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*** START OF THE PROJECT GUTENBERG EBOOK LOSS OF THE STEAMSHIP "TITANIC" ***

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LOSS OF THE STEAMSHIP "TITANIC"

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REPORT

OF A FORMAL INVESTIGATION INTO THE
CIRCUMSTANCES ATTENDING THE FOUND-
ERING ON APRIL 15, 1912, OF THE BRITISH
STEAMSHIP "TITANIC," OF LIVERPOOL,
AFTER STRIKING ICE IN OR NEAR LATI-
TITUDE 41° 46' N., LONGITUDE 50° 14' W.,
NORTH ATLANTIC OCEAN, AS CONDUCTED
BY THE BRITISH GOVERNMENT



PRESENTED BY MR. SMITH OF MICHIGAN
AUGUST 20, 1912.—Ordered to be printed with illustrations

WASHINGTON
1912

TABLE OF CONTENTS.

	Page.
Introduction	7
I. Description of the ship	10
The White Star Co.	10
The steamship Titanic	11
Detailed description	13
Water-tight compartments	14
Decks and accommodation	16
Structure	23
Life-saving appliances	25
Pumping arrangements	26
Electrical installation	27
Machinery	29
General	31
Crew and passengers	32
II. Account of the ship's journey across the Atlantic, the messages she received, and the disaster	32
The sailing orders	32
The route followed	33
Ice messages received	35
Speed of the ship	39
The weather conditions	40
Action that should have been taken	40
The collision	41
III. Description of the damage to the ship and of its gradual and final effect, with observations thereon	42
Extent of the damage	42
Time in which the damage was done	42
The flooding in the first 10 minutes	42
Gradual effect of the damage	43
Final effect of the damage	44
Observations	45
Effect of additional subdivision upon floatation	46
IV. Account of the saving and rescue of those who survived	48
The boats	48
Conduct of Sir C. Duff Gordon and Mr. Ismay	53
The third-class passengers	53
Means taken to procure assistance	54
The rescue by the steamship "Carpathia"	54
Numbers saved	55
V. The circumstances in connection with the steamship "Californian"	56
VI. The Board of Trade's administration	60
VII. Finding of the court	77
VIII. Recommendations	85
Water-tight subdivision	85
Lifeboats and rafts	86
Manning the boats and boat drills	87
General	87

REPORT ON THE LOSS OF THE STEAMSHIP "TITANIC."

THE MERCHANTS SHIPPING ACTS, 1894 TO 1906.

In the matter of the formal investigation held at the Scottish Hall, Buckingham Gate, Westminster, on May 2, 3, 7, 8, 9, 10, 14, 15, 16, 17, 20, 21, 22, 23, and 24, June 4, 5, 6, 7, 10, 11, 12, 13, 14, 17, 18, 19, 21, 24, 25, 26, 27, 28, and 29; at the Caxton Hall, Caxton Street, Westminster, on July 1 and 3; and at the Scottish Hall, Buckingham Gate, Westminster, on July 30, 1912, before the Right Hon. Lord Mersey, Wreck Commissioner, assisted by Rear Admiral the Hon. S. A. Gough-Calthorpe, C. V. O., R. N.; Capt. A. W. Clarke; Commander F. C. A. Lyon, R. N. R.; Prof. J. H. Biles, D. Sc., LL. D. and Mr. E. C. Chaston, R. N. R., as assessors, into the circumstances attending the loss of the steamship *Titanic*, of Liverpool, and the loss of 1,490 lives in the North Atlantic Ocean, in lat. 41° 46' N., long. 50° 14' W. on April 15 last.

REPORT OF THE COURT.

The court, having carefully inquired into the circumstances of the above-mentioned shipping casualty, finds, for the reasons appearing in the annex hereto, that the loss of the said ship was due to collision with an iceberg, brought about by the excessive speed at which the ship was being navigated.

Dated this 30th day of July, 1912.

MERSEY,
Wreck Commissioner.

We concur in the above report.

ARTHUR GOUGH-CALTHORPE,
A. W. CLARKE,
F. C. A. LYON,
J. H. BILES,
EDWARD C. CHASTON,

Assessors.

LOSS OF THE STEAMSHIP "TITANIC."

REPORT OF A FORMAL INVESTIGATION INTO THE CIRCUMSTANCES ATTENDING THE FOUNDERING ON APRIL 15, 1912, OF THE BRITISH STEAMSHIP TITANIC, OF LIVERPOOL, AFTER STRIKING ICE IN OR NEAR LATITUDE 41° 46' N., LONGITUDE 50° 14' W., NORTH ATLANTIC OCEAN, WHEREBY LOSS OF LIFE ENSUED.

ANNEX TO THE REPORT.

INTRODUCTION.

On April 23, 1912, the Lord Chancellor appointed a wreck commissioner under the merchant shipping acts, and on April 26 the home secretary nominated five assessors. On April 30 the board of trade requested that a formal investigation of the circumstances attending the loss of the steamship *Titanic* should be held, and the court accordingly commenced to sit on May 2. Since that date there have been 37 public sittings, at which 97 witnesses have been examined, while a large number of documents, charts, and plans have been produced. The 26 questions formulated by the board of trade, which are set out in detail below, appear to cover all the circumstances to be inquired into. Briefly summarized, they deal with the history of the ship, her design, construction, size, speed, general equipment, life-saving apparatus, wireless installation, her orders and course, her passengers, her crew, their training, organization and discipline; they request an account of the casualty, its cause and effect, and of the means taken for saving those on board the ship; and they call for a report on the efficiency of the rules and regulations made by the board of trade under the merchant shipping acts and on their administration, and, finally, for any recommendations to obviate similar disasters which may appear to the court to be desirable. The 26 questions, as subsequently amended, are here attached:

1. When the *Titanic* left Queenstown on or about April 11 last—

(a) What was the total number of persons employed in any capacity on board her, and what were their respective ratings?

(b) What was the total number of her passengers, distinguishing sexes and classes, and discriminating between adults and children?

2. Before leaving Queenstown on or about April 11 last did the *Titanic* comply with the requirements of the merchant shipping acts, 1894-1906, and the rules and regulations made thereunder with regard to the safety and otherwise of "passenger steamers" and "emigrant ships"?

3. In the actual design and construction of the *Titanic* what special provisions were made for the safety of the vessel and the lives of those on board in the event of collisions and other casualties?

4. Was the *Titanic* sufficiently and efficiently officered and manned? Were the watches of the officers and crew usual and proper? Was the *Titanic* supplied with proper charts?

5. What was the number of the boats of any kind on board the *Titanic*? Were the arrangements for manning and launching the boats on board the *Titanic* in case of emergency proper and sufficient? Had a boat drill been held on board; and, if so, when? What was the carrying capacity of the respective boats?

6. What installations for receiving and transmitting messages by wireless telegraphy were on board the *Titanic*? How many operators were employed on working such installations? Were the installations in good and effective working order, and were the number of operators sufficient to enable messages to be received and transmitted continuously by day and night?

7. At or prior to the sailing of the *Titanic* what, if any, instructions as to navigation were given to the master or known by him to apply to her voyage? Were such instructions, if any, safe, proper, and adequate, having regard to the time of year and dangers likely to be encountered during the voyage?

8. What was in fact the track taken by the *Titanic* in crossing the Atlantic Ocean? Did she keep to the track usually followed by liners on voyages from the United Kingdom to New York in the month of April? Are such tracks safe tracks at that time of the year? Had the master any, and, if so, what, discretion as regards the track to be taken?

9. After leaving Queenstown on or about April 11 last did information reach the *Titanic* by wireless messages or otherwise by signals of the existence of ice in certain latitudes? If so, what were such messages or signals and when were they received, and in what position or positions was the ice reported to be, and was the ice reported in or near the track actually being followed by the *Titanic*? Was her course altered in consequence of receiving such information; and, if so, in what way? What replies to such messages or signals did the *Titanic* send, and at what times?

10. If at the times referred to in the last preceding question or later the *Titanic* was warned of or had reason to suppose she would encounter ice, at what time might she have reasonably expected to encounter it? Was a good and proper lookout for ice kept on board? Were any, and, if so, what, directions given to vary the speed; if so, were they carried out?

11. Were binoculars provided for and used by the lookout men? Is the use of them necessary or usual in such circumstances? Had the *Titanic* the means of throwing searchlights around her? If so, did she make use of them to discover ice? Should searchlights have been provided and used?

12. What other precautions were taken by the *Titanic* in anticipation of meeting ice? Were they such as are usually adopted by vessels being navigated in waters where ice may be expected to be encountered?

13. Was ice seen and reported by anybody on board the *Titanic* before the casualty occurred? If so, what measures were taken by the officer on watch to avoid it? Were they proper measures and were they promptly taken?

14. What was the speed of the *Titanic* shortly before and at the moment of the casualty? Was such speed excessive under the circumstances?

15. What was the nature of the casualty which happened to the *Titanic* at or about 11.45 p. m. on April 14 last? In what latitude and longitude did the casualty occur?

16. What steps were taken immediately on the happening of the casualty? How long after the casualty was its seriousness realized by those in charge of the vessel? What steps were then taken? What endeavors were made to save the lives of those on board and to prevent the vessel from sinking?

17. Was proper discipline maintained on board after the casualty occurred?

18. What messages for assistance were sent by the *Titanic* after the casualty, and at what times, respectively? What messages were received by her in response, and at what times, respectively? By what vessels were the messages that were sent by the *Titanic* received, and from what vessels did she receive answers? What vessels other than the *Titanic* sent or received messages at or shortly after the casualty in connection with such casualty? What were the vessels that sent or received such messages? Were any vessels prevented from going to the assistance of the *Titanic* or her boats owing to messages received from the *Titanic* or owing to any erroneous messages being sent or received? In regard to such erroneous messages, from what vessels were they sent and by what vessels were they received, and at what times, respectively?

19. Was the apparatus for lowering the boats on the *Titanic* at the time of the casualty in good working order? Were the boats swung out, filled, lowered, or otherwise put into the water and got away under proper superintendence? Were the boats sent away in seaworthy condition and properly manned, equipped, and provisioned? Did the boats, whether those under davits or otherwise, prove to be efficient and serviceable for the purpose of saving life?

20. What was the number of (a) passengers, (b) crew taken away in each boat on leaving the vessel? How was this number made up, having regard to (1) sex, (2) class, (3) rating? How many were children and how many adults? Did each boat carry its full load; and if not, why not?

21. How many persons on board the *Titanic* at the time of the casualty were ultimately rescued and by what means? How many lost their lives prior to the arrival of the steamship *Carpathia* in New York? What was the number of passengers distinguishing between men and women and adults and children of the first, second, and third classes, respectively, who were saved? What was the number of the crew, discriminating their ratings and sex, that were saved? What is the proportion which each of these numbers bears to the corresponding total number on board immediately before the casualty? What reason is there for the disproportion, if any?

22. What happened to the vessel from the happening of the casualty until she foundered?

23. Where and at what time did the *Titanic* founder?

24. What was the cause of the loss of the *Titanic*, and of the loss of life which thereby ensued or occurred? What vessels had the opportunity of rendering assistance to the *Titanic*; and if any, how was it that assistance did not reach the *Titanic* before the steamship *Carpathia* arrived? Was the construction of the vessel and its arrangements such as to make it difficult for any class of passengers or any portion of the crew to take full advantage of any of the existing provisions for safety?

25. When the *Titanic* left Queenstown, on or about April 11 last, was she properly constructed and adequately equipped as a passenger steamer and emigrant ship for the Atlantic service?

26. The court is invited to report upon the rules and regulations made under the merchant shipping acts, 1894-1906, and the administration of those acts and of such rules and regulations, so far as the consideration thereof is material to this casualty, and to make any recommendations or suggestions that it may think fit, having regard to the circumstances of the casualty with a view to promoting the safety of vessels and persons at sea.

In framing this report it has seemed best to divide it into sections in the following manner:

First. A description of the ship as she left Southampton on April 10 and of her equipment, crew, and passengers.

Second. An account of her journey across the Atlantic, of the messages she received and of the disaster.

Third. A description of the damage to the ship and of its gradual and final effect with observations thereon.

Fourth. An account of the saving and rescue of those who survived.

Fifth. The circumstances in connection with the steamship *Californian*.

Sixth. An account of the board of trade's administration.

Seventh. The finding of the court on the questions submitted; and

Eighth. The recommendations held to be desirable.

I.—DESCRIPTION OF THE SHIP.

THE WHITE STAR LINE.

The *Titanic* was one of a fleet of 13 ships employed in the transport of passengers, mails, and cargo between Great Britain and the United States, the usual ports of call for the service in which she was engaged being Southampton, Cherbourg, Plymouth, Queenstown, and New York.

The owners are the Oceanic Steam Navigation Co. (Ltd.), usually known as the White Star Line, a British registered company, with a capital of £750,000, all paid up, the directors being Mr. J. Bruce Ismay (chairman), the Right Hon. Lord Pirrie, and Mr. H. A. Sanderson.

The company are owners of 29 steamers and tenders; they have a large interest in 13 other steamers, and also own a training sailing ship for officers.

All the shares of the company, with the exception of eight held by Messrs. E. C. Grenfell, Vivian H. Smith, W. S. M. Burns, James Gray, J. Bruce Ismay, H. A. Sanderson, A. Kerr, and the Right Hon. Lord Pirrie, have, since the year 1902, been held by the International Navigation Co. (Ltd.), of Liverpool, a British registered company, with a capital of £700,000, of which all is paid up, the directors being Mr. J. Bruce Ismay (chairman), and Messrs. H. A. Sanderson, Charles F. Torrey, and H. Concannon.

The debentures of the company, £1,250,000, are held mainly, if not entirely, in the United Kingdom by the general public.

The International Navigation Co. (Ltd.), of Liverpool, in addition to holding the above-mentioned shares of the Oceanic Steam Navigation Co. (Ltd.), is also the owner of—

1. Practically the whole of the issued share capital of the British & North Atlantic Steam Navigation Co. (Ltd.), and the Mississippi & Dominion Steamship Co. (Ltd.), (the Dominion Line).
2. Practically the whole of the issued share capital of the Atlantic Transport Co. (Ltd), (the Atlantic Transport Line).
3. Practically the whole of the issued ordinary share capital and about one-half of the preference share capital of Frederick Leyland & Co. (Ltd.), (the Leyland Line).

As against the above-mentioned shares and other property, the International Navigation Co. (Ltd.) have issued share lien certificates for £25,000,000.

Both the shares and share lien certificates of the International Navigation Co. (Ltd.) are now held by the International Mercantile Marine Co. of New Jersey, or by trustees for the holders of its debenture bonds.

THE STEAMSHIP "TITANIC."

The *Titanic* was a three-screw vessel of 46,328 tons gross and 21,831 net register tons, built by Messrs. Harland & Wolff for the White Star Line service between Southampton and New York. She was registered as a British steamship at the port of Liverpool, her official number being 131,428. Her registered dimensions were—

	Feet
Length	852.50
Breadth	92.50
Depth from top of keel to top of beam at lowest point of sheer of C deck, the highest deck which extends continuously from bow to stern	64.75
Depth of hold	59.58
Height from B to C deck	9.00
Height from A to B deck	9.00
Height from boat to A deck	9.50
Height from boat deck to water line amidships at time of accident, about	<u>60.50</u>
Displacement at 34 feet 7 inches is	tons 52,310

The propelling machinery consisted of two sets of four-cylinder reciprocating engines, each driving a wing propeller, and a turbine driving the center propeller. The registered horsepower of the propelling machinery was 50,000. The power which would probably have been developed was at least 55,000.

Structural arrangements.—The structural arrangements of the *Titanic* consisted primarily of—

- (1) An outer shell of steel plating, giving form to the ship up to the top decks.
- (2) *Steel decks.*—These were enumerated as follows:

	Height to next deck above.	Distance from 34 feet 7 inches water line amidships.	
		Above.	Below.
	<i>Ft. in.</i>	<i>Ft. in.</i>	<i>Ft. in.</i>
Boat deck, length about 500 feet		58 0	
A deck, length about 500 feet	9 6	48 6	
B deck, length about 550 feet, with 125 feet forecastle and 105 feet poop	9 0	39 6	
C deck, whole length of ship	9 0	30 6	
D deck, whole length of ship	10 6	20 0	
		(Tapered down at ends.)	
E deck, whole length of ship	9 0	11 0	
F deck, whole length of ship	8 6	2 6	
G deck, 190 feet forward of boilers, 210 feet aft of machinery	8 0		5 6
Orlop deck, 190 feet forward of boilers, 210 feet aft of machinery	8 0		13 6

C, D, E, and F were continuous from end to end of the ship. The decks above these were continuous for the greater part of the ship, extending from amidships both forward and aft. The boat deck and A deck each had two expansion joints, which broke the strength continuity. The decks below were continuous outside the boiler and engine rooms and extended to the ends of the ship. Except in small patches none of these decks was water-tight in the steel parts, except the weather deck and the orlop deck aft.

(3) *Transverse vertical bulkheads.*—There were 15 transverse water-tight bulkheads, by which the ship was divided in the direction of her length into 16 separate compartments. These bulkheads are referred to as "A" to "P," commencing forward.

The water-tightness of the bulkheads extended up to one or other of the decks D or E; the bulkhead A extended to C, but was only water-tight to D deck. The position of the D, E, and F decks, which were the only ones to which the water-tight bulkheads extended, was in relation to the water line (34 feet 7 inches draft) approximately as follows:

	Height above water line (34 feet 7 inches).		
	Lowest part amid- ships.	At bow.	At stern.
		<i>Ft. in.</i>	<i>Ft. in.</i>	Ft. in.
D	20 0	33 0	25 0
E	11 0	24 0	16 0
F	2 6	15 6	7 6

These were the three of the four decks which, as already stated, were continuous all fore and aft. The other decks, G and orlop, which extended only along a part of the ship, were spaced about 8 feet apart. The G deck forward was about 7 feet 6 inches above the water line at the bow and about level with the water line at bulkhead D, which was at the fore end of boilers. The G deck aft and the orlop deck at both ends of the vessel were below the water line. The orlop deck abaft of the turbine engine room and forward of the collision bulkhead was water-tight. Elsewhere, except in very small patches, the decks were not water-tight. All the decks had large openings or hatchways in them in each compartment, so that water could rise freely through them.

There was also a water-tight inner bottom, or tank top, about 5 feet above the top of the keel, which extended for the full breadth of the vessel from bulkhead A to 20 feet before bulkhead P, i.e., for the whole length of the vessel except a small distance at each end. The transverse water-tight divisions of this double bottom practically coincided with the water-tight transverse bulkheads; there was an additional water-tight division under the middle of the reciprocating engine-room compartment (between bulkheads K and L). There were three longitudinal water-tight divisions in the double bottom, one at the center of the ship, extending for about 670 feet, and one on each side, extending for 447 feet.

All the transverse bulkheads were carried up water-tight to at least the height of the E deck. Bulkheads A and B, and all bulkheads from K (90 feet abaft amidships) to P, both inclusive, further extended water-tight up to the underside of D deck. A bulkhead further extended to C deck, but it was water-tight only to D deck.

Bulkheads A and B forward, and P aft, had no openings in them. All the other bulkheads had openings in them, which were fitted with water-tight doors. Bulkheads D to O, both inclusive, had each a vertical sliding water-tight door at the level of the floor of the engine and boiler rooms for the use of the engineers and firemen. On the Orlop deck there was one door, on bulkhead N, for access to the refrigerator rooms. On G deck there were no water-tight doors in the bulkheads. On both the F and E decks nearly all the bulkheads had water-tight doors, mainly for giving communication between the different blocks of passenger accommodation. All the doors, except those in the engine-rooms and boiler rooms, were horizontal sliding doors workable by hand, both at the door and at the deck above.

There were 12 vertical sliding water-tight doors which completed the water-tightness of bulkheads D to O, inclusive, in the boiler and engine rooms. Those were capable of being simultaneously closed from the bridge. The operation of closing was intended to be preceded by the ringing from the bridge of a warning bell.

