Forrest, a passenger on the Normandie, testifies also that through the port-hole of his state-room on the saloon-deck on the starboard side he saw men struggling in the water very near the ship; that he threw life-preservers to them, and afterwards saw them hauled aboard; and that when he first looked out the ship was then running only very slowly ahead. This confirms the conclusion that at collision the steamer‘s speed had been reduced to 4 or 5 knots.

It is not possible to reconcile the testimony of the master and the men and the lookout as to the shortness of time between the hearing of the first signal and the collision with the testimony of the first lieutenant and the engineer. The master thinks that the reversal of the engine took place within 5 or 6 seconds after the pilot-boat‘s signals were first heard, and within 20 seconds of the collision; and the order to reverse he says was given 2 or 3 seconds after the order to slow. It is not perhaps necessary to determine which is correct on this point. But the master must be mistaken if at the collision the Normandie‘s speed was reduced to 4 or 5 knots, as he estimates; for she could not retard from 11 knots to 5 in less than a minute and a half, even on instant reversal of the engines at full speed; and if during a minute of the interval she ran at the rate of 16 or 17 revolutions ahead before reversing, she could not retard to 5 knots in less than 2 minutes; and the distance run, I am confident, would, on the last supposition, be as much as a quarter of a mile. Such, or nearly such, are, I think, most probably the facts of the case. The master‘s testimony, also, that he did not reverse until a second blast of the pilot-boat‘s horn was heard nearer, agrees with the engineer‘s testimony that there was about a minute‘s slowing before reversal. Upon this view, had the engine been reversed full speed when the horn and bomb were first heard, whether that bomb was the first that was fired or the second, the steamer would have passed astern of the pilot-boat, and the collision would have been avoided. I do not say that she would have been fully stopped before reaching the line of the pilot-boat‘s course, for there is uncertainty both as to her actual distance from the pilot-boat at that time and as to the distance within which she could have been stopped by reversing; but I am confident that the estimates as to the distances required for stopping given in the testimony are much too small.[1] By reversing when the bomb was first heard the Normandie would have passed astern, both from the delay consequent on her reversal and from her greater change of heading to starboard. This change would have been from two to three points. As it was, the testimony shows that she changed but one point. The difference from both causes would have been sufficient to allow the pilot-boat, going from 150 to 200 feet a minute, to escape. If some uncertainty, however, remains on this last point, I cannot doubt that, had the Normandie been going at such moderate speed as the adjudications of this country require, she would have been stopped before reaching the pilot-boat, had she reversed when the first signals were heard so near, and the collision would have been thereby avoided. A decree must therefore be given for the libelants in the suit *in personam,* with costs. In the suit *in rem,* the testimony not being complete, and the omission to call the lookout not being satisfactory, no decree should be given until some necessity for that suit shall appear and the omission be supplied.

The defect in the testimony in the suit *in rem* being subsequently supplied, and it appearing that that suit had been brought because no security had been obtained in the prior suit *in personam,* and that the stipulation given in the suit *in rem* was sufficient to cover the libelants' demands, a decree was directed to be entered in the suit *in rem* only, with one bill of costs. See *The Normandie,* 40 Fed. Rep. 590.

NOTE I. The following is a summary of the observations of Lieut. Chambers, U. S. N., in his experiments with the Normandie. The experiments were made in the English channel, off Bar Fleur light, under the lea of the land, in 27 fathoms of water, in a light wind and smooth sea. The ship was light, drawing only 21½ feet, 3 feet less than when loaded.

(1)*Turning.* The helm is worked by steam. The propeller is right-handed. After the order to port or to starboard is given, it takes 23 seconds to get the helm hard over if the ship is going at her maximum speed of 16 knots, 20 seconds if she is going at 12 knots speed, and 18 seconds if she is going at 8 knots. In turning to starboard, the ship begins to change almost as soon as the helm is moved; but in going to port, and at 12 knots speed, not until she has traveled nearly a length. Going 16 knots, she makes a circle to starboard in 13 minutes and 5 seconds; going to port, in 15 minutes. Going at 12 knots speed, she makes a circle to starboard in 14′ 30″; to port, in 15′. Going at 8 knots, she makes a circle to starboard in 20′ 25″. Though the steam-power is kept the same, the speed is diminished nearly 25 per cent, in turning the first quadrant, through the drag of the rudder, the increased friction of the ship in swinging, and the indirect thrust of the propeller. The ship's path is not an exact circle, but a spiral, ending inside the point of departure, and in advance of it, viz., when beginning under full speed, 30 feet inside the point of departure; when beginning at 12 knots speed, 155 feet, and when starting at 8 knots, 320 feet inside.