These doors were closed by the bringing into operation of an electric current and could not be opened until this current was cut off from the bridge. When this was done the doors could only be opened by a mechanical operation manually worked separately at each door. They could, however, be individually lowered again by operating a lever at the door. In addition, they would be automatically closed, if open, should water enter the compartment. This operation was done in each case by means of a float, actuated by the water, which was in either of the compartments which happened to be in the process of being flooded.

There were no sluice valves or means of letting water from one compartment to another.

DETAILED DESCRIPTION.

The following is a more detailed description of the vessel, her passenger and crew accommodation, and her machinery.

WATER-TIGHT COMPARTMENTS.

The following table shows the decks to which the bulkheads extended, and the number of doors in them:

Bulkhead letter.	Extends up to underside of deck.	Engine and boiler spaces (all controlled from bridge).	Orlop to G deck.	F to E deck.	E to D deck.
A	C	...	...	...	...
B	D	...	...	...	...
C	E	...	...	1	...
D	E	[1]1	...	1	...
E	E	[2]1	...	...	...
F	E	[2]1	...	2	...
G	E	[2]1	...	...	...

H	E	[2]1	...	2	...
J	E	[2]1	...	2	...
K	D	1	...	...	2
L	D	1	...	...	2
M	D	1	...	1	2
N	D	1	1	1	2
O	D	1	...	...	1
P	D	...	...	...	...

The following table shows the actual contents of each separate water-tight compartment. The compartments are shown in the left column, the contents of each compartment being read off horizontally. The contents of each water-tight compartment is separately given in the deck space in which it is:

Water-tight compartment	Length of each water-tight compartment in fore and aft direction.	Hold.	Orlop to G deck.	G to F deck.	F to E deck.	E to D deck.
Bow to A	<i>Feet.</i> 46	Forepeak tank (not used excepting for trimming ship).	Forepeak storeroom.	Forepeak storeroom.	Forepeak storeroom.	Forepeak storeroom.
A-B	45	Cargo.	Cargo.	Living spaces for firemen, etc.	Living spaces for firemen.	Living spaces for firemen.
B-C	51	do	do	Third-class passenger accommodation.	Third-class passenger accommodation.	Third-class passenger and seamen's spaces.
C-D	51	Alternately coal and cargo.	Luggage and mails.	Baggage, squash rackets, & third-class passengers.	do	Third-class passenger accommodation.
D-E	54	No. 6 boiler room.	No. 6 boiler room.	Coal and boiler casing.	do	First-class passenger accommodation.
E-F	57	No. 5 boiler room.	No. 5 boiler room.	Coal bunker and boiler casing and swimming bath.	Linen rooms and swimming bath.	Do.
F-G	57	No. 4 boiler room.	No. 4 boiler room.	Coal bunker and boiler casing.	Steward's, Turkish baths, etc.	First-class and stewards.
G-H	57	No. 3 boiler room.	No. 3 boiler room.	do.	Third-class saloon.	First and second class and stewards.
H-J	60	No. 2 boiler room.	No. 2 boiler room.	do.	do.	First class.
J-K	35	No. 1 boiler room.	No. 1 boiler room.	do.	Third-class galley, stewards, etc.	First class and stewards.
K-L	69	Reciprocating-engine room.	Reciprocating-engine room.	Reciprocating-engine room casing, workshop and engineers' stores.	Engineers' and reciprocating-engine casing.	First class and engineers' mess, etc.
L-M	57	Turbine-engine room.	Turbine-engine room.	Turbine-engine room casing and small stewards' stores.	Second-class and turbine-engine room casing.	Second class and stewards etc.
M-N	63	Electric-engine room.	Provisions and electric engine	Provisions.	Second class	Second and third class.

N-O	54	Tunnel	casing. Refrigerated cargo.	Third class	do	Do.
O-P P to stern	57	do Afterpeak tank for trimming ship.	Cargo Afterpeak tank for trimming ship.	do Stores	Third class Stores	Third class. Stores.

The vessel was constructed under survey of the British Board of Trade for a passenger certificate, and also to comply with the American immigration laws.

Steam was supplied from six entirely independent groups of boilers in six separate water-tight compartments. The after boiler room No. 1 contained five single-ended boilers. Four other boiler rooms, Nos. 2, 3, 4, and 5, each contained five double-ended boilers. The forward boiler room, No. 6, contained four double-ended boilers. The reciprocating engines and most of the auxiliary machinery were in a seventh separate water-tight compartment aft of the boilers; the low-pressure turbine, the main condensers, and the thrust blocks of the reciprocating engine were in an eighth separate water-tight compartment. The main electrical machinery was in a ninth separate water-tight compartment immediately abaft the turbine engine room. Two emergency steam-driven dynamos were placed on the D deck, 21 feet above the level of the load water line. These dynamos were arranged to take their supply of steam from any of the three of the boiler rooms Nos. 2, 3, and 5, and were intended to be available in the event of the main dynamo room being flooded.

The ship was equipped with the following:

- (1) Wireless telegraphy.
- (2) Submarine signaling.
- (3) Electric lights and power systems.
- (4) Telephones for communication between the different working positions in the vessel. In addition to the telephones, the means of communication included engine and docking telegraphs, and duplicate or emergency engine-room telegraph, to be used in the event of any accident to the ordinary telegraph.
- (5) Three electric elevators for taking passengers in the first class up to A deck, immediately below the boat deck, and one in the second class for taking passengers up to the boat deck.
- (6) Four electrically driven boat winches on the boat deck for hauling up the boats.
- (7) Life-saving appliances to the requirements of the board of trade, including boats and life belts.
- (8) Steam whistles on the two foremost funnels, worked on the Willett-Bruce system of automatic control.
- (9) Navigation appliances, including Kelvin's patent sounding machines for finding the depth of water under the ship without stopping; Walker's taffrail log for determining the speed of the ship; and flash signal lamps fitted above the shelters at each of the navigating bridge for Morse signaling with other ships.

DECKS AND ACCOMMODATION.

The boat deck was an uncovered deck, on which the boats were placed. At its lowest point it was about 92 feet 6 inches above the keel. The overall length of this deck was about 500 feet. The forward end of it was fitted to serve as the navigating bridge of the vessel and was 190 feet from the bow. On the after end of the bridge was a wheel house, containing the steering wheel and a steering compass. The chart room was immediately abaft this. On the starboard side of the wheel house and funnel casing were the navigating room, the captain's quarters, and some officers' quarters. On the port side were the remainder of the officers' quarters. At the middle line abaft the forward funnel casing were the wireless-telegraphy rooms and the operators' quarters. The top of the officers' house formed a short deck. The connections from the Marconi aerials were made on this deck, and two of the collapsible boats were placed on it. Aft of the officers' house were the first-class passengers' entrance and stairways and other adjuncts to the passengers' accommodation below. These stairways had a minimum effective width of 8 feet. They had assembling landings at the level of each deck, and three elevators communicating from E to A decks, but not to the boat deck, immediately on the fore side of the stairway.

All the boats except two Engelhardt life rafts were carried on this deck. There were seven lifeboats on each side, 30 feet long, 9 feet wide. There was an emergency cutter, 25 feet long, on each side at the fore end of the deck. Abreast of each cutter was an Engelhardt life raft. One similar raft was carried on the top of the officers' house on each side. In all there were 14 lifeboats, 2 cutters, and 4 Engelhardt life rafts.

The forward group of four boats and one Engelhardt raft were placed on each side of the deck alongside the officers' quarters and the first-class entrance. Further aft at the middle line on this deck was the special platform for the standard compass. At the after end of this deck was an entrance house for second-class passengers with a stairway and elevator leading directly down to F deck. There were two vertical iron ladders at the after end of this deck leading to A deck for the use of the crew. Alongside and immediately forward of the second-class entrance was the after group of lifeboats, four on each side of the ship.

In addition to the main stairways mentioned there was a ladder on each side amidships giving access from the A deck below. At the forward end of the boat deck there was on each side a ladder leading up from A deck with a landing there, from which by a ladder access to B deck could be obtained direct. Between the reciprocating engine casing and the third funnel casing there was a stewards' stairway, which communicated with all the decks below as far as E deck. Outside the deck houses was promenading space for first-class passengers.

A deck.—The next deck below the boat deck was A deck. It extended over a length of about 500 feet. On this deck was a long house extending nearly the whole length of the deck. It was of irregular shape, varying in width from 24 feet to 72 feet. At the forward end it contained 34 staterooms and abaft these a number of public rooms, etc., for first-class passengers, including two first-class entrances and stairway, reading room, lounge, and the smoke room. Outside the deck house was a promenade for first-class passengers. The forward end of it on both sides of the ship, below the forward group of boats and for a short distance farther aft, was protected against the weather by a

steel screen, 192 feet long, with large windows in it. In addition to the stairway described on the boat deck, there was near the after end of the A deck and immediately forward of the first-class smoke room another first-class entrance, giving access as far down as C deck. The second-class stairway at the after end of this deck (already described under the boat deck) had no exit on to the A deck. The stewards' staircase opened onto this deck.

B deck.—The next lowest deck was B deck, which constituted the top deck of the strong structure of the vessel, the decks above and the side plating between them being light plating. This deck extended continuously for 550 feet. There were breaks or wells both forward and aft of it, each about 50 feet long. It was terminated by a poop and forecastle. On this deck were placed the principal staterooms of the vessel, 97 in number, having berths for 198 passengers, and aft of these was the first-class stairway and reception room, as well as the restaurant for first-class passengers and its pantry and galley. Immediately aft of this restaurant were the second-class stairway and smoke room. At the forward end of the deck outside the house was an assembling area, giving access by the ladders, previously mentioned, leading directly to the boat deck. From this same space a ladderway led to the forward third-class promenade on C deck. At the after end of it were two ladders giving access to the after third-class promenade on C deck. At the after end of this deck, at the middle line, was placed another second-class stairway, which gave access to C, D, E, F, and G decks.

At the forward end of the vessel, on the level of the B deck, was situated the forecastle deck, which was 125 feet long. On it were placed the gear for working the anchors and cables and for warping (or moving) the ship in dock. At the after end, on the same level, was the poop deck, about 105 feet long, which carried the after-warping appliances and was a third-class promenading space. Arranged above the poop was a light docking bridge, with telephone, telegraphs, etc., communicating to the main navigating bridge forward.

C deck.—The next lowest deck was C deck. This was the highest deck which extended continuously from bow to stern. At the forward end of it, under the forecastle, was placed the machinery required for working the anchors and cables and for the warping of the ship referred to on B deck above. There were also the crew's galley and the seamen's and firemen's mess-room accommodation, where their meals were taken. At the after end of the forecastle, at each side of the ship, were the entrances to the third-class spaces below. On the port side, at the extreme after end and opening onto the deck, was the lamp room. The break in B deck between the forecastle and the first-class passenger quarters formed a well about 50 feet in length, which enabled the space under it on C deck to be used as a third-class promenade. This space contained two hatchways, the No. 2 hatch, and the bunker hatch. The latter of these hatchways gave access to the space allotted to the first and second class baggage hold, the mails, specie and parcel room, and to the lower hold, which was used for cargo or coals. Aft of this well there was a house 450 feet long and extending for the full breadth of the ship. It contained 148 staterooms for first class, besides service rooms of various kinds. On this deck, at the forward first-class entrance, were the purser's office and the inquiry office, where passengers' telegrams were received for sending by the Marconi apparatus. Exit doors through the ship's side were fitted abreast of this entrance. Aft of the after end of this long house was a promenade at the ship's side for second-class passengers, sheltered by bulwarks and bulkheads. In the middle of the promenade stood the second-class library. The two second-class stairways were at the ends of the library, so that from the promenade access was obtained at each end to a second-class main stairway. There was also access by a door from this space into each of the alleyways in the first-class accommodation on each side of the ship and by two doors at the after end into the after well. This after well was about 50 feet in length and contained two hatchways called No. 5 and No. 6 hatches. Aft of this well, under the poop, was the main third-class entrance for the after end of the vessel leading directly down to G deck, with landings and access at each deck. The effective width of this stairway was 16 feet to E deck. From E to F it was 8 feet wide. Aft of this entrance on B deck were the third-class smoke room and the general room. Between these rooms and the stern was the steam steering gear and the machinery for working the after-capstan gear, which was used for warping the after end of the vessel. The steam steering gear had three cylinders. The engines were in duplicate to provide for the possibility of breakdown of one set.

D deck.—The general height from D deck to C deck was 10 feet 6 inches, this being reduced to 9 feet at the forward end, and 9 feet 6 inches at the after end, the taper being obtained gradually by increasing the sheer of the D deck. The forward end of this deck provided accommodation for 108 firemen, who were in two separate watches. There was the necessary lavatory accommodation, abaft the firemen's quarters at the sides of the ship. On each side of the middle line immediately abaft the firemen's quarters there was a vertical spiral staircase leading to the forward end of a tunnel, immediately above the tank top, which extended from the foot of the staircase to the forward stokehole, so that the firemen could pass direct to their work without going through any passenger accommodation or over any passenger decks. On D deck abaft of this staircase was the third class promenade space which was covered in by C deck. From this promenade space there were 4 separate ladderways with 2 ladders, 4 feet wide to each. One ladderway on each side forward led to C deck, and one, the starboard, led to E deck and continued to F deck as a double ladder and to G deck as a single ladder. The two ladderways at the after end led to E deck on both sides and to F deck on the port side. Aft of this promenade space came a block of 50 first-class staterooms. This surrounded the forward funnel. The main first-class reception room and dining saloon were aft of these rooms and surrounded the No. 2 funnel. The reception room and staircase occupied 83 feet of the length of the ship. The dining saloon occupied 112 feet, and was between the second and third funnels. Aft of this came the first-class pantry, which occupied 56 feet of the length of the ship. The reciprocating engine hatch came up through this pantry.

Aft of the first-class pantry, the galley, which provides for both first and second class passengers, occupied 45 feet of the length of the ship. Aft of this were the turbine engine hatch and the emergency dynamos. Aft of and on the port side of this hatch were the second-class pantry and other spaces used for the saloon service of the passengers. On the starboard side abreast of these there was a series of rooms used for hospitals and their attendants. These spaces occupied about 54 feet of the length. Aft of these was the second-class saloon occupying 70 feet of the length. In the next 88 feet of length there were 38 second-class rooms and the necessary baths and lavatories. From here to the stern was accommodation for third-class passengers and the main third-class lavatories for the passengers in the after end of the ship. The water-tight bulkheads come up to this deck throughout the length from the stern as far forward as the bulkhead dividing the after boiler room from the reciprocating engine room. The water-tight bulkhead of the two compartments abaft the stem was carried up to this deck.

E deck.—The water-tight bulkheads, other than those mentioned as extending to D deck, all stopped at this deck. At the forward end was provided accommodation for three watches of trimmers, in three separate

compartments, each holding 24 trimmers. Aft of this, on the port side, was accommodation for 44 seamen. Aft of this, and also on the starboard side of it, were the lavatories for crew and third-class passengers; further aft again came the forward third-class lavatories. Immediately aft of this was a passageway right across the ship communicating directly with the ladderways leading to the decks above and below and gangway doors in the ship's side. This passage was 9 feet wide at the sides and 15 feet at the center of the ship.

From the after end of this cross passage main alleyways on each side of the ship ran right through to the after end of the vessel. That on the port side was about 8-1/2 feet wide. It was the general communication passage for the crew and third-class passengers and was known as the working passage. In this passage at the center line in the middle of the length of the ship direct access was obtained to the third-class dining rooms on the deck below by means of a ladderway 20 feet wide. Between the working passage and the ship's side was the accommodation for the petty officers, most of the stewards, and the engineers' mess room. This accommodation extended for 475 feet. From this passage access was obtained to both engine rooms and the engineers' accommodation, some third-class lavatories and also some third-class accommodation at the after end. There was another cross passage at the end of this accommodation about 9 feet wide, terminating in gangway doors on each side of the ship. The port side of it was for third-class passengers and the starboard for second class. A door divided the parts, but it could be opened for any useful purpose, or for an emergency. The second-class stairway leading to the boat deck was in the cross passageway.

The passage on the starboard side ran through the first and then the second-class accommodation, and the forward main first-class stairway and elevators extended to this deck, whilst both the second-class main stairways were also in communication with this starboard passage. There were 4 first-class, 8 first or second alternatively, and 19 second-class rooms leading off this starboard passage.

The remainder of the deck was appropriated to third-class accommodation. This contained the bulk of the third-class accommodation. At the forward end of it was the accommodation for 53 firemen constituting the third watch. Aft of this in three water-tight compartments there was third-class accommodation extending to 147 feet. In the next water-tight compartment were the swimming bath and linen rooms. In the next water-tight compartments were stewards' accommodation on the port side, and the Turkish baths on the starboard side. The next two water-tight compartments each contained a third-class dining room.

The third-class stewards' accommodation, together with the third-class galley and pantries, filled the water-tight compartment. The engineers' accommodation was in the next compartment directly alongside the casing of the reciprocating engine room. The next 3 compartments were allotted to 64 second-class staterooms. These communicated direct with the second-class main stairways. The after compartments contained third-class accommodation. All spaces on this deck had direct ladderway communication with the deck above, so that if it became necessary to close the water-tight doors in the bulkheads an escape was available in all cases. On this deck in the way of the boiler rooms were placed the electrically driven fans which provided ventilation to the stokeholes.

G deck.—The forward end of this deck had accommodation for 15 leading firemen and 30 greasers. The next water-tight compartment contained third-class accommodation in 26 rooms for 106 people. The next water-tight compartment contained the first-class baggage room, the post-office accommodation, a racquet court, and 7 third-class rooms for 34 passengers. From this point to the after end of the boiler room the space was used for the 'tween deck bunkers. Alongside the reciprocating engine room were the engineers' stores and workshop. Abreast of the turbine engine room were some of the ship's stores. In the next water-tight compartment abaft the turbine room were the main body of the stores. The next two compartments were appropriated to 186 third-class passengers in 60 rooms; this deck was the lowest on which any passengers or crew were carried.

Below G deck were two partial decks, the orlop and lower orlop decks, the latter extending only through the fore peak and No. 1 hold; on the former deck, abaft the turbine engine room, were some storerooms containing stores for ship's use.

Below these decks again came the inner bottom, extending fore-and-aft through about nine-tenths of the vessel's length, and on this were placed the boilers, main and auxiliary machinery, and the electric-light machines. In the remaining spaces below G deck were cargo holds or 'tween decks, seven in all, six forward and one aft. The firemen's passage, giving direct access from their accommodation to the forward boiler room by stairs at the forward end, contained the various pipes and valves connected with the pumping arrangements at the forward end of the ship, and also the steam pipes conveying steam to the windlass gear forward and exhaust steam pipes leading from winches and other deck machinery. It was made thoroughly water-tight throughout its length, and at its after end was closed by a water-tight vertical sliding door of the same character as other doors on the inner bottom. Special arrangements were made for pumping this space out, if necessary. The pipes were placed in this tunnel to protect them from possible damage by coal or cargo, and also to facilitate access to them.

On the decks was provided generally, in the manner above described, accommodation for a maximum number of 1,034 first-class passengers, and at the same time 510 second-class passengers and 1,022 third-class passengers. Some of the accommodation was of an alternative character and could be used for either of two classes of passengers. In the statement of figures the higher alternative class has been reckoned. This makes a total accommodation for 2,566 passengers.

Accommodation was provided for the crew as follows: About 75 of the deck department, including officers and doctors, 326 of the engine-room department, including engineers, and 544 of the victualing department, including pursers and leading stewards.

Access of passengers to the boat deck.—The following routes led directly from the various parts of the first-class passenger accommodation to the boat deck: From the forward ends of A, B, C, D, and E decks by the staircase in the forward first-class entrance direct to the boat deck. The elevators led from the same decks as far as A deck, where further access was obtained by going up the top flight of the main staircase.

The same route was available for first-class passengers forward of midships on B, C, and E decks.

First-class passengers abaft midships on B and C decks could use the staircase in the after main entrance to A deck, and then could pass out onto the deck and by the midships stairs beside the house ascend to the boat deck. They could also use the stewards' staircase between the reciprocating-engine casing and Nos. 1 and 2 boiler casing, which led direct to the boat deck. This last route was also available for passengers on E deck in the same divisions who could use the forward first-class main stairway and elevators.

Second-class passengers on D deck could use their own after stairway to B deck and could then pass up their forward stairway to the boat deck, or else could cross their saloon and use the same stairway throughout.

Of the second-class passengers on E deck, those abreast of the reciprocating-engine casing, unless the water-tight door immediately abaft of them was closed, went aft and joined the other second-class passengers. If, however, the water-tight door at the end of their compartment was closed, they passed through an emergency door into the engine room and directly up to the boat deck by the ladders and gratings in the engine-room casing.

The second-class passengers on E deck in the compartment abreast the turbine casing on the starboard side, and also those on F deck on both sides below could pass through M water-tight bulkhead to the forward second-class main stairway. If this door were closed, they could pass by the stairway up to the serving space at the forward end of the second-class saloon and go into the saloon and thence up the forward second-class stairway.

Passengers between M and N bulkheads on both E and F decks could pass directly up to the forward second-class stairway to the boat deck.

Passengers between N and O bulkheads on D, E, F, and G decks could pass by the after second-class stairway to B deck and then cross to the forward second-class stairway and go up to the boat deck.

Third-class passengers at the fore end of the vessel could pass by the staircases to C deck in the forward well and by ladders on the port and starboard sides at the forward end of the deck houses, thence direct to the boat deck outside the officers' accommodation. They might also pass along the working passage on E deck and through the emergency door to the forward first-class main stairway, or through the door on the same deck at the forward end of the first-class alleyway and up the first-class stairway direct to the boat deck.

The third-class passengers at the after end of the ship passed up their stairway to E deck and into the working passage and through the emergency doors to the two second-class stairways and so to the boat deck, like second-class passengers. Or, alternatively, they could continue up their own stairs and entrance to C deck, thence by the two ladders at the after end of the bridge onto the B deck and thence by the forward second-class stairway direct to the boat deck.

Crew.—From each boiler room an escape or emergency ladder was provided direct to the boat deck by the fidleys, in the boiler casings, and also into the working passage on E deck, and thence by the stair immediately forward of the reciprocating-engine casing, direct to the boat deck.

From both the engine rooms ladders and gratings gave direct access to the boat deck.

From the electric engine room, the after tunnels, and the forward pipe tunnels escapes were provided direct to the working passage on E deck and thence by one of the several routes already detailed from that space.

From the crew's quarters they could go forward by their own staircases into the forward well and thence, like the third-class passengers, to the boat deck.

The stewards' accommodation being all connected to the working passage or the forward main first-class stairway, they could use one of the routes from thence.

The engineers' accommodation also communicated with the working passage, but as it was possible for them to be shut between two water-tight bulkheads, they had also a direct route by the gratings in the engine-room casing to the boat deck.

On all the principal accommodation decks the alleyways and stairways provided a ready means of access to the boat deck, and there were clear deck spaces in way of all first, second, and third class main entrances and stairways on boat deck and all decks below.

STRUCTURE.

The vessel was built throughout of steel and had a cellular double bottom of the usual type, with a floor at every frame, its depth at the center line being 63 inches, except in way of the reciprocating machinery, where it was 78 inches. For about half of the length of the vessel this double bottom extended up the ship's side to a height of 7 feet above the keel. Forward and aft of the machinery space the protection of the inner bottom extended to a less height above the keel. It was so divided that there were four separate water-tight compartments in the breadth of the vessel. Before and abaft the machinery space there was a water-tight division at the center line only, except in the foremost and aftermost tanks. Above the double bottom the vessel was constructed of the usual transverse frame system, reenforced by web frames, which extended to the highest decks.

At the forward end the framing and plating was strengthened with a view to preventing panting and damage when meeting thin harbor ice.

Beams were fitted on every frame at all decks from the boat deck downward. An external bilge keel about 300 feet long and 25 inches deep was fitted along the bilge amidships.

The heavy ship's plating was carried right up to the boat deck, and between the C and B decks was doubled. The stringer or edge plate of the B deck was also doubled. This double plating was hydraulic riveted.

All decks were steel plated throughout.

The transverse strength of the ship was in part dependent on the 15 transverse water-tight bulkheads, which were specially stiffened and strengthened to enable them to stand the necessary pressure in the event of accident, and they were connected by double angles to decks, inner bottom, and shell plating.

The two decks above the B deck were of comparatively light scantling, but strong enough to insure their proving satisfactory in these positions in rough weather.

Water-tight subdivision.—In the preparation of the design of this vessel it was arranged that the bulkheads and divisions should be so placed that the ship would remain afloat in the event of any two adjoining compartments being flooded and that they should be so built and strengthened that the ship would remain afloat under this condition. The minimum freeboard that the vessel would have in the event of any two compartments being flooded was between 2 feet 6 inches and 3 feet from the deck adjoining the top of the water-tight bulkheads. With this object in view, 15 water-tight bulkheads were arranged in the vessel. The lower part of C bulkhead was doubled and was in the form of a cofferdam. So far as possible the bulkheads were carried up in one plane to their upper sides, but in cases where they had for any reason to be stepped forward or aft, the deck, in way of the step, was made into a water-tight flat,

thus completing the water-tightness of the compartment. In addition to this, G deck in the after peak was made a water-tight flat. The orlop deck between bulkheads which formed the top of the tunnel was also water-tight. The orlop deck in the forepeak tank was also a water-tight flat. The electric-machinery compartment was further protected by a structure some distance in from the ship's side, forming six separate water-tight compartments, which were used for the storage of fresh water.

Where openings were required for the working of the ship in these water-tight bulkheads they were closed by water-tight sliding doors which could be worked from a position above the top of the water-tight bulkhead, and those doors immediately above the inner bottom were of a special automatic closing pattern, as described below. By this subdivision there were in all 73 compartments, 29 of these being above the inner bottom.

Water-tight doors.—The doors (12 in number) immediately above the inner bottom were in the engine and boiler room spaces. They were of Messrs. Harland & Wolff's latest type, working vertically. The doorplate was of cast iron of heavy section, strongly ribbed. It closed by gravity, and was held in the open position by a clutch which could be released by means of a powerful electromagnet controlled from the captain's bridge. In the event of accident, or at any time when it might be considered desirable, the captain or officer on duty could, by simply moving an electric switch, immediately close all these doors. The time required for the doors to close was between 25 and 30 seconds. Each door could also be closed from below by operating a hand lever fitted alongside the door. As a further precaution floats were provided beneath the floor level, which, in the event of water accidentally entering any of the compartments, automatically lifted and thus released the clutches, thereby permitting the doors in that particular compartment to close if they had not already been dropped by any other means. These doors were fitted with cataracts, which controlled the speed of closing. Due notice of closing from the bridge was given by a warning bell.

A ladder or escape was provided in each boiler room, engine room, and similar water-tight compartment, in order that the closing of the doors at any time should not imprison the men working therein.

The water-tight doors on E deck were of horizontal pattern, with wrought-steel doorplates. Those on F deck and the one aft on the Orlop deck were of similar type, but had cast-iron doorplates of heavy section, strongly ribbed. Each of the between-deck doors, and each of the vertical doors on the tank top level could be operated by the ordinary hand gear from the deck above the top of the water-tight bulkhead, and from a position on the next deck above, almost directly above the door. To facilitate the quick closing of the doors, plates were affixed in suitable positions on the sides of the alleyways, indicating the positions of the deck plates, and a box spanner was provided for each door, hanging in suitable clips alongside the deck plate.

Ship's side doors.—Large side doors were provided through the side plating, giving access to passengers' or crew's accommodation as follows:

On the saloon (D) deck on the starboard side in the forward third-class open space, one baggage door.

In way of the forward first-class entrance, two doors close together on each side.

On the upper (E) deck, one door each side at the forward end of the working passage.

On the port side abreast the engine room, one door leading into the working passage. One door each side on the port and starboard sides aft into the forward second-class entrance.

All the doors on the upper deck were secured by lever handles, and were made water-tight by means of rubber strips. Those on the saloon deck were closed by lever handles, but had no rubber.

Accommodation ladder.—One teak accommodation ladder was provided, and could be worked on either side of the ship in the gangway door opposite the second-class entrance on the upper deck (E). It had a folding platform and portable stanchions, hand rope, etc. The ladder extended to within 3 feet 6 inches of the vessel's light draft, and was stowed overhead in the entrance abreast the forward second-class main staircase. Its lower end was arranged so as to be raised and lowered from a davit immediately above.

Masts and rigging.—The vessel was rigged with two masts and fore and aft sails. The two pole masts were constructed of steel, and stiffened with angle irons. The poles at the top of the mast were made of teak.

A lookout cage, constructed of steel, was fitted on the foremast at a height of about 95 feet above the water line. Access to the cage was obtained by an iron vertical ladder inside of the foremast, with an opening at C deck and one at the lookout cage. An iron ladder was fitted on the foremast from the hounds to the masthead light.

LIFE-SAVING APPLIANCES.

Life buoys.—Forty-eight, with beackets, were supplied, of pattern approved by the board of trade. They were placed about the ship.

Life belts.—Three thousand five hundred and sixty life belts, of the latest improved overhead pattern, approved by the board of trade, were supplied and placed on board the vessel and there inspected by the board of trade. These were distributed throughout all the sleeping accommodation.

Lifeboats.—Twenty boats in all were fitted on the vessel, and were of the following dimensions and capacities:

Fourteen wood lifeboats, each 30 feet long by 9 feet 1 inch broad by 4 feet deep, with a cubic capacity of 655.2 cubic feet, constructed to carry 65 persons each.

Emergency boats:

One wood cutter, 25 feet 2 inches long by 7 feet 2 inches broad by 3 feet deep, with a cubic capacity of 326.6 cubic feet, constructed to carry 40 persons.

One wood cutter, 25 feet 2 inches long by 7 feet 1 inch broad by 3 feet deep, with a cubic capacity of 322.1 cubic feet, constructed to carry 40 persons.

Four Engelhardt collapsible boats, 27 feet 5 inches long by 8 feet broad by 3 feet deep, with a cubic capacity of 376.6 cubic feet, constructed to carry 47 persons each.

Or a total of 11,327.9 cubic feet for 1,178 persons.

The lifeboats and cutters were constructed as follows:

The keels were of elm. The stems and stern posts were of oak. They were all clinker built of yellow pine, double

fastened with copper nails, clinched over rooves. The timbers were of elm, spaced about 9 inches apart, and the seats pitch pine, secured with galvanized-iron double knees. The buoyancy tanks in the lifeboats were of 18 ounce copper, and of capacity to meet the board of trade requirements.

The lifeboats were fitted with Murray's disengaging gear, with arrangements for simultaneously freeing both ends if required. The gear was fastened at a suitable distance from the forward and after ends of the boats, to suit the davits. Life lines were fitted round the gunwales of the lifeboats. The davit blocks were treble for the lifeboats and double for the cutters. They were of elm, with lignum vitæ roller sheaves, and were bound inside with iron, and had swivel eyes. There were manila rope falls of sufficient length for lowering the boats to the vessel's light draft, and when the boats were lowered, to be able to reach the boat winches on the boat deck.

The lifeboats were stowed on hinged wood chocks on the boat deck, by groups of three at the forward and four at the after ends. On each side of the boat deck the cutters were arranged forward of the group of three and fitted to lash outboard as emergency boats. They were immediately abaft the navigating bridge.

The Engelhardt collapsible lifeboats were stowed abreast of the cutters, one on each side of the ship, and the remaining two on top of the officers' house, immediately abaft the navigating bridge.

The boat equipment was in accordance with the board of trade requirements. Sails for each lifeboat and cutter were supplied and stowed in painted bags. Covers were supplied for the lifeboats and cutters, and a sea anchor for each boat. Every lifeboat was furnished with a special spirit boat compass and fitting for holding it; these compasses were carried in a locker on the boat deck. A provision tank and water beaker were supplied to each boat.

Compasses.—Compasses were supplied as follows:

One Kelvin standard compass, with azimuth mirror on compass platform.

One Kelvin steering compass inside of wheelhouse.

One Kelvin steering compass on captain's bridge.

One light card compass for docking bridge.

Fourteen spirit compasses for lifeboats.

All the ships' compasses were lighted with oil and electric lamps. They were adjusted by Messrs. C. J. Smith, of Southampton, on the passage from Belfast to Southampton and Southampton to Queenstown.

Charts.—All the necessary charts were supplied.

Distress signals.—These were supplied of number and pattern approved by Board of Trade—i. e., 36 socket signals in lieu of guns, 12 ordinary rockets, 2 Manwell Holmes deck flares, 12 blue lights, and 6 lifebuoy lights.

PUMPING ARRANGEMENTS.

The general arrangement of piping was designed so that it was possible to pump from any flooded compartment by two independent systems of 10-inch mains having cross connections between them. These were controlled from above by rods and wheels led to the level of the bulkhead deck. By these it was possible to isolate any flooded space, together with any suction in it. If any of these should happen accidentally to be left open, and consequently out of reach, it could be shut off from the main by the wheel on the bulkhead deck. This arrangement was specially submitted to the Board of Trade and approved by them.

The double bottom of the vessel was divided by 17 transverse water-tight divisions, including those bounding the fore and aft peaks, and again subdivided by a center fore-and-aft bulkhead, and two longitudinal bulkheads, into 46 compartments. Fourteen of these compartments had 8-inch suction, 23 had 6-inch suction, and 3 had 5-inch suction connected to the 10-inch ballast main suction; 6 compartments were used exclusively for fresh water.

The following bilge suction was provided for dealing with water above the double bottom, viz, in No. 1 hold two 3-1/2-inch suction, No. 2 hold two 3-1/2-inch and 2 3-inch suction, bunker hold, two 3-1/2-inch and two 3-inch suction.

The valves in connection with the forward bilge and ballast suction were placed in the firemen's passage, the water-tight pipe tunnel extending from No. 6 boiler room to the after end of No. 1 hold. In this tunnel, in addition to two 3-inch bilge suction, one at each end, there was a special 3-1/2-inch suction with valve rod led up to the lower deck above the load line, so as always to have been accessible should the tunnel be flooded accidentally.

In No. 6 boiler room there were three 3-1/2-inch, one 4-1/2-inch, and two 3-inch suction.

In No. 5 boiler room there were three 3-1/2-inch, one 5-inch, and two 3-inch suction.

In No. 4 boiler room there were three 3-1/2-inch, one 4-1/2-inch, and two 3-inch suction.

In No. 3 boiler room there were three 3-1/2-inch, one 5-inch, and two 3-inch suction.

In No. 2 boiler room there were three 3-1/2-inch, one 5-inch, and two 3-inch suction.

In No. 1 boiler room there were two 3-1/2-inch, one 5-inch, and two 3-inch suction.

In the reciprocating engine room there were two 3-1/2-inch, six 3-inch, two 18-inch, and two 5-inch suction.

In the turbine engine room there were two 3-1/2-inch, three 3-inch, two 18-inch, two 5-inch, and one 4-inch suction.

In the electric engine room there were four 3-1/2-inch suction.

In the storerooms above the electric engine room there was one 3-inch suction.

In the forward tunnel compartment there were two 3-1/2-inch suction.

In the water-tight flat over the tunnel compartment there were two 3-inch suction.

In the tunnel after compartment there were two 3-1/2-inch suction.

In the water-tight flat over the tunnel after compartment there were two 3-inch suction.

ELECTRICAL INSTALLATION.

Main generating sets.—There were four engines and dynamos, each having a capacity of 400 kilowatts at 100 volts and consisting of a vertical three-crank compound-forced lubrication inclosed engine of sufficient power to drive the electrical plant.

The engines were direct-coupled to their respective dynamos.

These four main sets were situated in a separate water-tight compartment about 63 feet long by 24 feet high, adjoining the after end of the turbine room at the level of the inner bottom.

Steam to the electric engines was supplied from two separate lengths of steam pipes, connecting on the port side to the five single-ended boilers in compartment No. 1 and two in compartment No. 2, and on the starboard side to the auxiliary steam pipe which derived steam from the five single-ended boilers in No. 1 compartment, two in No. 2, and two in No. 4. By connections at the engine room forward bulkhead steam could be taken from any boiler in the ship.

Auxiliary generating sets.—In addition to the four main generating sets, there were two 30-kilowatt engines and dynamos situated on a platform in the turbine engine room casing on saloon deck level, 20 feet above the water line. They were the same general type as the main sets.

These auxiliary emergency sets were connected to the boilers by means of a separate steam pipe running along the working passage above E deck, with branches from three boiler rooms, Nos. 2, 3, and 5, so that should the main sets be temporarily out of action the auxiliary sets could provide current for such lights and power appliances as would be required in the event of emergency.

Electric lighting.—The total number of incandescent lights was 10,000, ranging from 16 to 100 candlepower, the majority being of Tantallum type, except in the cargo spaces and for the portable fittings, where carbon lamps were provided. Special dimming lamps of small amount of light were provided in the first-class rooms.

Electric heating and power and mechanical ventilation.—Altogether 562 electric heaters and 153 electric motors were installed throughout the vessel, including six 50-hundredweight and two 30-hundredweight cranes, four 3-ton cargo winches, and four 15-hundredweight boat winches.

There were also four electric passenger lifts, three forward of the first-class main entrance and one in the second-class forward entrance, each to carry 12 persons.

Telephones.—Loud speaking telephones of navy pattern were fitted for communication between the following:

Wheelhouse on the navigating bridge and the forecastle.

Wheelhouse on the navigating bridge and the lookout station on the crow's nest.

Wheelhouse on the navigating bridge and the engine room.

Wheelhouse on the navigating bridge and the poop.

Chief engineer's cabin and the engine room.

Engine room and Nos. 1, 2, 3, 4, 5, and 6 stokeholds.

These were operated both from the ship's lighting circuit, through a motor generator, and alternatively by a stand-by battery, which by means of an automatic switch could be introduced in the circuit should the main supply fail.

There was also a separate telephone system for intercommunication between a number of the chief officials and service rooms, through a 50-line exchange switchboard.

A number of the pantries and galleys were also in direct telephonic communication.

Wireless telegraphy.—The wireless telegraphy system was worked by a Marconi 5-kilowatt motor generator. The house for the Marconi instruments was situated on the boat deck close to the bridge. There were four parallel aerial wires extended between the masts, fastened to light booms; from the aerials the connecting wires were led to the instruments in the house. There were two complete sets of apparatus, one for the transmitting and one for receiving messages, the former being placed in a sound-proof chamber in one corner of the wireless house.

There was also an independent storage battery and coil, in event of the failure of the current supply, which came from the ship's dynamos.

Submarine signaling.—The Submarine Signal Co.'s apparatus was provided for receiving signals from the submarine bells. Small tanks containing the microphones were placed on the inside of the hull of the vessel on the port and starboard sides below the water level, and were connected by wires to receivers situated in the navigating room on the port side of the officer's deck house.

Various.—The whistles were electrically actuated on the Willett Bruce system. The boiler-room telegraphs, stoking indicators, rudder indicators, clocks and thermostats were also electrical. The water-tight doors were released by electric magnets.

Emergency circuit.—A separate and distinct installation was fitted in all parts of the vessel, deriving current from the two 30-kilowatt sets above mentioned, so that in the event of the current from the main dynamos being unavailable an independent supply was obtainable. Connected to the emergency circuit were above 500 incandescent lamps fitted throughout all passenger, crew, and machinery compartments, at the end of passages, and near stairways, also on the boat deck, to enable anyone to find their way from one part of the ship to the other.

The following were also connected to the emergency circuit by means of change-over switches: Five arc lamps, seven cargo and gangway lanterns, Marconi apparatus, mast, side, and stern lights, and all lights on bridge, including those for captain's, navigating, and chart rooms, wheelhouse, telegraphs and Morse signaling lanterns, and four electrically-driven boat winches. These latter, situated on the boat deck, were each capable of lifting a load of 15 hundredweight at a speed of 100 feet per minute.

Ventilating.—There were 12 electrically-driven fans for supplying air to the stokeholds, 6 electrically-driven fans for engine and turbine room ventilation. There were fans for engine and boiler rooms.

MACHINERY.