(2)*Rate of Change.* Going at full speed, (16 knots,) it takes 50″ after the order is given to change 2 points to starboard; to change 4 points, 1′ 33″; 8 points, 3′ 14″; 16 points, 6′ 33″; 24 points, 9′ 50″; 32 points, 13′ 5″; average speed for first 8 points, 181 knots; for the whole 32 points, 12 knots; diameter of circle, 5,130 feet; average change of one point in a little over a length. Turning to port, and going 12 knots, it takes 1′ 16″ after giving the order to change 2 points; to change 4 points, 2′ 4″; 6 points, 2′ 56″; 8 points, 3′ 48″; 16 points, 7′ 25″; 32 points, 15′; circle, 4,430 feet diameter; average speed of first 8 points, 10.6 knots; of the whole 32 points, 9 knots. Turning to starboard, going at 12 knots speed, it takes 58″ to change 2 points; to change 4 points, 1′ 50″; 8 points, 3′ 40″; 16 points, 7′ 19″; 24 points, 10′ 55″; 32 points, 14′ 30″; diameter of circle, 4,050 feet; average speed of first 8 points, 9.3 knots; of whole 32 points, average, 8.2 knots; average change of 1 point in about 5–6 of a length. Going at a speed of 8 knots, to change 2 points takes 1′ 29″; 4 points, 2′ 38″; 6 points, 3′ 48″; 8 points, 5′ 2″; 16 points, 9′ 59″; 24 points, 15′; 32 points, 20′ 25″; diameter of circle, 3,835 feet; average speed of first 8 points, 6.5 knots; of whole 32 points, 5.4 knots. According to these experiments the Normandie turns faster to starboard than to port. Under a speed of 16 knots she turns 4 points to starboard in 93″ after the order to port is given, going about 2,200 feet; at 12 knots speed, she makes the same change in 110,” in going about 2,025 feet; at 8 knots speed, the same change in 158,” going about 1,750 feet.

(3) *Backing,* On reversing full speed the rudder is said to have no perceptible effect, and was therefore put amid ships. No observation was made, however, as to the possible effect of a port or starboard helm during the first minute after reversal. See The Aurania, 29 Fed. Rep. 122, note. In the first experiment, reversing from full

speed ahead, 16 knots, to full speed astern, the Normandie ran 1½ lengths without change of heading; she then fell off rapidly to starboard, and stopped with a change of 4 points, in 245 seconds. In the second experiment, reversing full speed from a previous speed of 12 knots, (?) she changed 3½ points to starboard, and stopped in 165 seconds. (?) In the third experiment, reversing full speed from a previous speed of 8 knots, (?) she turned 2½ points to starboard and stopped in 121 seconds. (?) When loaded, as at the time of collision, 3 feet deeper, causing ah increased displacement of at least 1,400 tons, (one-sixth,) the times of stopping and distances advanced would be increased probably about one-tenth. See note 2, sub. 6, infra. The observations as to the actual speeds at which the above experiments were begun were lost. They are given as estimated, presenting, doubtless, some errors, at infra.

(4)*Distances Run in Stopping.* These distances were not measured, but were estimated as follows: In the first experiment, stopping from 16 knots, 1,771 feet; in the second, stopping from 12 knots, (?) 818 feet; in the third, stopping from 8 knots, 645 feet. These estimates are inconsistent and irreconcilable. Comparing the second with the third, they would make the ship, while retarding from 12 knots to 8, run only 173 feet in 44″; whereas the distance run in that time, going at the mean rate of nearly 10 knots, must have been about 700 feet. So a comparison of the estimated distances run in the first and second experiments shows only 953 feet traversed in 1′ 20″, while retarding from 16 knots to 12; but if that retard took 80," the distance run must have been about 1,800 feet. These inconsistencies are probably due to errors in the second and third experiments, because there is no probability that in the first experiment the time noted was too much, either by delay in reversing at the beginning, or by counting time after the ship stopped; nor could the speed of the ship at the start have, been more than full speed; whereas, in the second and third experiments, the initial speed might easily have been below the estimate, and the time of stopping might also have been noted too soon. In the absence of ranges, and considering the very slow movement of the ship during the last half minute, (see table, infra,) and especially if the quick-water is already running ahead of the observer, the exact time of stopping must be difficult to observe. In a paper by Lieut. F. F. Fletcher in the volume on Naval Mobilization, published in June, 1889, by the office of naval intelligence, it is stated at page 456 that the estimates of the distances advanced before coming to a dead stop after reversing the engine are much less than in similar cases where the distances have been measured. The appendix states the time required to stop in the cases of some 50 vessels, but no distances. In several cases the different times are also given for stopping when light and when loaded; the former being about two-thirds of the latter, a much greater difference than computation would indicate for the Normandie. On the basis of Lieut. Chambers‘ first experiment, the least distances in which the Normandie could stop from 16 knots, 12 knots, and 8 knots would probably be about 2,750, 1,850, and 970 feet, respectively. See note II, infra;