Description.—The propelling machinery was of the combination type, having two sets of reciprocating engines driving the wing propellers and a low-pressure turbine working the center propeller. Steam was supplied by 24 double-ended boilers and 5 single-ended boilers, arranged for a working pressure of 215 pounds per square inch. The turbine was placed in a separate compartment aft of the reciprocating-engine room and divided from it by a water-tight bulkhead. The main condensers, with their circulating pumps and air pumps, were placed in the turbine room. The boilers were arranged in six water-tight compartments, the single-ended boilers being placed in the one

nearest the main engines, the whole being built under board of trade survey for passenger certificate.

Reciprocating engines.—The reciprocating engines were of the four-crank triple-expansion type. Each set had four inverted, direct-acting cylinders, the high-pressure having a diameter of 54 inches, the intermediate pressure of 84 inches, and each of the two low-pressure cylinders of 97 inches, all with a stroke of 6 feet 3 inches. The valves of the high-pressure and intermediate cylinders were of the piston type, and the low-pressure cylinder had double-ported slide valves, fitted with Stephenson link motion. Each engine was reversed by a Brown type of direct-acting steam and hydraulic engine. There was also a separate steam-driven high-pressure pump fitted for operating either or both of the reversing engines. This alternative arrangement was a stand-by in case of breakdown of the steam pipes to these engines.

Turbine.—The low-pressure turbine was of the Parsons reaction type, direct coupled to the center line of shafting and arranged for driving in the ahead direction only. It exhausted to the two condensers, placed one on each side of it. A shut-off valve was fitted in each of the eduction pipes leading to the condensers. An emergency governor was fitted and arranged to shut off steam to the turbine and simultaneously change over the exhaust from the reciprocating engines to the condensers, should the speed of the turbine become excessive through the breaking of a shaft or other accident.

Boilers.—All the boilers were 15 feet 9 inches in diameter, the 24 double-ended boilers being 20 feet long, and the single-ended 11 feet 9 inches long. Each double-ended boiler had six and each single-ended boiler three furnaces, with a total heating surface of 144,142 square feet and a grate surface of 3,466 square feet. The boilers were constructed in accordance with the rules of the board of trade for a working pressure of 215 pounds per square inch. They were arranged for working under natural draft, assisted by fans, which blew air into the open stokehold.

Auxiliary steam pipes.—The five single-ended boilers and those in boiler rooms Nos. 2 and 4 had separate steam connections to the pipe supplying steam for working the auxiliary machinery, and the five single-ended boilers and the two port boilers in boiler room No. 2 had separate steam connections to the pipe supplying steam for working the electric-light engines. A cross connection was also made between the main and auxiliary pipes in the reciprocating-engine room, so that the auxiliaries could be worked from any boiler in the ship. Steam pipes also were led separately from three of the boiler rooms (Nos. 2, 3, 5) above the water-tight bulkheads and along the working passage to the emergency electric-light engines placed above the load line in the turbine room. Pipes were also led from this steam supply to the pumps in the engine room, which were connected to the bilges throughout the ship.

Main steam pipes.—There were two main lines of steam pipes led to the engine room, with shut-off valves at three of the bulkheads. Besides the shut-off valves at the engine-room bulkhead, a quick-acting emergency valve was fitted on each main steam pipe, so that the steam could at once be shut off in case of rupture of the main pipe.

Condensing plant and pumps.—There were two main condensers, having a combined cooling surface of 50,550 square feet, designed to work under a vacuum of 28 inches with cooling water at 60° F. The condensers were pear shaped in section, and built of mild steel plates.

Four gun-metal centrifugal pumps were fitted for circulating water through the condensers. Each pump had suction and discharge pipes of 29-inch bore, and was driven by a compound engine. Besides the main sea suction, two of the pumps had direct bilge suction from the turbine room and the other two from the reciprocating-engine room. The bilge suction were 18 inches diameter. Four of Weir's "Dual" air pumps were fitted, two to each condenser, and discharged to two feed tanks placed in the turbine engine room.

Bilge and ballast pumps.—The ship was also fitted with the following pumps: Five ballast and bilge pumps, each capable of discharging 250 tons of water per hour; three bilge pumps, each of 150 tons per hour capacity.

One ash ejector was placed in each of the large boiler compartments to work the ash ejectors, and to circulate or feed the boilers as required. This pump was also connected to the bilges, except in the case of three of the boiler rooms, where three of the ballast and bilge pumps were placed. The pumps in each case had direct bilge suction as well as a connection to the main bilge pipe, so that each boiler room might be independent. The remainder of the auxiliary pumps were placed in the reciprocating and turbine engine rooms. Two ballast pumps were placed in the reciprocating-engine room, with large suction from the bilges direct and from the bilge main. Two bilge pumps were also arranged to draw from bilges. One bilge pump was placed in the turbine room and one of the hot salt-water pumps had a connection from the bilge main pipe for use in emergency. A 10-inch main ballast pipe was carried fore and aft through the ship with separate connections to each tank, and with filling pipes from the sea connected at intervals for trimming purposes. The five ballast pumps were arranged to draw from this pipe. A double line of bilge main pipe was fitted forward of No. 5 boiler room and aft of No. 1.

GENERAL.

There were four elliptical-shaped funnels; the three forward ones took the waste gases from the boiler furnaces, and the after one was placed over the turbine hatch and was used as a ventilator. The galley funnels were led up this funnel. The uptakes by which the waste gases were conveyed to the funnels were united immediately above the water-tight bulkhead which separated the boiler rooms.

All overhead discharge from the circulating pumps, ballast pumps, bilge pumps, etc., were below the deep load line, but above the light line.

The boilers were supported in built steel cradles, and were stayed to the ship's side and to each other athwart ships by strong steel stays. Built steel chocks were also fitted to prevent movement fore and aft.

Silent blow-offs from the main steam pipes were connected direct to both condensers.

CREW AND PASSENGERS.

When the *Titanic* left Queenstown on April 11 the total number of persons employed on board in any capacity was 885.

The respective ratings of these persons were as follows:

Deck department	66
Engine department	325

Eight bandsmen were included in the second-class passenger list.

In the deck department the master, Edward Charles Smith, held an extra master's certificate; Chief Officer H. F. Wilde held an ordinary master's certificate; First Officer W. M. Murdock held an ordinary master's certificate; Second Officer C. H. Lightoller held an extra master's certificate; Third Officer H. J. Pitman held an ordinary master's certificate; Fourth Officer J. G. Boxall held an extra master's certificate; Fifth Officer H. G. Lowe held an ordinary master's certificate; Sixth Officer J. P. Moody held an ordinary master's certificate.

In the engine department were included the chief engineer and 7 senior and 17 assistant engineers.

In the victualing department there were 23 women employed.

The total number of passengers on board was 1,316.

	Male.	Female.	Total.
Of these—			
First class	180	145	325
Second class	179	106	285
Third class	510	196	706
			1,316

Of the above 6 children were in the first class; 24 children were in the second class; 79 children were in the third class; or 109 in all.

About 410 of the third-class passengers were foreigners, and these, with the foreigners in the first and second class and in the victualing department, would make a total of nearly 500 persons on board who were presumably not English speaking, so far as it is possible to ascertain. The disposition of the different classes of passengers and of the crew in the ship has already been described (pp. 10-15). In all, 2,201 persons were on board.

II. ACCOUNT OF THE SHIP'S JOURNEY ACROSS THE ATLANTIC, THE MESSAGES SHE RECEIVED, AND THE DISASTER.

THE SAILING ORDER.

The masters of vessels belonging to the White Star Line are not given any special "sailing orders" before the commencement of any particular voyage. It is understood, however, that the "tracks" or "lane routes" proper to the particular time of the year, and agreed upon by the great steamship companies, are to be generally adhered to. Should any master see fit during this passage to deviate from his route he has to report on and explain this deviation at the end of his voyage. When such deviation has been in the interests of safety, and not merely to shorten his passage, his action has always been approved of by the company.

A book of general ship's rules and uniform regulations is also issued by the company as a guide; there are in this book no special instructions in regard to ice, but there is a general instruction that the safety of the lives of the passengers and ship are to be the first consideration.

Besides the book of ship's rules, every master when first appointed to command a ship is addressed by special letter from the company, of which the following passage is an extract:

You are to dismiss all idea of competitive passages with other vessels and to concentrate your attention upon a cautious, prudent, and ever-watchful system of navigation, which shall lose time or suffer any other temporary inconvenience rather than incur the slightest risk which can be avoided.

Mr. Sanderson, one of the directors, in his evidence says with reference to the above letter:

We never fail to tell them in handing them these letters that we do not wish them to take it as a mere matter of form; that we wish them to read these letters, and to write an acknowledgment to us that they have read them, and that they will be influenced by what we have said in those letters.

THE ROUTE FOLLOWED.

The *Titanic* left Southampton on Wednesday, April 10, and after calling at Cherbourg, proceeded to Queenstown, from which port she sailed on the afternoon of Thursday, April 11, following what was at that time the accepted outward-bound route for mail steamers from the Fastnet Light, off the southwest coast of Ireland, to the Nantucket Shoal light vessel, off the coast of the United States. It is desirable here to explain that it has been, since 1899, the practice, by common agreement between the great North Atlantic steamship companies, to follow lane routes, to be used by their ships at the different seasons of the year. Speaking generally, it may be said that the selection of these routes has hitherto been based on the importance of avoiding as much as possible the areas where fog and ice are prevalent at certain seasons, without thereby unduly lengthening the passage across the Atlantic, and also with the view of keeping the tracks of "outward" and "homeward" bound mail steamers well clear of one another. A further advantage is that, in case of a breakdown, vessels are likely to receive timely assistance from other vessels following the same route. The decisions arrived at by the steamship companies referred to above have, from time to time, been communicated to the Hydrographic Office, and the routes have there been marked on the North Atlantic route charts printed and published by the Admiralty; and they have also been embodied in the sailing directions.

Before the *Titanic* disaster the accepted mail steamers outward track between January 15 and August 14 followed the arc of a great circle between the Fastnet Light and a point in latitude 42° N. and 47° W. (sometimes

termed the "turning point"), and from thence by Rhumb Line so as to pass just south of the Nantucket Shoal light vessel, and from this point on to New York. This track, usually called the outward southern track, was that followed by the *Titanic* on her journey.

An examination of the North Atlantic route chart shows that this track passes about 25 miles south (that is outside) of the edge of the area marked "field ice between March and July," but from 100 to 300 miles to the northward (that is inside) of the dotted line on the chart marked, "Icebergs have been seen within this line in April, May, and June."

That is to say, assuming the areas indicated to be based on the experience of many years, this track might be taken as passing clear of field ice under the usual conditions of that time of year, but well inside the area in which icebergs might be seen.

It is instructive here to remark that had the "turning point" been in longitude 45° W. and latitude 38° N., that is some 240 miles to the south-eastward, the total distance of the passage would only have been increased by about 220 miles, or some 10 hours' steaming for a 22-knot ship. This is the route which was provisionally decided on by the great trans-Atlantic companies subsequent to the *Titanic* disaster.

It must not be supposed that the lane routes referred to had never been changed before. Owing to the presence of ice in 1903, 1904, and 1905 from about early in April to mid-June or early in July, westward-bound vessels crossed the meridian of 47° W. in latitude 41° N., that is 60 miles further south than the then accepted track.

The publications known as "Sailing Directions," compiled by the hydrographic office at the Admiralty, indicate the caution which it is necessary to use in regions where ice is likely to be found.

The following is an extract from one of these books, named "United States Pilot (East Coast)," Part I (second edition, 1909, p. 34), referring to the ocean passages of the large trans-Atlantic mail and passenger steamers:

To these vessels one of the chief dangers in crossing the Atlantic lies in the probability of encountering masses of ice, both in the form of bergs and of extensive fields of solid compact ice, released at the breaking up of winter in the Arctic regions, and drifted down by the Labrador current across their direct route. Ice is more likely to be encountered in this route between April and August, both months inclusive, than at other times, although icebergs have been seen at all seasons northward of the parallel of 43° N., but not often so far south after August.

These icebergs are sometimes over 200 feet in height and of considerable extent. They have been seen as far south as latitude 39° N., to obtain which position they must have crossed the Gulf Stream impelled by the cold Arctic current underrunning the warm waters of the Gulf Stream. That this should happen is not to be wondered at when it is considered that the specific gravity of fresh-water ice, of which these bergs are composed, is about seven-eighths that of sea water; so that, however vast the berg may appear to the eye of the observer, he can in reality see one-eighth of its bulk, the remaining seven-eighths being submerged and subject to the deep-water currents of the ocean. The track of an iceberg is indeed directed mainly by current, so small a portion of its surface being exposed to the action of the winds that its course is but slightly retarded or deflected by moderate breezes. On the Great Bank of Newfoundland bergs are often observed to be moving south or southeast; those that drift westward of Cape Race usually pass between Green and St. Pierre Banks.

The route chart of the North Atlantic, No. 2058, shows the limits within which both field ice and icebergs may be met with, and where it should be carefully looked out for at all times, but especially during the spring and summer seasons. From this chart it would appear that whilst the southern and eastern limits of field ice are about latitude 42° N., and longitude 45° W., icebergs may be met with much farther from Newfoundland; in April, May, and June they have been seen as far South as latitude 39° N. and as far east as longitude 38° 30' W."

And again, on page 35:

It is, in fact, impossible to give, within the outer limits named, any distinct idea of where ice may be expected, and no rule can be laid down to insure safe navigation, as its position and the quantity met with differs so greatly in different seasons. Everything must depend upon the vigilance, caution, and skill with which a vessel is navigated when crossing the dangerous ice-bearing regions of the Atlantic Ocean.

Similar warnings as to ice are also given in the "Nova Scotia (Southeast Coast) and Bay of Fundy Pilot" (sixth edition, 1911), which is also published by the hydrographic office.

Both the above quoted books were supplied to the master of the *Titanic* (together with other necessary charts and books) before that ship left Southampton.

The above extracts show that it is quite incorrect to assume that icebergs had never been encountered or field ice observed so far south, at the particular time of year when the *Titanic* disaster occurred; but it is true to say that the field ice was certainly at that time farther south than it has been seen for many years.

It may be useful here to give some definitions of the various forms of ice to be met with in these latitudes, although there is frequently some confusion in their use.

An iceberg may be defined as a detached portion of a polar glacier carried out to sea. The ice of an iceberg formed from a glacier is of quite fresh water. Only about an eighth of its mass floats above the surface of sea water.

A "growler" is a colloquial term applied to icebergs of small mass, which therefore only show a small portion above the surface. It is not infrequently a berg which has turned over, and is therefore showing what has been termed "black ice" or, more correctly, dark-blue ice.

Pack ice is the floating ice which covers wide areas of the polar seas, broken into large pieces, which are driven ("packed") together by wind and current, so as to form a practically continuous sheet. Such ice is generally frozen from sea water, and not derived from glaciers.

Field ice is a term usually applied to frozen sea water floating in much looser form than pack ice.

An icefloe is the term generally applied to the same ice (i.e., field ice) in a smaller quantity.

A floe berg is a stratified mass of floe ice (i.e., sea-water ice).

The *Titanic* followed the outward southern track until Sunday, April 14, in the usual way. At 11.40 p. m. on that day she struck an iceberg and at 2.20 a. m. on the next day she foundered.

At 9 a. m. (*Titanic* time) on that day a wireless message from the steamship *Caronia* was received by Capt. Smith. It was as follows:

CAPTAIN, *Titanic*:

West-bound steamers report bergs, growlers, and field ice in 42° N., from 49° to 51° W., April 12. Compliments.

BARR.

It will be noticed that this message referred to bergs, growlers, and field ice sighted on April 12—at least 48 hours before the time of the collision. At the time this message was received the *Titanic's* position was about latitude 43° 35' N. and longitude 43° 50' W. Capt. Smith acknowledged the receipt of this message.

At 1.42 p. m., a wireless message from the steamship *Baltic* was received by Capt. Smith. It was as follows:

Capt. SMITH, *Titanic*:

Have had moderate, variable winds and clear, fine weather since leaving. Greek steamer *Athenai* reports passing icebergs and large quantities of field ice to-day in latitude 41° 51' N., longitude 49° 52' W. Last night we spoke German oiltank steamer *Deutschland*, Stettin to Philadelphia, not under control, short of coal, latitude 40° 42' N., longitude 55° 11' W. Wishes to be reported to New York and other steamers. Wish you and *Titanic* all success.

COMMANDER.

At the time this message was received the *Titanic* position was about 42° 35' N., 45° 50' W. Capt. Smith acknowledged the receipt of this message also.

Mr. Ismay, the managing director of the White Star Line, was on board the *Titanic*, and it appears that the master handed the *Baltic's* message to Mr. Ismay almost immediately after it was received. This no doubt was in order that Mr. Ismay might know that ice was to be expected. Mr. Ismay states that he understood from the message that they would get up to the ice "that night." Mr. Ismay showed this message to two ladies, and it is therefore probable that many persons on board became aware of its contents. This message ought in my opinion to have been put on the board in the chart room as soon as it was received. It remained, however, in Mr. Ismay's possession until 7.15 p. m., when the master asked Mr. Ismay to return it. It was then that it was first posted in the chart room.

This was considerably before the time at which the vessel reached the position recorded in the message. Nevertheless, I think it was irregular for the master to part with the document, and improper for Mr. Ismay to retain it, but the incident had, in my opinion, no connection with or influence upon the manner in which the vessel was navigated by the master.

It appears that about 1.45 p. m. (*Titanic* time) on the 14th a message was sent from the German steamer *Amerika* to the Hydrographic Office in Washington, which was in the following terms:

Amerika passed two large icebergs in 41° 27' N., 50° 8' W., on April 14.

This was a position south of the point of the *Titanic's* disaster. The message does not mention at what hour the bergs had been observed. It was a private message for the hydrographer at Washington, but it passed to the *Titanic* because she was nearest to Cape Race, to which station it had to be sent in order to reach Washington. Being a message affecting navigation, it should in the ordinary course have been taken to the bridge. So far as can be ascertained, it was never heard of by anyone on board the *Titanic* outside the Marconi room. There were two Marconi operators in the Marconi room, namely, Phillips, who perished, and Bride, who survived and gave evidence. Bride did not receive the *Amerika* message nor did Phillips mention it to him, though the two had much conversation together after it had been received. I am of opinion that when this message reached the Marconi room it was put aside by Phillips to wait until the *Titanic* would be within call of Cape Race (at about 8 or 8.30 p. m.), and that it was never handed to any officer of the *Titanic*.

At 5.50 p. m. the *Titanic's* course (which had been S. 62° W.) was changed to bring her on a westerly course for New York. In ordinary circumstances this change in her course should have been made about half an hour earlier, but she seems on this occasion to have continued for about 10 miles longer on her southwesterly course before turning, with the result that she found herself, after altering course at 5.50 p. m., about 4 or 5 miles south of the customary route on a course S. 86° W. true. Her course, as thus set, would bring her at the time of the collision to a point about 2 miles to the southward of the customary route and 4 miles south and considerably to the westward of the indicated position of the *Baltic's* ice. Her position at the time of the collision would also be well to the southward of the indicated position of the ice mentioned in the *Caronia* message. This change of course was so insignificant that in my opinion it can not have been made in consequence of information as to ice.

In this state of things, at 7.30 p.m. a fourth message was received, and is said by the Marconi operator Bride to have been delivered to the bridge. This message was from the steamship *Californian* to the steamship *Antillian*, but was picked up by the *Titanic*. It was as follows:

To CAPTAIN, *Antillian*:

Six-thirty p. m., apparent ship's time; latitude 42° 3' N., longitude 49° 9' W. Three large bergs 5 miles to southward of us. Regards.

LORD

Bride does not remember to what officer he delivered this message.

By the time the *Titanic* reached the position of the collision (11.40 p. m.) she had gone about 50 miles to the westward of the indicated position of the ice mentioned in this fourth message. Thus it would appear that before the collision she had gone clear of the indicated positions of ice contained in the messages from the *Baltic* and *Californian*. As to the ice advised by the *Caronia* message, so far as it consisted of small bergs and field ice, it had

before the time of the collision possibly drifted with the Gulf Stream to the eastward; and so far as it consisted of large bergs (which would be deep enough in the water to reach the Labrador current) it had probably gone to the southward. It was urged by Sir Robert Finlay, who appeared for the owners, that this is strong evidence that the *Titanic* had been carefully and successfully navigated so as to avoid the ice of which she had received warning. Mr. Ismay, however, stated that he understood from the *Baltic* message that "we would get up to the ice that night."

There was a fifth message received in the Marconi room of the *Titanic* at 9.40 p. m. This was from a steamer called the *Mesaba*. It was in the following terms:

From "Mesaba" to "Titanic" and all east-bound ships:

Ice report in latitude 42° N. to 41° 25' N., longitude 49° to longitude 50° 30' W. Saw much heavy pack ice and great number large icebergs. Also field ice. Weather good, clear.

This message clearly indicated the presence of ice in the immediate vicinity of the *Titanic*, and if it had reached the bridge would perhaps have affected the navigation of the vessel. Unfortunately, it does not appear to have been delivered to the master or to any of the officers. The Marconi operator was very busy from 8 o'clock onward transmitting messages via Cape Race for passengers on board the *Titanic*, and the probability is that he failed to grasp the significance and importance of the message, and put it aside until he should be less busy. It was never acknowledged by Capt. Smith, and I am satisfied that it was not received by him. But, assuming Sir Robert Finlay's contentions to be well founded that the *Titanic* had been navigated so as to avoid the *Baltic* and the *Californian* ice, and that the *Caronia* ice had drifted to the eastward and to the southward, still there can be no doubt, if the evidence of Mr. Lightoller, the second officer, is to be believed, that both he and the master knew that the danger of meeting ice still existed. Mr. Lightoller says that the master showed him the *Caronia* message about 12.45 p. m. on April 14, when he was on the bridge. He was about to go off watch, and he says he made a rough calculation in his head which satisfied him that the *Titanic* would not reach the position mentioned in the message until he came on watch again at 6 p. m. At 6 p. m. Mr. Lightoller came on the bridge again to take over the ship from Mr. Wilde, the chief officer (dead). He does not remember being told anything about the *Baltic* message, which had been received at 1.42 p. m. Mr. Lightoller then requested Mr. Moody, the sixth officer (dead), to let him know "at what time we should reach the vicinity of ice," and says that he thinks Mr. Moody reported "about 11 o'clock." Mr. Lightoller says that 11 o'clock did not agree with a mental calculation he himself had made and which showed 9.30 as the time. This mental calculation he at first said he had made before Mr. Moody gave him 11 o'clock as the time, but later on he corrected this, and said his mental calculation was made between 7 and 8 o'clock, and after Mr. Moody had mentioned 11. He did not point out the difference to him, and thought that perhaps Mr. Moody had made his calculations on the basis of some "other" message. Mr. Lightoller excuses himself for not pointing out the difference by saying that Mr. Moody was busy at the time, probably with stellar observations. It is, however, an odd circumstance that Mr. Lightoller, who believed that the vicinity of ice would be reached before his watch ended at 10 p.m., should not have mentioned the fact to Mr. Moody, and it is also odd that if he thought that Mr. Moody was working on the basis of some "other" message, he did not ask what the other message was or where it came from. The point, however, of Mr. Lightoller's evidence is that they both thought that the vicinity of ice would be reached before midnight. When he was examined as to whether he did not fear that on entering the indicated ice region he might run foul of a growler (a low-lying berg) he answers: "No, I judged I should see it with "sufficient distinctness" and at a distance of a "mile and a half, more probably 2 miles." He then adds:

In the event of meeting ice there are many things we look for. In the first place, a slight breeze. Of course, the stronger the breeze the more visible will the ice be, or, rather, the breakers on the ice.

He is then asked whether there was any breeze on this night, and he answers:

When I left the deck at 10 o'clock there was a slight breeze. Oh, pardon me, no; I take that back. No, it was calm, perfectly calm—

And almost immediately afterwards he describes the sea as "absolutely flat." It appeared, according to this witness, that about 9 o'clock the master came on the bridge and that Mr. Lightoller had a conversation with him which lasted half an hour. This conversation, so far as it is material, is described by Mr. Lightoller in the following words:

We commenced to speak about the weather. He said, "there is not much wind." I said, "No, it is a flat calm," as a matter of fact. He repeated it, he said, "A flat calm." I said, "Quite flat; there is no wind." I said something about it was rather a pity the breeze had not kept up whilst we were going through the ice region. Of course, my reason was obvious: he knew I meant the water ripples breaking on the base of the berg * * * We then discussed the indications of ice. I remember saying, "In any case, there will be a certain amount of reflected light from the bergs." He said, "Oh, yes, there will be a certain amount of reflected light." I said or he said—blue was said between us—that even though the blue side of the berg was towards us, probably the outline, the white outline, would give us sufficient warning, that we should be able to see it at a good distance, and as far as we could see, we should be able to see it. Of course, it was just with regard to that possibility of the blue side being toward us, and that if it did happen to be turned with the purely blue side toward us, there would still be the white outline.

Further on Mr. Lightoller says that he told the master nothing about his own calculation as to coming up with the ice at 9.30 or about Mr. Moody's calculation as to coming up with it at 11.

The conversation with the master ended with the master saying, "If it becomes at all doubtful let me know at once; I will be just inside." This remark Mr. Lightoller says undoubtedly referred to ice.

At 9.30 the master went to his room, and the first thing that Mr. Lightoller did afterwards was to send a message to the crow's nest "to keep a sharp lookout for ice, particularly small ice and growlers," until daylight. There seems to be no doubt that this message was in fact sent, and that it was passed on to the next lookouts when they came on watch. Hitchens, the quartermaster, says he heard Mr. Lightoller give the message to Mr. Moody, and both the men in the crow's nest at the time (Jewell and Symons) speak to having received it. From 9.30 to 10 o'clock, when his watch ended, Mr. Lightoller remained on the bridge "looking out for ice." He also said that the night order

book for the 14th had a footnote about keeping a sharp lookout for ice, and that this note was "initialed by every officer." At 10 o'clock Mr. Lightoller handed over the watch to Mr. Murdoch, the first officer (dead), telling him that "we might be up around the ice any time now." That Mr. Murdoch knew of the danger of meeting ice appears from the evidence of Hemming, a lamp trimmer, who says that about 7.15 p. m. Mr. Murdoch told him to go forward and see the foreshuttle hatch closed—

as we are in the vicinity of ice and there is a glow coming from that, and I want everything dark before the bridge.

The foregoing evidence establishes quite clearly that Capt. Smith, the master; Mr. Murdoch, the first officer; Mr. Lightoller, the second officer; and Mr. Moody, the sixth officer, all knew on the Sunday evening that the vessel was entering a region where ice might be expected; and this being so, it seems to me to be of little importance to consider whether the master had by design or otherwise succeeded in avoiding the particular ice indicated in the three messages received by him.

SPEED OF THE SHIP.

The entire passage had been made at high speed, though not at the ship's maximum, and this speed was never reduced until the collision was unavoidable. At 10 p. m. the ship was registering 45 knots every two hours by the Cherub log.

The quartermaster on watch aft when the *Titanic* struck states that the log, reset at noon, then registered 260 knots, and the fourth officer, when working up the position from 7.30 p. m. to the time of the collision, states he estimated the *Titanic's* speed as 22 knots, and this is also borne out by evidence that the engines were running continuously at 75 revolutions.

THE WEATHER CONDITIONS.

From 6 p. m. onward to the time of the collision the weather was perfectly clear and fine. There was no moon, the stars were out, and there was not a cloud in the sky. There was, however, a drop in temperature of 10° in slightly less than two hours, and by about 7.30 p. m. the temperature was 33° F., and it eventually fell to 32° F. That this was not necessarily an indication of ice is borne out by the sailing directions. The Nova Scotia (S. E. Coast) and Bay of Fundy Pilot (sixth edition, 1911, p. 16) says:

No reliance can be placed on any warning being conveyed to a mariner by a fall of temperature, either of the air or sea, on approaching ice. Some decrease in temperature has occasionally been recorded, but more often none has been observed.

Sir Ernest Shackleton was, however, of opinion that—

if there was no wind and the temperature fell abnormally for the time of the year, I would consider that I was approaching an area which might have ice in it.

ACTION THAT SHOULD HAVE BEEN TAKEN.

The question is what ought the master to have done. I am advised that with the knowledge of the proximity of ice which the master had, two courses were open to him: The one was to stand well to the southward instead of turning up to a westerly course; the other was to reduce speed materially as night approached. He did neither. The alteration of the course at 5.50 p. m. was so insignificant that it can not be attributed to any intention to avoid ice. This deviation brought the vessel back to within about 2 miles of the customary route before 11.30 p. m. And there was certainly no reduction of speed. Why, then, did the master persevere in his course and maintain his speed? The answer is to be found in the evidence. It was shown that for many years past, indeed, for a quarter of a century or more, the practice of liners using this track when in the vicinity of ice at night had been in clear weather to keep the course, to maintain the speed and to trust to a sharp lookout to enable them to avoid the danger. This practice, it was said, had been justified by experience, no casualties having resulted from it. I accept the evidence as to the practice and as to the immunity from casualties which is said to have accompanied it. But the event has proved the practice to be bad. Its root is probably to be bound in competition and in the desire of the public for quick passages rather than in the judgment of navigators. But unfortunately experience appeared to justify it. In these circumstances I am not able to blame Capt. Smith. He had not the experience which his own misfortune has afforded to those whom he has left behind, and he was doing only that which other skilled men would have done in the same position. It was suggested at the bar that he was yielding to influences which ought not to have affected him; that the presence of Mr. Ismay on board and the knowledge which he perhaps had of a conversation between Mr. Ismay and the chief engineer at Queenstown about the speed of the ship and the consumption of coal probably induced him to neglect precautions which he would otherwise have taken. But I do not believe this. The evidence shows that he was not trying to make any record passage or indeed any exceptionally quick passage. He was not trying to please anybody, but was exercising his own discretion in the way he thought best. He made a mistake, a very grievous mistake, but one in which, in face of the practice and of past experience, negligence can not be said to have had any part; and in the absence of negligence it is, in my opinion, impossible to fix Capt. Smith with blame. It is, however, to be hoped that the last has been heard of the practice and that for the future it will be abandoned for what we now know to be more prudent and wiser measures. What was a mistake in the case of the *Titanic* would without doubt be negligence in any similar case in the future.

THE COLLISION.

Mr. Lightoller turned over the ship to Mr. Murdoch, the first officer, at 10 o'clock, telling him that the ship was within the region where ice had been reported. He also told him of the message he had sent to the crow's nest, and of his conversation with the master, and of the latter's orders.

The ship appears to have run on, on the same course, until, at a little before 11.40, one of the lookouts in the

crow's nest struck three blows on the gong, which was the accepted warning for something ahead, following this immediately afterward by a telephone message to the bridge "Iceberg right ahead." Almost simultaneously with the three-gong signal Mr. Murdoch, the officer of the watch, gave the order "Hard-a-starboard," and immediately telegraphed down to the engine room "Stop. Full speed astern." The helm was already "hard over," and the ship's head had fallen off about two points to port, when she collided with an iceberg well forward on her starboard side.

Mr. Murdoch at the same time pulled the lever over which closed the water-tight doors in the engine and boiler rooms.

The master "rushed out" onto the bridge and asked Mr. Murdoch what the ship had struck.

Mr. Murdoch replied:

An iceberg, sir. I hard-a-starboarded and reversed the engines, and I was going to hard-a-port round it, but she was too close. I could not do any more. I have closed the water-tight doors.

From the evidence given it appears that the *Titanic* had turned about two points to port before the collision occurred. From various experiments subsequently made with the steamship *Olympic*, a sister ship to the *Titanic*, it was found that traveling at the same rate as the *Titanic*, about 37 seconds would be required for the ship to change her course to this extent after the helm had been put hard-a-starboard. In this time the ship would travel about 466 yards, and allowing for the few seconds that would be necessary for the order to be given, it may be assumed that 500 yards was about the distance at which the iceberg was sighted either from the bridge or crow's nest.

That it was quite possible on this night, even with a sharp lookout at the stemhead, crow's nest, and on the bridge, not to see an iceberg at this distance is shown by the evidence of Capt. Rostron, of the *Carpathia*.

The injuries to the ship, which are described in the next section, were of such a kind that she foundered in 2 hours and 40 minutes.

III.—DESCRIPTION OF THE DAMAGE TO THE SHIP AND OF ITS GRADUAL AND FINAL EFFECT, WITH OBSERVATIONS THEREON.

The damage done to the ship was as follows:

EXTENT OF THE DAMAGE.

The collision with the iceberg, which took place at 11.40 p. m., caused damage to the bottom of the starboard side of the vessel at about 10 feet above the level of the keel, but there was no damage above this height. There was damage in—

The forepeak, No. 1 hold, No. 2 hold, No. 3 hold, No. 6 boiler room, No. 5 boiler room.

The damage extended over a length of about 300 feet.

TIME IN WHICH THE DAMAGE WAS DONE.

As the ship was moving at over 20 knots, she would have passed through 300 feet in less than 10 seconds, so that the damage was done in about this time.

THE FLOODING IN FIRST TEN MINUTES.

At first it is desirable to consider what happened in the first 10 minutes.

The forepeak was not flooded above the orlop deck—i.e., the peak tank top, from the hole in the bottom of the peak tank.

In No. 1 hold there was 7 feet of water.

In No. 2 hold five minutes after the collision water was seen rushing in at the bottom of the firemen's passage on the starboard side, so that the ship's side was damaged abaft of bulkhead B sufficiently to open the side of the firemen's passage, which was 3-1/2 feet from the outer skin of the ship, thereby flooding both the hold and the passage.

In No. 3 hold the mail room was filled soon after the collision. The floor of the mail room is 24 feet above the keel.

In No. 6 boiler room, when the collision took place, water at once poured in at about 2 feet above the stokehold plates, on the starboard side, at the after end of the boiler room. Some of the firemen immediately went through the water-tight door opening to No. 5 boiler room because the water was flooding the place. The water-tight doors in the engine rooms were shut from the bridge almost immediately after the collision. Ten minutes later it was found that there was water to the height of 8 feet above the double bottom in No. 6 boiler room.

No. 5 boiler room was damaged at the ship's side in the starboard forward bunker at a distance of 2 feet above the stokehold plates, at 2 feet from the water-tight bulkhead between Nos. 5 and 6 boiler rooms. Water poured in at that place as it would from an ordinary fire hose. At the time of the collision this bunker had no coal in it. The bunker door was closed when water was seen to be entering the ship.

In No. 4 boiler room there was no indication of any damage at the early stages of the sinking.

GRADUAL EFFECT OF THE DAMAGE.

It will thus be seen that all the six compartments forward of No. 4 boiler room were open to the sea by damage which existed at about 10 feet above the keel. At 10 minutes after the collision the water seems to have risen to about 14 feet above the keel in all these compartments except No. 5 boiler room. After the first ten minutes the water rose steadily in all these six compartments. The forepeak above the peak tank was not filled until an hour after

the collision, when the vessel's bow was submerged to above C deck. The water then flowed in from the top through the deck scuttle forward of the collision bulkhead. It was by this scuttle that access was obtained to all the decks below C down to the peak tank top on the orlop deck.

At 12 o'clock water was coming up in No. 1 hatch. It was getting into the firemen's quarters and driving the firemen out. It was rushing round No. 1 hatch on G deck and coming mostly from the starboard side, so that in 20 minutes the water had risen above G deck in No. 1 hold.

In No. 2 hold about 40 minutes after the collision the water was coming in to the seamen's quarters on E deck through a burst fore and aft wooden bulkhead of a third-class cabin opposite the seamen's wash place. Thus, the water had risen in No. 2 hold to about 3 feet above E deck in 40 minutes.

In No. 3 hold the mail room was afloat about 20 minutes after the collision. The bottom of the mail room which is on the orlop deck, is 24 feet above the keel.

The water-tight doors on F deck at the fore and after ends of No. 3 compartment were not closed then.

The mail room was filling and water was within 2 feet of G deck, rising fast when the order was given to clear the boats.

There was then no water on F deck.

There is a stairway on the port side on G deck which leads down to the first-class baggage room on the orlop deck immediately below. There was water in this baggage room 25 minutes after the collision. Half an hour after the collision water was up to G deck in the mail room.

Thus the water had risen in this compartment to within 2 feet of G deck in 20 minutes, and above G deck in 25 to 30 minutes.

No. 6 boiler room was abandoned by the men almost immediately after the collision. Ten minutes later the water had risen to 8 feet above the top of the double bottom, and probably reached the top of the bulkhead at the after end of the compartment, at the level of E deck, in about one hour after the collision.

In No. 5 boiler room there was no water above the stokehold plates, until a rush of water came through the pass between the boilers from the forward end, and drove the leading stoker out.

It has already been shown in the description of what happened in the first 10 minutes, that water was coming into No. 5 boiler room in the forward starboard bunker at 2 feet above the plates in a stream about the size of a deck hose. The door in this bunker had been dropped probably when water was first discovered, which was a few minutes after the collision. This would cause the water to be retained in the bunker until it rose high enough to burst the door which was weaker than the bunker bulkhead. This happened about an hour after the collision.

No. 4 boiler room.—One hour and 40 minutes after the collision water was coming in forward, in No. 4 boiler room, from underneath the floor in the forward part, in small quantities. The men remained in that stokehold till ordered on deck.

Nos. 3, 2, and 1 boiler rooms.—When the men left No. 4 some of them went through Nos. 3, 2, and 1 boiler rooms into the reciprocating engine room, and from there on deck. There was no water in the boiler rooms abaft No. 4 one hour 40 minutes after the collision (1.20 a. m.), and there was then none in the reciprocating and turbine engine rooms.

Electrical engine room and tunnels.—There was no damage to these compartments.

From the foregoing it follows that there was no damage abaft No. 4 boiler room.

All the water-tight doors aft of the main engine room were opened after the collision.

Half an hour after the collision the water-tight doors from the engine room to the stokehold were opened as far forward as they could be to No. 4 boiler room.

FINAL EFFECT OF THE DAMAGE.

The later stages of the sinking can not be stated with any precision, owing to a confusion of the times which was natural under the circumstances.

The forecastle deck was not under water at 1.35 a. m. Distress signals were fired until two hours after the collision (1.45 a. m.). At this time the fore deck was under water. The forecastle head was not then submerged though it was getting close down to the water, about half an hour before she disappeared (1.50 a. m.).

When the last boat, lowered from davits (D), left the ship, A deck was under water, and water came up the stairway under the boat deck almost immediately afterwards. After this the other port collapsible (B), which had been stowed on the officers' house, was uncovered, the lashings cut adrift, and she was swung round over the edge of the coamings of the deckhouse on to the boat deck.

Very shortly afterwards the vessel, according to Mr. Lightoller's account, seemed to take a dive, and he just walked into the water. When he came to the surface all the funnels were above the water.

Her stern was gradually rising out of the water, and the propellers were clear of the water. The ship did not break in two, and she did, eventually, attain the perpendicular, when the second funnel from aft about reached the water. There were no lights burning then, though they kept alight practically until the last.

Before reaching the perpendicular, when at an angle of 50° or 60°, there was a rumbling sound which may be attributed to the boilers leaving their beds and crashing down on to or through the bulkheads. She became more perpendicular and finally absolutely perpendicular, when she went slowly down.

After sinking as far as the after part of the boat deck she went down more quickly. The ship disappeared at 2.20 a. m.

OBSERVATIONS.

I am advised that the *Titanic* as constructed could not have remained afloat long with such damage as she received. Her bulkheads were spaced to enable her to remain afloat with any two compartments in communication with the sea. She had a sufficient margin of safety with any two of the compartments flooded which were actually damaged.

In fact, any three of the four forward compartments could have been flooded by the damage received without sinking the ship to the top of her bulkheads.

Even if the four forward compartments had been flooded the water would not have got into any of the compartments abaft of them though it would have been above the top of some of the forward bulkheads. But the ship, even with these four compartments flooded, would have remained afloat. But she could not remain afloat with the four compartments and the forward boiler room (No. 6) also flooded.