NOTE II. In the absence of any tables showing the rate at which steamers retard knot by knot on reversing, the subjoined tables, computed by approximation, without the use of the calculus, and based on Lieut. Chambers' first observation of stopping in 245″, will be generally intelligible, and found capable of many useful applications. A few explanations are prefixed. By Newton's first law, the amount of retard under a constant force is proportionate to the time the force acts. The time required to retard a given mass a given amount, under different forces, is inversely proportional to the acting forces. To obtain the times occupied in stopping, and the distances traversed during each interval, knot by knot, it is therefore only necessary to know the comparative amount of the retarding forces at work during each of these intervals, and the whole time it takes to stop; in this case, 245″. The retarding forces are (1) that of the reversed engine and propeller, which may be assumed to be constant, or nearly so; (2) the resistance of air and water, which is variable, diminishing mostly as the square of the ship's velocity. At high speeds, the ratio of the water resistance approaches the cube of the velocity; but as the square gives the least distance traversed, and applies for the most part, and the object being to find the least possible theoretical distance, the rule of the square is applied throughout. The cube rule applied between 16 knots and 12 would result in a net increase of less than 40 feet. At the full speed of any vessel the resistance of air and water just equals the effective propelling power of her engine. If the full-speed propelling power of the Normandie (16 knots) be represented by 16, the resistance of air and water at her full speed will be 16 also. If, then, on reversing full speed, the engine and propeller worked as effectively astern as ahead, the combined retarding forces would at first he represented by 32. But neither the engine nor the propeller blades are so constructed as to work astern as effectively as ahead; the loss in different vessels has been estimated to be from 20 per cent to 60 per cent. Supposing the Normandie's backing power to be 60 per cent of her propelling power, the combined retarding forces on reversing full speed would then be, at first, 9.60–16–25.60. As will appear below, the precise amount of the assumed loss of power in backing is not very material when the time is fixed. In the first computation, the retarding force of the engine and propeller is taken as—9.6, and as constant throughout; in the second computation, (columns 7, 8, and 9,) as equal to the propelling force—16. As regards the variable resistance Of air and water, it is sufficiently accurate to take the force and speed at the mean between the successive knots for those intervals, where the intervals are so small. The error is less than one-fourth of 1 per cent. This resistance at a speed of 16 knots, being represented by 16, will, for the interval between 16 and 15 knots, therefore be to 16 as $(15½)^2$: $(16)^2$, or 15.016. The second column of the table gives the proportionate amount of air and water resistance, computed in the same way for the mean of each interval down to stopping. Adding 9.6 for the constant retarding force of the Normandie‘s engine, gives (column 3) the total amount of the retarding forces for each interval. Let T represent the time it would take for the engine alone, exerting a constant force—9.60, to retard the ship one knot, then the time required to retard from 16 knots to 15, by the combined retarding forces, will be to T, by the inverse proportion of the forces, as 9.6:21.616—.890 T. The time required to retard during all the other intervals being found in the same way in multiples of T, (column 4,) their sum, 11.800 T, equals by observation 245″. T therefore—21″.6808; and this value, applied to column 4, gives (column 5) the time in seconds for retarding each knot. Multiplying this time by the mean speed per second for each interval, gives (column 6) the advance of the ship during each knot‘s retard, aggregating 2,757 feet. The computations in the seventh, eighth, and ninth columns are made in the same way, but on the assumption that the retarding and propulsive forces of the engine are the same; and 16, as the engine constant, instead of 9.60, is therefore added to column 2 to obtain the whole retarding force.

SPEED.	RESIST. A. & W.	TOTAL RESIST. FORCE.		SECONDS.	FEET.		SECONDS.	FEET.
16—15	15.016	24.616	T. 390	8.465	221	T. 516	10.06	262.3
15—14	18.140	22.740	T. 422	9.153	224	T. 549	10.70	262.
14—13	11.390	20.990	T. 457	9.916	226	T. 584	11.39	259.7
13—12	9.766	19.366	T. 496	10.742	227	T. 621	12.11	255.5
12—11	8.266	17.866	T. 587	11.650	226	T. 659	12.85	249.4
11—10	6.891	16.491	T. 582	12.621	224	T. 699	18.63	241.6
10—9	5.641	15.241	T. 630	13.656	219	T. 739	14.41	281.6

SPEED.	RESIST. A. & W.	TOTAL RESIST. FORCE.		SECONDS.	FEET.		SECONDS.	FEET.
9–8	4.516	14.116	T. 680	14.745	212	T. 780	15.20	218.2
8–7	8.516	18.116	T. 732	15.869	201	T. 820	15.98	202.4
7–6	2.641	12.241	T. 784	17.00	186	T. 858	16.73	183.6
6–5	1.890	11.490	T. 836	18.11	168	T. 894	17.43	162.1
5–4	1.266	10.866	T. 883	19.154	145	T. 927	18.07	137.3
4–3	.766	10.366	T. 926	20.077	118	T. 954	18.60	110.
3–2	.891	9.991	T. 961	20.832	88	T. 976	19.03	80.3
2–1	.141	9.741	T. 986	21.369	54	T. 991	19.34	49.
1–0	.016	9.616	T. 998	21.642	18	T. 999	19.47	16.4
			T 11.300=245″		2757	T 12.5676=245″		2921.4
		C. E.=208.1	T=21.″6808			T=19.″49457		C. E.=811.9

By columns 5 and 6 in the above table the Normandie, in stopping from 16 knots in 245″, would advance 2,757 feet, or about 6 lengths; from 12 knots speed she would stop in 212″, advancing 1859 feet, or about 4 lengths; and from 8 knots speed, in 154″, in 978 feet, a little over 2 lengths. If she could stop from 12 knots speed in 165″, she would stop from 16 knots in 199″, instead of 245″.

(1) Columns 6 and 9 show that, when the time of stopping is given, but little difference results in the distance advanced, though a large decrease be assumed in the backing efficiency of the engine. A greater proportion of the work is thereby assigned to the water resistance. A decrease of 40 per cent in the assumed backing efficiency, the time being fixed. Is shown to make the distance advanced only about 6 per cent. less; the distance is less because the less the proportion of work done by the engine, and the greater that done by the water resistance, the greater must be the effect of the variable water resistance in

diminishing the distance run below what would be run (3,310 feet) if the engine alone could stop the ship in the same time.

(2) Saving this small percentage of variation through differences in backing efficiency, the above table is applicable to all propellers that stop in the same time on reversing full speed from the same maximum speed of 16 knots, without regard to the model or mass of the ship.

(3) The proportion of work done by the engine in retarding each knot is expressed by the decimals in column 4. Multiplying the different times in column 5 into the constant engine force (here 9.6) and into the variable water resistance, column 2, the sum of the products of each gives the relative proportions of the work done by each during the whole or any part of the interval. From 16 knots to 12, the engine does 44 per cent, of the work; from 12 to 8,61 per cent.; from 8 to 4,81 per cent.; from 4 to 0, 96¾ per cent.; from 16 to 8,53 per cent; from 8 to 0, 88¾ per cent. If the engine's backing power equaled three-fourths its propelling power, its proportion of the work done in stopping from 16 knots to 8 would be 57 per cent.; from 8 knots to 0, 92 per cent. The power of the engine is therefore a very important factor in determining the time and distance required to come to a stop. But see, *contra,* White, Nav. Arch. 604.

, (4) The items of total retarding force and time, as given in columns 3 and 5, multiplied together, produce a constant throughout. This product, 908.1, represents the constant of energy (C. E.) requisite to retard the Nomandie 1 knot, on her supposed backing efficiency of 6–10. If this efficiency equaled 75 per cent of her propelling power, and the time required to stop remained the same, the constant would be 248; if it equaled 100 per cent., it would be 311.9. Dividing the constant of energy by the total retarding force for any knot, gives the time required to retard that knot.