The flooding of these five compartments alone would have sunk the ship sufficiently deep to have caused the water to rise above the bulkhead at the after end of the forward boiler room (No. 6) and to flow over into the next boiler room (No. 5), and to fill it up until in turn its after bulkhead would be overwhelmed and the water would thereby flow over and fill No. 4 boiler room, and so on in succession to the other boiler rooms till the ship would ultimately fill and sink.

It has been shown that water came into the five forward compartments to a height of about 14 feet above the keel in the first 10 minutes. This was at a rate of inflow with which the ship's pumps could not possibly have coped, so that the damage done to these five compartments alone inevitably sealed the doom of the ship.

The damage done in the boiler rooms Nos. 4 and 5 was too slight to have hastened appreciably the sinking of the ship, for it was given in evidence that no considerable amount of water was in either of these compartments for an hour after the collision. The rate at which water came into No. 6 boiler room makes it highly probable that the compartment was filled in not more than an hour, after which the flow over the top of the bulkhead between 5 and 6 began and continued till No. 5 was filled.

It was shown that the leak in No. 5 boiler room was only about equal to the flow of a deck hose pipe about 3 inches in diameter.

The leak in No. 4, supposing that there was one, was only enough to admit about 3 feet of water in that compartment in 1 hour 40 minutes.

Hence the leaks in Nos. 4 and 5 boiler rooms did not appreciably hasten the sinking of the vessel.

The evidence is very doubtful as to No. 4 being damaged. The pumps were being worked in No. 5 soon after the collision. The 10-inch leather special suction pipe which was carried from aft is more likely to have been carried for use in No. 5 than No. 4 because the doors were ordered to be opened probably soon after the collision when water was known to be coming into No. 5. There is no evidence that the pumps were being worked in No. 4.

The only evidence possibly favorable to the view that the pipe was required for No. 4, and not for No. 5, is that Scott, a greaser, says that he saw engineers dragging the suction pipe along one hour after the collision. But even as late as this it may have been wanted for No. 5 only.

The importance of the question of the damage to No. 5 is small because the ship as actually constructed was doomed as soon as the water in No. 6 boiler room and all compartments forward of it entered in the quantities it actually did.

It is only of importance in dealing with the question of what would have happened to the ship had she been more completely subdivided.

It was stated in evidence that if No. 4 had not been damaged or had only been damaged to an extent within the powers of the pumps to keep under, then, if the bulkheads had been carried to C deck, the ship might have been saved. Further methods of increased subdivision and their effect upon the fate of the ship are discussed later.

Evidence was given showing that after the water-tight doors in the engine and boiler rooms had been all closed, except those forward of No. 4 group of boilers, they were opened again, and there is no evidence to show that they were again closed. Though it is probable that the engineers who remained below would have closed these doors as the water rose in the compartments, yet it was not necessary for them to do this, as each door had an automatic closing arrangement which would have come into operation immediately a small amount of water came through the door.

It is probable, however, that the life of the ship would have been lengthened somewhat if these doors had been left open, for the water would have flowed through them to the after part of the ship, and the rate of flow of the water into the ship would have been for a time reduced as the bow might have been kept up a little by the water which flowed aft.

It is thus seen that the efficiency of the automatic arrangements for the closing of the water-tight doors, which was questioned during the inquiry, had no important bearing on the question of hastening the sinking of the ship, except that, in the case of the doors not having been closed by the engineers, it might have retarded the sinking of the ship if they had not acted. The engineers would not have prevented the doors from closing unless they had been convinced that the ship was doomed. There is no evidence that they did prevent the doors from closing.

The engineers were applying the pumps when Barrett, leading stoker, left No. 5 boiler room, but even if they had succeeded in getting all the pumps in the ship to work they could not have saved the ship or prolonged her life to any appreciable extent.

EFFECT OF SUGGESTED ADDITIONAL SUBDIVISION UPON FLOATATION.

Water-tight decks.—It is in evidence that advantage might be obtained from the point of view of greater safety in having a water-tight deck.

Without entering into the general question of the advantage of water-tight decks for all ships, it is desirable to form an opinion in the case of the *Titanic* as to whether making the bulkhead deck water-tight would have been an advantage in the circumstances of the accident, or in case of accident to ships of this class.

I am advised that it is found that with all the compartments certainly known to have been flooded, viz., those forward of No. 4 boiler room, the ship would have remained afloat if the bulkhead deck had been a water-tight deck. If, however, No. 4 boiler room had also been flooded the ship would not have remained afloat unless, in addition to making the bulkhead deck water-tight, the transverse bulkhead abaft of No. 4 boiler room had been carried up to D deck.

To make the bulkhead deck effectively water-tight for this purpose it would have been necessary to carry water-

tight trunks round all the openings in the bulkhead deck up to C deck.

It has been shown that with the bulkhead abaft No. 5 boiler room carried to C deck the ship would have remained afloat if the compartments certainly known to have been damaged had been flooded.

I do not desire to express an opinion upon the question whether it would have conduced to safety in the case of the *Titanic* if a water-tight deck had been fitted below the water line, as there may be some objections to such a deck. There are many considerations involved, and I think that the matter should be dealt with by the bulkhead committee for ships in general.

Longitudinal subdivision.—The advantages and disadvantages of longitudinal subdivision by means of water-tight bunker bulkheads were pointed out in evidence.

While not attempting to deal with this question generally for ships, I am advised that if the *Titanic* had been divided in the longitudinal method, instead of in the transverse method only, she would have been able, if damaged as supposed, to remain afloat, though with a list which could have been corrected by putting water ballast into suitable places.

This subject is one, however, which again involves many considerations, and I think that for ships generally the matter should be referred to the bulkhead committee for their consideration and report.

Extending double bottom up the sides.—It was shown in evidence that there would be increased protection in carrying the double bottom higher up the side than was done in the *Titanic*, and that some of the boiler rooms would probably not then have been flooded, as water could not have entered the ship except in the double bottom.

In the case of the *Titanic* I am advised that this would have been an advantage, but it was pointed out in evidence that there are certain disadvantages which in some ships may outweigh the advantages.

In view of what has already been said about the possible advantages of longitudinal subdivision, it is unnecessary further to discuss the question of carrying up the double bottom in ships generally. This matter should also be dealt with by the bulkhead committee.

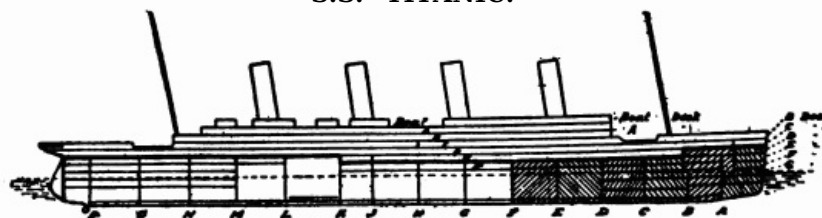
Water-tight doors.—With reference to the question of the water-tight doors of the ship, there does not appear to have been any appreciable effect upon the sinking of the ship caused by either shutting or not shutting the doors. There does not appear to have been any difficulty in working the water-tight doors. They appear to have been shut in good time after the collision.

But in other cases of damage in ships constructed like the *Titanic*, it is probable that the efficiency of the closing arrangement of the water-tight doors may exert a vital influence on the safety of the ship. It has been represented that in future consideration should be given to the question—

as to how far bulkhead should be solid bulkheads, and how far there should be water-tight doors, and, if there should be water-tight doors, how far they may or may not be automatically operated.

This again is a question on which it is not necessary here to express any general opinion, for there are conflicting considerations which vary in individual cases. The matter, however, should come under the effective supervision of the board of trade much more than it seems to come at present, and should be referred to the bulkhead committee for their consideration with a view to their suggesting in detail where doors should or should not be allowed, and the type of door which should be adopted in the different parts of ships.

S.S. "TITANIC."



NOTE.—The vertical letters signify the different decks. The horizontal letters signify the water-tight bulkheads. The heavy line shows the top of the water-tight bulkheads. The crosshatched compartments are those opened to the sea at the time of the collision with the iceberg.

IV.—ACCOUNT OF THE SAVING AND RESCUE OF THOSE WHO SURVIVED.

THE BOATS.

The *Titanic* was provided with 20 boats. They were all on the boat deck. Fourteen were life boats. These were hung inboard in davits, 7 on the starboard side and 7 on the port side, and were designed to carry 65 persons each. Two were emergency boats. These were also in davits, but were hung outboard, one on the starboard side and one on the port side, and were designed to carry 40 persons each. The remaining 4 boats were Engelhardt or collapsible boats. Two of these were stowed on the boat deck and 2 on the roof of the officers' quarters, and were designed to carry 47 persons each. Thus the total boat accommodation was for 1,178 persons. The boats in davits were numbered, the odd numbers being on the starboard side and the even numbers on the port side. The numbering began with the emergency boats, which were forward, and ran aft. Thus the boats on the starboard side were numbered 1 (an emergency boat), 3, 5, 7, 9, 11, 13, and 15 (lifeboats), and those on the port side 2 (an emergency boat), 4, 6, 8, 10, 12, 14, and 16 (lifeboats). The collapsible boats were lettered, A and B being on the roof of the officers' quarters and C and D being on the boat deck; C was abreast of No. 1 (emergency boat) and D abreast of No. 2 (emergency boat). Further particulars as to the boats will be found on page 18.

In ordinary circumstances all these boats (with the exception of 1 and 2) were kept covered up, and contained

only a portion of their equipment, such as oars, masts, and sails, and water; some of the remaining portion, such as lamps, compasses, and biscuits being stowed in the ship in some convenient place, ready for use when required. Much examination was directed at the hearing to showing that some boats left the ship without a lamp and others without a compass, and so on, but in the circumstances of confusion and excitement which existed at the time of the disaster this seems to me to be excusable.

Each member of the crew had a boat assigned to him in printed lists, which were posted up in convenient places for the men to see; but it appeared that in some cases the men had not looked at these lists and did not know their respective boats.

There had been no proper boat drill nor a boat muster. It was explained that great difficulty frequently exists in getting firemen to take part in a boat drill. They regard it as no part of their work. There seem to be no statutory requirements as to boat drills or musters, although there is a provision (sec. 9 of the merchant shipping act of 1906) that when a boat drill does take place the master of the vessel is, under a penalty, to record the fact in his log. I think it is desirable that the board of trade should make rules requiring boat drills and boat musters to be held of such a kind and at such times as may be suitable to the ship and to the voyage on which she is engaged. Boat drill, regulated according to the opportunities of the service, should always be held.

It is perhaps worth recording that there was an inspection of the boats themselves at Southampton by Mr. Clarke, the emigration officer, and that, as a result, Mr. Clarke gave his certificate that the boats were satisfactory. For the purpose of this inspection two of the boats were lowered to the water and crews exercised in them.

The collision took place at 11.40 p. m. (ship's time). About midnight it was realized that the vessel could not live, and at about 12.05 the order was given to uncover the 14 boats under davits. The work began on both sides of the ship under the superintendence of five officers. It did not proceed quickly at first; the crew arrived on the boat deck only gradually, and there was an average of not more than three deck hands to each boat. At 12.20 the order was given to swing out the boats, and this work was at once commenced. There were a few passengers on the deck at this time. Mr. Lightoller, who was one of the officers directing operations, says that the noise of the steam blowing off was so great that his voice could not be heard, and that he had to give directions with his hands.

Before this work had been begun, the stewards were rousing the passengers in their different quarters, helping them to put on life-belts and getting them up to the boat deck. At about 12.30 the order was given to place women and children in the boats. This was proceeded with at once and at about 12.45 Mr. Murdoch gave the order to lower No. 7 boat (on the starboard side) to the water. The work of uncovering, filling, and lowering the boats was done under the following supervision: Mr. Lowe, the fifth officer, saw to Nos. 1, 3, 5, and 7; Mr. Murdoch (lost) saw also to 1 and 7 and to A and C. Mr. Moody (lost) looked after Nos. 9, 11, 13, and 15. Mr. Murdoch also saw to 9 and 11. Mr. Lightoller saw to Nos. 4, 6, 8, B, and D. Mr. Wilde (lost) also saw to 8 and D. Mr. Lightoller and Mr. Moody saw to 10 and 16 and Mr. Lowe to 12 and 14. Mr. Wilde also assisted at No. 14, Mr. Boxall helping generally.

The evidence satisfies me that the officers did their work very well and without any thought of themselves. Capt. Smith, the master, Mr. Wilde, the chief officer, Mr. Murdoch, the first officer, and Mr. Moody, the sixth officer, all went down with the ship while performing their duties. The others, with the exception of Mr. Lightoller, took charge of boats and thus were saved. Mr. Lightoller was swept off the deck as the vessel went down and was subsequently picked up.

So far as can be ascertained the boats left the ship at the following times, but I think it is necessary to say that these, and, indeed, all the times subsequent to the collision which are mentioned by the witnesses, are unreliable.

No.	Starboard Side.	No.	Port side.
	<i>a. m.</i>		<i>a. m.</i>
7	12.46	6	12.55
5	12.55	8	1.10
3	1.0	10	1.20
1	1.10	12	1.25
9	1.20	14	1.30
11	1.25	16	1.35
13	1.35	2	1.45
15	1.35	4	1.56
C	1.40	D	2.05
[1]A		[3]B	

As regards the collapsible boats, C and D were properly lowered; as to A and B, which were on the roof of the officers' house, they were left until the last. There was difficulty in getting these boats down to the deck, and the ship had at this time a list. Very few of the deck hands were left in the ship, as they had nearly all gone to man the lifeboats, and the stewards and firemen were unaccustomed to work the collapsible boats. Work appears to have been going on in connection with these two boats at the time that the ship sank. The boats seem to have floated from the deck and to have served in the water as rafts.

The following table shows the numbers of the male crew, male passengers, and women and children who, according to the evidence, left the ship in each boat. In three or four instances the numbers of women and children are only arrived at by subtracting the numbers of crew and male passengers from the total said to be in the boat (these are in italics). In each case the lowest figures given are taken:

Star-board side boat. No.	Men of crew.	Men passen-gers.	Women and children.	Total.	Port side boat No.	Men of crew.	Men passen-gers.	Women and children.	Total
7	3	4	20	27	6	2	2	24	28

5	5	6	30	41	8	4		35	39
3	15	10	25	50	10	5		50	55
1	7	3	2	12	2	4	1	21	26
9	8	6	42	56	12	2		40	42
11	9	1	60	70	14	8		53	63
13	5		59	64	16	6		50	56
15	13	4	53	70	4	4		36	40
C	5	2	64	71	D	2	2	40	44
A ^[1]					B ^[1]				
Total	70	36	355	461		37	7	349	393

General total:

Men of crew	107
Men passengers	43
Women and children	704

This shows in all 107 men of the crew, 43 male passengers, and 704 women and children, or a total of 854 in 18 boats. In addition, about 60 persons, two of whom were women, were said to have been transferred, subsequently, from A and B collapsible boats to other boats, or rescued from the water, making a total of 914 who escaped with their lives. It is obvious that these figures are quite unreliable, for only 712 were in fact saved by the *Carpathia*, the steamer which came to the rescue at about 4 a. m., and all the boats were accounted for. Another remarkable discrepancy is that, of the 712 saved, 189 were in fact men of the crew, 129 were male passengers, and 394 were women and children. In other words, the real proportion of women to men saved was much less than the proportion appearing in the evidence from the boats. Allowing for those subsequently picked up, of the 712 persons saved only 652 could have left the *Titanic* in boats, or an average of about 36 per boat. There was a tendency in the evidence to exaggerate the numbers in each boat, to exaggerate the proportion of women to men, and to diminish the number of crew. I do not attribute this to any wish on the part of the witnesses to mislead the court, but to a natural desire to make the best case for themselves and their ship. The seamen who gave evidence were too frequently encouraged when under examination in the witness box to understate the number of crew in the boats. The number of crew actually saved was 189, giving an average of 10 per boat, and if from this figure the 58 men of the 60 persons above mentioned be deducted the average number of crew leaving the ship in the boats must still have been at least 7. The probability, however, is that many of the 60 picked up were passengers.

The discipline both among passengers and crew during the lowering of the boats was good, but the organization should have been better, and if it had been it is possible that more lives would have been saved.

The real difficulty in dealing with the question of the boats is to find the explanation of so many of them leaving the ship with comparatively few persons in them. No. 1 certainly left with only 12; this was an emergency boat with a carrying capacity of 40. No. 7 left with only 27, and No. 6 with only 28; these were lifeboats with a carrying capacity of 65 each; and several of the others, according to the evidence, and certainly according to the truth, must have left only partly filled. Many explanations are forthcoming, one being that the passengers were unwilling to leave the ship. When the earlier boats left, and before the *Titanic* had begun materially to settle down, there was a drop of 65 feet from the boat deck to the water, and the women feared to get into the boats. Many people thought that the risk in the ship was less than the risk in the boats. This explanation is supported by the evidence of Capt. Rostron, of the *Carpathia*. He says that after those who were saved got on board his ship he was told by some of them that when the boats first left the *Titanic* the people "really would not be put in the boats; they did not want to go in." There was a large body of evidence from the *Titanic* to the same effect, and I have no doubt that many people, particularly women, refused to leave the deck for the boats. At one time the master appears to have had the intention of putting the people into the boats from the gangway doors in the side of the ship. This was possibly with a view to allay the fears of the passengers, for from these doors the water could be reached by means of ladders, and the lowering of some of the earlier boats when only partly filled may be accounted for in this way. There is no doubt that the master did order some of the partly filled boats to row to a position under one of the doors with the object of taking in passengers at that point. It appears, however, that these doors were never opened. Another explanation is that some women refused to leave their husbands. It is said further that the officers engaged in putting the people into the boats feared that the boats might buckle if they were filled; but this proved to be an unfounded apprehension, for one or more boats were completely filled and then successfully lowered to the water.

At 12.35 the message from the *Carpathia* was received announcing that she was making for the *Titanic*. This probably became known and may have tended to make the passengers still more unwilling to leave the ship, and the lights of a ship (the *Californian*) which were seen by many people may have encouraged the passengers to hope that assistance was at hand. These explanations are perhaps sufficient to account for so many of the lifeboats leaving without a full boat load; but I think, nevertheless, that if the boats had been kept a little longer before being lowered, or if the after gangway doors had been opened, more passengers might have been induced to enter the boats. And if women could not be induced to enter the boats, the boats ought then to have been filled up with men. It is difficult to account for so many of the lifeboats being sent from the sinking ship, in a smooth sea, far from full. These boats left behind them many hundreds of lives to perish. I do not, however, desire these observations to be read as casting any reflection on the officers of the ship or on the crew who were working on the boat deck. They all worked admirably, but I think that if there had been better organization the results would have been more satisfactory.

I heard much evidence as to the conduct of the boats after the *Titanic* sank and when there must have been many struggling people in the water, and I regret to say that in my opinion some, at all events, of the boats failed to attempt to save lives when they might have done so, and might have done so successfully. This was particularly the case with boat No. 1. It may reasonably have been thought that the risk of making the attempt was too great; but it seems to me that if the attempt had been made by some of these boats it might have been the means of saving a few more lives. Subject to these few adverse comments, I have nothing but praise for both passengers and crew. All the witnesses speak well of their behavior. It is to be remembered that the night was dark, the noise of the escaping

steam was terrifying, the peril, though perhaps not generally recognized, was imminent and great, and many passengers who were unable to speak or to understand English were being collected together and hurried into the boats.

CONDUCT OF SIR C. DUFF GORDON AND MR. ISMAY.

An attack was made in the course of the inquiry on the moral conduct of two of the passengers, namely, Sir Cosmo Duff Gordon and Mr. Bruce Ismay. It is no part of the business of the court to inquire into such matters, and I should pass them by in silence if I did not fear that my silence might be misunderstood. The very gross charge against Sir Cosmo Duff Gordon that, having got into No. 1 boat, he bribed the men in it to row away from drowning people is unfounded. I have said that the members of the crew in that boat might have made some attempt to save the people in the water, and that such an attempt would probably have been successful; but I do not believe that the men were deterred from making the attempt by any act of Sir Cosmo Duff Gordon's. At the same time I think that if he had encouraged the men to return to the position where the *Titanic* had foundered they would probably have made an effort to do so and could have saved some lives.

As to the attack on Mr. Bruce Ismay, it resolved itself into the suggestion that, occupying the position of managing director of the steamship company, some moral duty was imposed upon him to wait on board until the vessel foundered. I do not agree. Mr. Ismay, after rendering assistance to many passengers, found C collapsible, the last boat on the starboard side, actually being lowered. No other people were there at the time. There was room for him and he jumped in. Had he not jumped in he would merely have added one more life, namely, his own, to the number of those lost.

THE THIRD-CLASS PASSENGERS.

It had been suggested before the inquiry that the third-class passengers had been unfairly treated; that their access to the boat deck had been impeded, and that when at last they reached that deck the first and second class passengers were given precedence in getting places in the boats. There appears to have been no truth in these suggestions. It is no doubt true that the proportion of third-class passengers saved falls far short of the proportion of the first and second class, but this is accounted for by the greater reluctance of the third-class passengers to leave the ship, by their unwillingness to part with their baggage, by the difficulty of getting them up from their quarters, which were at the extreme ends of the ship, and by other similar causes. The interests of the relatives of some of the third-class passengers who had perished were in the hands of Mr. Harbinson, who attended the inquiry on their behalf. He said at the end of his address to the court:

I wish to say distinctly that no evidence has been given in the course of this case which would substantiate a charge that any attempt was made to keep back the third-class passengers. * * * I desire further to say that there is no evidence that when they did reach the boat deck there was any discrimination practiced either by the officers or the sailors in putting them into the boats.

I am satisfied that the explanation of the excessive proportion of third-class passengers lost is not to be found in the suggestion that the third-class passengers were in any way unfairly treated. They were not unfairly treated.

MEANS TAKEN TO PROCURE ASSISTANCE.

As soon as the dangerous condition of the ship was realized, messages were sent by the master's orders to all steamers within reach. At 12.15 a. m. the distress signal CQD was sent. This was heard by several steamships and by Cape Race. By 12.25 Mr. Boxall, the fourth officer, had worked out the correct position of the *Titanic*, and then another message was sent: "Come at once, we have struck a berg." This was heard by the Cunard steamer *Carpathia*, which was at this time bound from New York to Liverpool and 58 miles away. The *Carpathia* answered, saying that she was coming to the assistance of the *Titanic*. This was reported to Capt. Smith on the boat deck. At 12.26 a message was sent out, "Sinking; can not hear for noise of steam." Many other messages were also sent, but as they were only heard by steamers which were too far away to render help, it is not necessary to refer to them. At 1.45 a message was heard by the *Carpathia*, "Engine-room full up to boilers." The last message sent out was "CQ" which was faintly heard by the steamer *Virginian*. This message was sent at 2.17. It thus appears that the Marconi apparatus was at work until within a few minutes of the foundering of the *Titanic*.

Meanwhile Mr. Boxall was sending up distress signals from the deck. These signals (rockets) were sent off at intervals from a socket by No. 1 emergency boat on the boat deck. They were the ordinary distress signals, exploding in the air and throwing off white stars. The firing of these signals began about the time that No. 7 boat was lowered (12.45 a. m.), and it continued until Mr. Boxall left the ship at about 1.45.

Mr. Boxall was also using a Morse light from the bridge in the direction of a ship whose lights he saw about half a point on the port bow of the *Titanic* at a distance, as he thought, of about 5 or 6 miles. He got no answer. In all, Mr. Boxall fired about eight rockets. There appears to be no doubt that the vessel whose lights he saw was the *Californian*. The evidence from the *Californian* speaks of eight rockets having been seen between 12.30 and 1.40. The *Californian* heard none of the *Titanic's* messages; she had only one Marconi operator on board and he was asleep.

THE RESCUE BY THE STEAMSHIP "CARPATHIA."

On the 15th of April the steamship *Carpathia*, 13,600 tons gross, of the Cunard Line, Mr. Arthur Henry Rostron, master, was on her passage to Liverpool from New York. She carried some 740 passengers and 325 crew.

On receipt of the *Titanic's* first distress message the captain immediately ordered the ship to be turned around and driven at her highest speed (17-1/2 knots) in the direction of the *Titanic*. He also informed the *Titanic* by wireless that he was coming to her assistance, and he subsequently received various messages from her. At about 2.40 a. m. he saw a green flare which, as the evidence shows, was being sent up by Mr. Boxall in No. 2 boat. From

this time until 4 a. m. Capt. Rostron was altering his course continually in order to avoid icebergs. He fired rockets in answer to the signals he saw from Boxall's boat. At 4 o'clock he considered he was practically up to the position given and he stopped his ship at 4.05. He sighted the first boat (No. 2) and picked her up at 4.10. There was then a large number of icebergs around him, and it was just daylight. Eventually he picked up in all 13 lifeboats, two emergency boats, and two collapsible boats, all of which were taken on board the *Carpathia*, the other boats being abandoned as damaged or useless. From these boats he took on board 712 persons, one of whom died shortly afterwards. The boats were scattered over an area of 4 or 5 miles, and it was 8 a. m. before they had all been picked up. He saw very little wreckage when he got near to the scene of the disaster, only a few deck chairs, cork life belts, etc., and only one body. The position was then 41° 46' N., 50° 14' W.

The *Carpathia* subsequently returned to New York with the passengers and crew she had rescued.

The court desires to record its great admiration of Capt. Rostron's conduct. He did the very best that could be done.

NUMBERS SAVED.

The following were the numbers saved:

First class:

Adult males	57 out of 175, or 32.57 per cent.
Adult females	140 out of 144, or 97.22 per cent.
Male children (all saved)	5
Female children (all saved)	<u>1</u>
	<u>203</u> out of 325, or 62.46 per cent.

Second class:

Adult males	14 out of 168, or 8.33 per cent.
Adult females	80 out of 93, or 86.02 per cent.
Male children (all saved)	11
Female children (all saved)	<u>13</u>
	<u>118</u> out of 285, or 41.40 per cent.

Third class:

Adult males	75 out of 462, or 16.23 per cent.
Adult females	76 out of 165, or 46.06 per cent.
Male children	13 out of 48, or 27.08 per cent.
Female children	<u>14</u> out of 31, or 45.16 per cent.
	<u>178</u> out of 706, or 25.21 per cent.

Total	<u>499</u> out of 1,316, or 37.94 per cent.
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Crew saved:

Deck department	43 out of 66, or 65.15 per cent.
Engine-room department	72 out of 325, or 22.15 per cent.
Victualing department	
(including 20 women out of 23)	<u>97</u> out of 494, or 19.63 per cent.
Total	<u>212</u> out of 885, or 23.95 per cent.
Total on board saved	<u>711</u> out of 2,201, or 32.30 per cent.

Passengers and crew:

Adult males	338 out of 1,667, or 20.27 per cent.
Adult females	316 out of 425, or 74.35 per cent.
Children	<u>57</u> out of 109, or 52.29 per cent.
Total	711 out of 2,201, or 32.30 per cent.

V.—THE CIRCUMSTANCES IN CONNECTION WITH THE STEAMSHIP "CALIFORNIAN."

It is here necessary to consider the circumstances relating to the steamship *Californian*.

On the 14th of April the steamship *Californian*, of the Leyland Line, Mr. Stanley Lord, master, was on her passage from London, which port she left on April 5, to Boston, United States, where she subsequently arrived on April 19. She was a vessel of 6,223 tons gross and 4,038 net. Her full speed was 12-1/2 to 13 knots. She had a passenger certificate, but was not carrying any passengers at the time. She belonged to the International Mercantile Marine Co., the owners of the *Titanic*.

At 7.30 p.m., ship's time, on April 14, a wireless message was sent from this ship to the *Antillian*:

To CAPTAIN, *Antillian*:

Six thirty p.m., apparent ship's time, latitude 42° 3' N., longitude 49° 9' W. Three large bergs, 5 miles to southward of us. Regards.

LORD

The message was intercepted by the *Titanic*, and when the Marconi operator (Evans) of the *Californian* offered this ice report to the Marconi operator of the *Titanic*, shortly after 7.30 p. m., the latter replied:

It is all right. I heard you sending it to the *Antillian*, and I have got it.

The *Californian* proceeded on her course S. 89° W. true until 10.20 p. m., ship's time, when she was obliged to stop and reverse engines because she was running into field ice, which stretched as far as could then be seen to the northward and southward.

The master told the court that he made her position at that time to be 42° 5' N., 57° 7' W. This position is recorded in the log book, which was written up from the scrap log book by the chief officer. The scrap log is destroyed. It is a position about 19 miles N. by E. of the position of the *Titanic* when she foundered, and is said to have been fixed by dead reckoning and verified by observations. I am satisfied that this position is not accurate. The master "twisted her head" to E. N. E. by the compass and she remained approximately stationary until 5.15 a. m. on the following morning. The ship was slowly swinging around to starboard during the night.

At about 11 p. m. a steamer's light was seen approaching from the eastward. The master went to Evans's room and asked what ships he had. The latter replied: "I think the *Titanic* is near us. I have got her." The master said: "You had better advise the *Titanic* we are stopped and surrounded with ice." This Evans did, calling up the *Titanic* and sending: "We are stopped and surrounded by ice." The *Titanic* replied: "Keep out." The *Titanic* was in communication with Cape Race, which station was then sending messages to her. The reason why the *Titanic* answered "keep out" was that her Marconi operator could not hear what Cape Race was saying, as from her proximity the message from the *Californian* was much stronger than any message being taken in by the *Titanic* from Cape Race, which was much farther off. Evans heard the *Titanic* continuing to communicate with Cape Race up to the time he turned in at 11.30 p. m.

The master of the *Californian* states that when observing the approaching steamer as she got nearer he saw more lights, a few deck lights, and also her green side light. He considered that at 11 o'clock she was approximately 6 or 7 miles away, and at some time between 11 and 11.30 he first saw her green light; she was then about 5 miles off. He noticed that about 11.30 she stopped. In his opinion this steamer was of about the same size as the *Californian*—a medium-sized steamer, "something like ourselves."

From the evidence of Mr. Groves, third officer of the *Californian*, who was the officer of the first watch, it would appear that the master was not actually on the bridge when the steamer was sighted.

Mr. Groves made out two masthead lights; the steamer was changing her bearing slowly as she got closer, and as she approached he went to the chart room and reported this to the master; he added, "She is evidently a passenger steamer." In fact, Mr. Groves never appears to have had any doubt on this subject. In answer to a question during his examination, "Had she much light?" he said, "Yes, a lot of light. There was absolutely no doubt of her being a passenger steamer, at least in my mind."

Gill, the assistant donkey man of the *Californian*, who was on deck at midnight, said, referring to this steamer: "It could not have been anything but a passenger boat, she was too large."

By the evidence of Mr. Groves, the master, in reply to his report, said: "Call her up on the Morse lamp, and see if you can get any answer." This he proceeded to do. The master came up and joined him on the bridge and remarked: "That does not look like a passenger steamer." Mr. Groves replied: "It is, sir. When she stopped her lights seemed to go out, and I suppose they have been put out for the night." Mr. Groves states that these lights went out at 11.40, and remembers that time because "one bell was struck to call the middle watch." The master did not join him on the bridge until shortly afterwards, and consequently after the steamer had stopped.

In his examination Mr. Groves admitted that if this steamer's head was turning to port after she stopped, it might account for the diminution of lights, by many of them being shut out. Her steaming lights were still visible and also her port side light.

The captain only remained upon the bridge for a few minutes. In his evidence he stated that Mr. Groves had made no observations to him about the steamer's deck lights going out. Mr. Groves's Morse signaling appears to have been ineffectual (although at one moment he thought he was being answered), and he gave it up. He remained on the bridge until relieved by Mr. Stone, the second officer, just after midnight. In turning the *Californian* over to him, he pointed out the steamer and said: "she has been stopped since 11.40; she is a passenger steamer. At about the moment she stopped she put her lights out." When Mr. Groves was in the witness box the following questions were put to him by me:

Speaking as an experienced seaman and knowing what you do know now, do you think that steamer that you know was throwing up rockets, and that you say was a passenger steamer, was the *Titanic*?—Do I think it? Yes. From what I have heard subsequently? Yes. Most decidedly I do, but I do not put myself as being an experienced man. But that is your opinion as far as your experience goes?—Yes, it is, my lord.

Mr. Stone states that the master, who was also up (but apparently not on the bridge), pointed out the steamer to him with instructions to tell him if her bearings altered or if she got any closer; he also stated that Mr. Groves had called her up on the Morse lamp and had received no reply.

Mr. Stone had with him during the middle watch an apprentice named Gibson, whose attention was first drawn to the steamer's lights at about 12.20 a. m. He could see a masthead light, her red light (with glasses), and a "glare of white lights on her afterdeck." He first thought her masthead light was flickering and next thought it was a Morse light, "calling us up." He replied, but could not get into communication, and finally came to the conclusion that it was, as he had first supposed, the masthead light flickering. Sometime after 12.30 a. m., Gill, the donkey man, states that he saw two rockets fired from the ship which he had been observing, and about 1.10 a. m., Mr. Stone reported to the captain by voice pipe, that he had seen five white rockets from the direction of the steamer. He states that the master answered, "Are they company's signals?" and that he replied, "I do not know, but they appear to me to be white rockets." The master told him to "go on Morsing," and, when he received any information, to send the apprentice down to him with it. Gibson states that Mr. Stone informed him that he had reported to the master, and that the master had said the steamer was to be called up by Morse light. This witness thinks the time was 12.55; he

at once proceeded again to call the steamer up by Morse. He got no reply, but the vessel fired three more white rockets; these rockets were also seen by Mr. Stone.

Both Mr. Stone and the apprentice kept the steamer under observation, looking at her from time to time with their glasses. Between 1 o'clock and 1.40 some conversation passed between them. Mr. Stone remarked to Gibson: "Look at her now, she looks very queer out of water, her lights look queer." He also is said by Gibson to have remarked, "A ship is not going to fire rockets at sea for nothing;" and admits himself that he may possibly have used that expression.

Mr. Stone states that he saw the last of the rockets fired at about 1.40, and after watching the steamer for some 20 minutes more he sent Gibson down to the master.

I told Gibson to go down to the master, and be sure and wake him, and tell him that altogether we had seen eight of these white lights like white rockets in the direction of this other steamer; that this steamer was disappearing in the southwest, that we had called her up repeatedly on the Morse lamp and received no information whatsoever.

Gibson states that he went down to the chart room and told the master; that the master asked him if all the rockets were white, and also asked him the time. Gibson stated that at this time the master was awake. It was five minutes past two, and Gibson returned to the bridge to Mr. Stone and reported. They both continued to keep the ship under observation until she disappeared. Mr. Stone describes this as "A gradual disappearing of all her lights, which would be perfectly natural with a ship steaming away from us."

At about 2.40 a. m. Mr. Stone again called up the master by voice pipe and told him that the ship from which he had seen the rockets come had disappeared bearing SW. 1/2 W., the last he had seen of the light; and the master again asked him if he was certain there was no color in the lights. "I again assured him they were all white, just white rockets." There is considerable discrepancy between the evidence of Mr. Stone and that of the master. The latter states that he went to the voice pipe at about 1.15, but was told then of a white rocket (not five white rockets). Moreover, between 1.30 and 4.30, when he was called by the chief officer (Mr. Stewart), he had no recollection of anything being reported to him at all, although he remembered Gibson opening and closing the chart-room door.

Mr. Stewart relieved Mr. Stone at 4 a. m. The latter told him he had seen a ship 4 or 5 miles off when he went on deck at 12 o'clock, and at 1 o'clock he had seen some white rockets, and that the moment the ship started firing them she started to steam away. Just at this time (about 4 a. m.) a steamer came in sight with two white masthead lights and a few lights amidships. He asked Mr. Stone whether he thought this was the steamer which had fired rockets, and Mr. Stone said he did not think it was. At 4.30 he called the master and informed him that Mr. Stone had told him he had seen rockets in the middle watch. The master said, "Yes, I know; he has been telling me." The master came at once on to the bridge, and apparently took the fresh steamer for the one which had fired rockets, and said, "She looks all right; she is not making any signals now." This mistake was not corrected. He, however, had the wireless operator called.

At about 6 a. m. Capt. Lord heard from the *Virginian* that the "*Titanic* had struck a berg, passengers in boats, ship sinking;" and he at once started through the field ice at full speed for the position given.

Capt. Lord stated that about 7.30 a. m. he passed the *Mount Temple*, stopped, and that she was in the vicinity of the position given him as where the *Titanic* had collided (lat. 41° 46' N.; long. 50° 14' W.). He saw no wreckage there, but did later on near the *Carpathia*, which ship he closed soon afterwards, and he stated that the position where he subsequently left this wreckage was 41° 33' N.; 50° 1' W. It is said in the evidence of Mr. Stewart that the position of the *Californian* was verified by stellar observations at 7.30 p. m. on the Sunday evening, and that he verified the captain's position given when the ship stopped (42° 5' N.; 50° 7' W.) as accurate on the next day. The position in which the wreckage was said to have been seen on the Monday morning was verified by sights taken on that morning.

All the officers are stated to have taken sights, and Mr. Stewart in his evidence remarks that they all agreed. If it is admitted that these positions were correct, then it follows that the *Titanic's* position as given by that ship when making the CQD. signal was approximately S. 16° W. (true), 19 miles from the *Californian*; and further that the position in which the *Californian* was stopped during the night, was 30 miles away from where the wreckage was seen by her in the morning, or that the wreckage had drifted 11 miles in a little more than five hours.

There are contradictions and inconsistencies in the story as told by the different witnesses. But the truth of the matter is plain. The *Titanic* collided with the berg at 11.40. The vessel seen by the *Californian* stopped at this time. The rockets sent up from the *Titanic* were distress signals. The *Californian* saw distress signals. The number sent up by the *Titanic* was about eight. The *Californian* saw eight. The time over which the rockets from the *Titanic* were sent up was from about 12.45 to 1.45 o'clock. It was about this time that the *Californian* saw the rockets. At 2.40 Mr. Stone called to the master that the ship from which he had seen the rockets had disappeared. At 2.20 a. m. the *Titanic* had foundered. It was suggested that the rockets seen by the *Californian* were from some other ship, not the *Titanic*. But no other ship to fit this theory has ever been heard of.

These circumstances convince me that the ship seen by the *Californian* was the *Titanic*, and if so, according to Capt. Lord, the two vessels were about 5 miles apart at the time of the disaster. The evidence from the *Titanic* corroborates this estimate, but I am advised that the distance was probably greater, though not more than 8 to 10 miles. The ice by which the *Californian* was surrounded was loose ice extending for a distance of not more than 2 or 3 miles in the direction of the *Titanic*. The night was clear and the sea was smooth. When she first saw the rockets, the *Californian* could have pushed through the ice to the open water without any serious risk and so have come to the assistance of the *Titanic*. Had she done so she might have saved many if not all of the lives that were lost.

VI.—THE BOARD OF TRADE'S ADMINISTRATION.

The court was invited by the board of trade—

"to report upon the rules and regulations made under the merchant shipping acts, 1894-1906, and the administration of those acts, and of such rules and regulations so far as the consideration thereof is material to this casualty" (No. 26 of the questions

submitted to the court by the board of trade).

Charges were made against the board of trade during the progress of the inquiry of a twofold kind. First, it was said that the board had been negligent in that they had failed to keep up to date their rules and regulations relating generally to the provision of life-saving appliances at sea, and, secondly, it was said that their officials had in the particular instance of the *Titanic* failed to exercise due care in the supervision of the vessel's plans and the inspection of the work done upon her.

With reference to the first of these charges, it was reduced in the course of the inquiry to a charge of neglect to keep the board's scale for the provision of lifeboat accommodation up to date. The circumstances are these: In March, 1886, the board appointed a departmental committee, consisting of three of their principal officers, to inquire into the question of boats, rafts, and life-saving apparatus carried by sea-going merchant ships. In their report this committee pointed out that, as regards boats for ocean-going steamers carrying large numbers of passengers, the boats would be of little use in saving life (although they might for a time prolong its existence) unless succor were at hand from other ships or from proximity to shore; and speaking with special reference to passenger steam vessels carrying emigrants across the Atlantic to ports on the east coast of North America, they said as follows:

Considering the number of vessels employed in this trade, and the large number of passengers they carry, and also taking into consideration the stormy character of the ocean they have to cross, and the thick and foggy weather encountered, we think this class is the most important of any, and we can not pass over the fact that of late years this traffic has been carried on with remarkable immunity from loss of life.