(5) The gain in time and distance from any increased backing efficiency of the engine is thus easily deduced. If the Normandie's actual backing power were increased from 9.60 to 12, each item of total retarding force in column 3 would be increased by 2.40, and, the times and distances in columns 5 and 6 reduced in proportion, making a saving of 37″ in time, and of 370 feet in distance advanced. If her backing power were increased from 9.60 to 16, so as to equal her propelling power, as in the case of ferryboats, the stop would be made in 163″, and in 1,945 feet, a gain of 82″ in time, and of 807 feet in space. From 8 knots speed, as in fog, the stop would be made in 97″, and in 789 feet. The importance of keeping a full head of steam in reserve when going at moderate speed in a fog is thus apparent.

(6) Other things being equal, the times and distances for stopping vary directly as the mass, and inversely as the combined forces of engine and water resistance. The greater the water resistance at the same speed, in the ease of different vessels, owing to differences of model, or of the same vessel when more deeply loaded, the greater must be the engine force necessary to attain that speed; and hence the greater the combined retarding forces on reversing. If the water resistance increased precisely as the mass, or weight, or draft of the ship, these opposite effects would neutralize each other, and the stop from the same speed would be made in the same time and distance. But the rate of increase of the water resistance, depending chiefly on the amount of the submerged surface of the ship, (White, Naval Arch. 460,) does not usually much exceed one-half that of the draft; and an increase of cargo therefore increases the stopping distance.

In stopping from the same speed, however, the proportional values given in columns 2, 3, and 4 are independent of mass or any particular engine power, or water resistance; and hence the distances advanced, (column 6,) by different vessels in stopping from the same speed, are in proportion to the observed times they occupy in stopping.

The following table shows computations for (1) the Willamette, (length 335 feet; gross tonnage, 2,561,) stopping from 10 knots in 120″; (2) the Pennsylvania, (343 feet; tons, 8,104,) stopping from 12 knots in 140″; and (3) the Wyoming, (366 feet; tons, 8,288,) stopping from 14 knots in 160″,—as stated in the appendix to Lieut. Fletcher's paper, *ut supra*; also for the Normandie, (4,) and for an 18-knot steamer, (5):

MAX. SPEED	STOPS IN.	ENGINE. CONST.	ENGINE. PER CENT.	STOPS. FEET.	PR. CT. OF ADV.	C. E.	STOPS FROM HALF OF FULL SPEED IN.	
(1) 10. kn.	120″	5.	80	874	43.	79.8	73.″	300 ft.=14.8 per cent.
(2) 12. “	140″	6.75	75	1215	42.8	106.8	55.″5	413 ft.=14.6 “
(3) 14. “	160″	8.	66	1588	42.	126.9	99″	555 ft.=14.7 “
(4) 16. “	245″	9.60	60	2757	41.6	208.1	154″	976 ft.=14.9 “
(5) 18. “	270″	12.	59	3420	41.6	255.6	170″	1217 ft.=14.8 “

(7) From the lost table the distance advanced by any other steamer in stopping from either of the full speeds above given, or from half that speed on reversing full speed, when her time of stopping is known, may be approximately ascertained; the distances being in the proportion of the respective times of stopping. The distance traversed for any particular knot or knots may be ascertained by first obtaining the *time* required to retard that knot by dividing the tabular Constant of Energy (C. B.) for similar speed by the whole retarding forces at that knot, as per above tables, and then increasing or diminishing the *time* so obtained in the proportion of the whole observed times of the two vessels & stopping. From this the distance is readily obtained.

(8) From the above tables it will be seen, as previously deduced, through the shorter method of the calculus, by Lieut. Fletoher, to whom I am indebted for various facts and suggestions in the above calculations, that the whole advance which may be expected to be made by screw propellers in stopping from full speed is from 41 per cent, to 48 per cent, of the full speed advance for the same time; and that the stopping distance from half of full Bpeed, on reversing at full speed, is about 14.7 of that advance. The tables show that the rule should be general, subject only to the small variation above noted, (sub. 1,) and that the rule would apply on reversing from any given speed with the same power used in going ahead. These conclusions nearly accord with the few results best reported.

[1] Reported by Edward G. Benedict, Esq., of the New York bar.

[1] See note I, *post*, 159.

[1] See note II, *post*, 160.