The boat accommodation these vessels are forced to carry when sailing with emigrants is regulated by the scale in the passengers act, 1855, which provides for boat accommodation for 216 people as a maximum, so that, supposing a vessel leaves with 1,000 passengers and 200 crew under the present statutory requirements, she need only carry sufficient boat accommodation for 216 of these people. Thus it will be seen that the boats carried by this class of vessels are also quite inadequate as an effectual means of saving life should a disaster happen to a ship with her full complement of passengers on board. We are glad to be able to say that there are many liberal and careful shipowners who do all in their power to provide for the safety of their passengers by equipping their vessels with boats far in excess of the number required by statute. But, at the same time, there are others carrying large numbers of emigrants who do no more than they are required to do by law.

We have gone into this question with reference to this class of vessels very fully, and have visited many of them, and we think that the boats required by act should be increased 100 per cent., and in addition to them that the owners should be induced to carry sufficient collapsible boats and approved rafts, so that each ship shall have sufficient life-saving gear for all on board at any one time, provided, as said before, that no ship need carry more boat accommodation than is sufficient for all on board at that time.

In 1887 a select committee of the House of Commons, of which Lord Charles Beresford was the chairman, was appointed to report on saving life at sea, and they found in their report—

That many passenger ships could not, without great inconvenience, carry so many of the ordinary wooden boats as would suffice to carry the whole of the passengers and crew with safety in bad weather. Under such circumstances the crew would not be sufficient to man so many boats; nor could they all be got into the water in sufficient time in the event of very rapid foundering. Having regard, however, to the fact that accidents occur probably as often in moderate weather as in bad, and having regard also to the fact that the very cause of the accident frequently incapacitates many of the boats, and to the further fact that an insufficiency of boats undoubtedly tends to cause panic, we are of opinion that all sea-going passenger ships should be compelled by law to carry such boats, and other life-saving apparatus, as would in the aggregate best provide for the safety of all on board in moderate weather.

As a result of these reports, the merchant shipping (life-saving appliances) act, 1888, appears to have been passed, under which rules were made by the board of trade at different dates. The merchant shipping act, 1894, repealed the act of 1888, and substituted therefor sections 427 to 431 and the seventeenth schedule of the new act. Under this act (1894) a table showing the minimum number of boats to be placed under davits and their minimum cubic contents was issued by the board. It was dated March 9, 1894, and came into operation on June 1 of that year. This table was based on the gross tonnage of the vessels to which it was to apply, and not upon the numbers carried, and it provided that the number of boats and their capacity should increase as the tonnage increased. The table, however, stopped short at the point where the gross tonnage of the vessels reached "10,000 and upwards." As to all such vessels, whatever their size might be, the minimum number of boats under davits was fixed by the table at 16, with a total minimum capacity of 5,500 cubic feet.

But as regarded emigrant steamships there was a rule which provided that if the boats under davits required by the table did not furnish sufficient accommodation for all on board, then additional boats of approved description (whether under davits or not) or approved life rafts should be carried, and that these additional boats or rafts should be of at least such carrying capacity that they and the boats required by the table should provide together in vessels of 5,000 tons and upwards three-fourths more than the minimum cubic contents required by the table, so that in the case of an emigrant ship such as the *Titanic* the requirements under the rules and table together exacted a provision of 9,625 cubic feet of lifeboat and raft accommodation (5,500 feet in boats under davits with three-fourths, namely, 4,125, added). Taken at 10 cubic feet per person, this would be equivalent to a provision for 962 persons. No doubt at the time these rules were made and this table was drawn up it was thought that, having regard to the size of vessels then built and building, it was unnecessary to carry the table further. The largest emigrant steamer then afloat was the *Lucania*, of 12,952 tons.

In the report of the select committee of the House of Commons a reference to water-tight bulkheads had been made, which was in the following terms:

Though the question of construction was clearly not included in the reference to the committee, still they think it only right to state, after having heard the evidence, that the proper placing of bulkheads, so as to enable a ship to keep afloat for some length of time after an accident has occurred, is most important for saving life at sea, and a thing upon which the full efficiency of life-saving appliances largely depends.

This passage probably explains the insertion in the board of trade's rules for life-saving appliances of rule No. 12, which is as follows:

Water-tight compartments.—When ships of any class are divided into efficient water-tight compartments to the satisfaction of the board of trade, they shall only be required to carry additional boats, rafts and buoyant apparatus of one-half of the capacity required by these rules, but the exemption shall not extend to life jackets or similar approved articles of equal buoyancy suitable to be worn on the person.

If this rule had become applicable to the *Titanic*, then the total cubical lifeboat or raft accommodation which she would have been required to carry would not have been more than 7,562 (equivalent to accommodation for 756 persons). It did not, however, become applicable for the owners never required the board of trade to express any opinion under the rule as to the efficiency of the water-tight compartments. The *Titanic*, in fact, carried boat accommodation for 1,178 persons, a number far in excess of the requirements of the table and rules, and therefore no concession under rule 12 was needed. Speaking generally, recourse to this rule (12) by shipowners has been so insignificant that the rule itself may be regarded as of no practical account.

The foregoing rules with the table were laid before Parliament in the usual way, and so received the required statutory sanction.

After 1894 steamers were built of a much larger tonnage than 10,000, the increase culminating in the *Titanic*, with a gross tonnage of 46,328. As the vessels built increased in size, one would have thought the necessity for increased lifeboat accommodation would grow; but the rules and table remained stationary and nothing was done to them by way of change. The explanation of this long delay (from 1894-1912) was given before me by Sir Alfred Chalmers, who had served under the board of trade as nautical adviser from 1896 to August, 1911. He is now retired. I think it will be well if I give his explanation in his own words. He says:

I considered the matter very closely from time to time. I first of all considered the record of the trade—that is to say, the record of the casualties—and to see what immunity from loss there was. I found it was the safest mode of travel in the world, and I thought it was neither right nor the duty of a state department to impose regulations upon that mode of travel as long as the record was a clean one. Secondly, I found that as ships grew bigger there were such improvements made in their construction that they were stronger and better ships, both from the point of view of water-tight compartments and also absolute strength, and I considered that that was the road along which the shipowners were going to travel, and that they should not be interfered with. I then went to the maximum that is down in the table, 16 boats and upward, together with the supplementary boats, and I considered from my experience that that was the maximum number that could be rapidly dealt with at sea and that could be safely housed without incumbering the vessel's decks unduly. In the next place I considered that the traffic was very safe on account of the routes, the definite routes being agreed upon by the different companies, which tended to lessen the risk of collision and to avoid ice and fog. Then again, there was the question of wireless telegraphy, which had already come into force on board of these passenger ships. I was seized of the fact that in July, 1901, the *Lucania* had been fitted with wireless telegraphy, and the Cunard Line generally fitted it during that year to all their ships. The Allan Line fitted it in 1902, and I am not sure that in 1904 it had not become quite general on the trans-Atlantic ships. That, of course, entered into my consideration as well. Then another point was the manning. It was quite evident to me that if you went on crowding the ships with boats you would require a crew which were not required otherwise for the safe navigation of the ship, or for the proper upkeep of the ship, but you are providing a crew which would be carried uselessly across the ocean, that never would be required to man the boats. Then the last point, and not the least, was this, that the voluntary action of the owners was carrying them beyond the requirements of our scale, and when voluntary action on the part of shipowners is doing that, I think that any state department should hold its hand before it steps in to make a hard and fast scale for that particular type of shipping. I considered that that scale fitted all sizes of ships that were then afloat, and I did not consider it necessary to increase it, and that was my advice to Sir Walter Howell.

I appreciate this explanation, and I think there is much force in it. At the same time, it seems to me that it does not justify the delay. Even taking all these matters into consideration, it can not be that the provision for boat accommodation made in 1894 for vessels of 10,000 tons and upward remained sufficient to 1910, when vessels of 45,000 tons were being built. Two considerations demonstrate this. The first is that some shipowners recognized the insufficiency of the requirements of the board of trade, and voluntarily exceeded those requirements by providing larger boat accommodation than the old rules and table exacted. The second is that shortly before Sir Alfred Chalmers left the board of trade, the board had begun to direct attention to the amending of their rules in this connection.

It appears that in November, 1910, a question was asked in the House of Commons as to whether the attention of the president of the board of trade had been called to the fact that the *Olympic*, a sister ship of the *Titanic*, was provided with 14 lifeboats only. The answer given was that the *Olympic* (which was then in course of construction) would carry 14 lifeboats and two ordinary boats of an aggregate capacity of 9,752 cubic feet, which was in excess of the requirements of the statutory rules. On February 15, 1911, a further question was asked as to the date of the last regulations, and whether, having regard to the increased tonnage of modern ships, the desirability of revising the regulations would be considered by the board of trade. The answer by the president was:

Those regulations were last revised in 1894. The question of their further revision is engaging the serious attention of the board of trade, and I have decided to refer the matter to the merchant shipping advisory committee for consideration and advice.

Three days afterwards, namely, on February 18, 1911, a circular letter was sent out by the board of trade to the board's principal officers at Liverpool, London, and Glasgow asking each of those gentlemen to draft such an extension of the existing boat scale as he might think satisfactory and reasonable for the conditions of large passenger steamers. This circular letter was answered by the principal officer in Glasgow (Mr. Harris) on February 24, 1911, by the principal officer in London (Mr. Park) on February 27, 1911, and by the principal officer in Liverpool (Mr. Young) on March 3, 1911. It is sufficient to say of these answers that they all suggested a large extension of the statutory requirements.

Meanwhile, namely, on February 28, 1911, Mr. Archer, the board of trade's principal ship surveyor, had also drawn up a scale. This was a more exacting scale than that of any of the three principal officers. By his scale a vessel of the tonnage of the *Titanic* would have had to carry boat accommodation equivalent to at least 24,937 cubic feet, which would have been sufficient to hold all and more than all the persons who were on board at the time of the disaster (2,201). It would not, however, have been nearly sufficient to have held all that the vessel might lawfully have carried, viz, 3,547, and it is to be observed with reference to Mr. Archer's scale that in it he suggests an extension of rule 12, by which (if the vessel were divided into efficient water-tight compartments) the total boat accommodation might be reduced much more than rule 12 as it stands would permit. If this reduction be taken into

account, the boat accommodation would fall so that it would be sufficient only for 1,750 persons. Mr. Archer's view was that shipowners should be encouraged to increase the floatability of the ships they built, and that the way to encourage them was to relax the legal requirements as to boats as their plans advanced in that direction. The great object was so to build the ship that in the event of a disaster she would be her own lifeboat.^[4]

Having obtained these four reports, the board of trade, on April 4, 1911, submitted the matter to their advisory committee, and obtained the committee's report on July 4, 1911. The following are copies (with omissions of immaterial passages) of the board of trade's letter of April 4, 1911, and of the advisory committee's report of July 4, 1911:

BOARD OF TRADE, MARINE DEPARTMENT,
7 WHITEHALL GARDENS,
London, SW., April 4, 1911.

SIR: I am directed by the board of trade to inclose herewith, for the information of the merchant shipping advisory committee, a copy of a question asked in the House of Commons on February 15 and of the answer given by the president of the board of trade with reference to the life-saving appliances rules made under section 427 of the merchant shipping act, 1894.

The board are of opinion that the table in the appendix to the rules should be extended upward in the form indicated in the accompanying scale, so as to provide for vessels of tonnage up to 50,000 tons gross and upward.

It appears to the board that the number of boats and the boat capacity need not necessarily increase in a regular proportion according to the increase in tonnage, and that due regard should be paid to what is reasonable and practicable in passenger steamers exceeding 10,000 tons. * * *

I am to state that the board would be obliged if the merchant shipping advisory committee would be so good as to suggest in what manner the scale (see accompanying copy) should be continued upward, having due regard to the considerations indicated above.

I am further to state that the board would be glad to learn whether the advisory committee are of opinion that rule 12 should or should not be revised so as to exempt altogether from the requirement of additional boats or rafts those vessels which are divided into efficient water-tight compartments to the satisfaction of the board of trade. * * *

I am, etc.,

WALTER J. HOWELL.

The SECRETARY,
Merchant Shipping Advisory Committee

MERCHANT SHIPPING ADVISORY COMMITTEE,
July 4, 1911.

SIR: We have the honor to report that your letter of April 4 with reference to the minimum number of lifeboats to be earned on vessels of 10,000 tons gross tonnage and upward, and your letter of May 17 on the subject of the depth of lifeboats, have been very carefully considered by the merchant shipping advisory committee and that it was unanimously decided at a meeting held on the 29th ultimo to adopt the report of a subcommittee which was specially appointed to inquire into these questions.

A copy of the report is accordingly forwarded herewith, and the committee desire us to suggest for the consideration of the board of trade that effect should be given to the recommendations contained in it.

We are, etc.,

NORMAN HILL, *Chairman.*
R. W. MATTHEW, *Secretary.*

SIR WALTER J. HOWELL,
Assistant Secretary Marine Department, Board of Trade.

REPORT OF THE LIFE-SAVING APPLIANCES SUBCOMMITTEE TO THE MERCHANT SHIPPING ADVISORY COMMITTEE.

In accordance with the decision of the merchant shipping advisory committee, at their meeting on Friday, April 28, we have given careful consideration to the latter of April 4 from the board of trade, in which the committee were asked to advise: (1) As to the manner in which the table in the appendix to the Life-Saving Appliances Rules should be extended so as to provide for vessels of tonnage up to 50,000 tons gross and upward; and (2) as to whether rule 12 should or should not be revised so as to exempt altogether from the requirement of additional boats and (or) rafts, those vessels which are divided into efficient water-tight compartments to the satisfaction of the board of trade.

In considering these questions, we have had specially in mind the fact that the number of passengers carried does not necessarily increase in proportion to the increase in the tonnage of the vessel. This is particularly true in the case of vessels exceeding 10,000 tons, a type of vessel which is practically only built to provide special accommodation for large numbers of first and second class passengers.

Similarly there is no fixed relation between the tonnage of vessels and the deck space available for the carrying of lifeboats under davits. Increase in the length of a vessel is only one of the factors, and often not the most material factor contributing to the increase in its tonnage, and it should also be remembered, in estimating the space available for the launching of lifeboats, that it is impossible to place davits forward of the bridge, and very undesirable to have them on the quarters of the vessel.

We are strongly of opinion that every encouragement should be given to secure the provision of vessels which by their construction have been rendered as unsinkable as possible, and which are provided with efficient means for communicating with the shore or with other vessels in case of disaster.

In view of these considerations, we have agreed upon the following recommendations:

1. That it is questionable whether it is practicable to increase the number of davits.
2. That any increase in the number of lifeboats to be carried can probably be best effected by providing for the launching of further boats from the existing davits.

3. That the table should be extended in the manner indicated below, viz.:

Gross tonnage.	Minimum number of boats to be placed under davits.	Minimum number of additional boats to be readily available for attachment to davits.	Total minimum cubic contents of boats required by columns 2 and 3.
			<i>Cubic feet.</i>
10,000 and under 12,000	16	—	,500
12,000 and under 20,000	16	2	6,200
20,000 and under 35,000	16	4	6,900
35,000 and under 45,000	16	6	7,600
45,000 and upward	16	8	8,300

It is further recommended that all passenger vessels of 10,000 tons gross tonnage and upward should be required to be fitted with wireless telegraphy apparatus.

4. That the rules should be amended so as to admit of decked lifeboats of an approved type being stowed on top of one another or under an open lifeboat, subject to suitable arrangements being made for launching promptly the boats so stowed.

5. That the additional boats and rafts required under the provisions of Division A, class 1(d) of the Life-Saving Appliances Rules shall be of at least such carrying capacity that they, and the boats required by columns 2 and 3 of the above table, provide together three-fourths more than the minimum cubic contents required by column 4 of that table.

6. That vessels divided into efficient water-tight compartments to the satisfaction of the board of trade should (provided they are fitted with wireless telegraphy apparatus) be exempt from the requirement of additional boats and (or) rafts. The committee suggest, in this connection, that the board of trade should review the requirements designed to attain the standards as to water-tight compartments at present enforced by them under rule 12, having regard to the developments of shipbuilding since the report of the committee on the spacing and construction of water-tight bulkheads.

We have also had before us the board's further letter of May 17 inquiring whether, in the opinion of the advisory committee, it would be advisable to prescribe a maximum depth for lifeboats as compared with their breadth, and, if so, what that proportion should be.

In connection with this letter we have been supplied by the board of trade with reports from their principal officers in Great Britain, giving the dimensions and cubic capacities of the various kinds of boats on five typical ships in each of eight ports.

We recommend that the board should be advised to alter the Life-Saving Appliances Rules so as to provide that, in future, the depth of lifeboats supplied to a British merchant vessel shall not exceed 44 per cent. of their breadth.

NORMAN HILL.	A. M. CARLISLE.
S. CROSS.	WM. THEODORE DOXFORD.
GEO. N. HAMPSON.	ROBERT A. OGILVIE.
T. ROYDEN.	T. ROME.
THOMAS SPENCER.	J. HAVELOCK WILSON.

It will be observed that if effect had been given by the board of trade to the report of the advisory committee the requirements for a vessel of the size of the *Titanic* would have reached 14,525 cubic feet (8,300 plus three-fourths of 8,300, namely, 6,225), with, however, this qualification that if the vessel were divided into efficient water-tight compartments (as she probably was) and fitted with wireless telegraphy (as she certainly was) a provision of a boat capacity of 8,300 cubic feet, equivalent to space for 830 persons, would have been legally sufficient. This would have been much less than the accommodation with which the *Titanic* when she put to sea was, in fact, provided (namely, for 1,178 persons).

Effect, however, was not given to the report. A question arose with reference to the dimensions of lifeboats, and it was thought better to get that question settled before proceeding to revise the rules. The examination of this question involved making several experiments which caused delay; and it was not until April 16, 1912, that a reply was sent by the board of trade to the advisory committee. It will be noticed that the date of this reply is just after the disaster to the *Titanic* became known. I am, however, quite satisfied that instructions for the preparation of this letter had been given in the offices of the board of trade some days before the 16th, and that the letter was not sent in consequence of the disaster. It is desirable to set it out.

BOARD OF TRADE, MARINE DEPARTMENT,
7 WHITEHALL GARDENS,
London, S. W., April 16, 1912.

SIR: With reference to your letter of the 4th July last respecting certain questions raised in connection with the proposed revision of the Life-Saving Appliances Rules, I am directed by the board of trade to state, for the information of the advisory committee, that they have given very careful consideration to the report of the life-saving appliances subcommittee which was forwarded with your letter.

As regards the recommendations with reference to the proposed extension of the table (appendix to the Life Saving Appliances Rules) showing the minimum number of boats to be placed under davits, the board are glad to observe that the committee agree that alterations and additions are now necessary to meet the changed conditions due to recent developments in the size of passenger steamships and in the number of persons which these vessels can accommodate.

The board of trade note that the gradations of tonnage in the extension of the scale suggested by the advisory committee are not

the same as those in the form of scale submitted to them by the board; while the increase in the number of boats is not in the number to be placed under davits, but in the number of additional boats required to be readily available for attachments to davits. It is observed that the committee hold the view that "it is questionable whether it is practicable to increase the number of davits," and "that any increase in the number of lifeboats to be carried can probably be best effected by providing for the launching of further boats from the existing davits."

The board presume that, in arriving at these conclusions, the committee have had regard to ships already built rather than to new ships, as they see no reason why there would be any difficulty in having more than eight pairs of davits on each side of the ship, provided that the requirements of Life-Saving Appliances Rules were known before the plans were prepared.

The board are of opinion that a very careful and thorough revision of the table should now be made, and I am to transmit herewith a copy of a memorandum and tables prepared by the professional advisor to the marine department, containing a full and considered opinion on the subject of the extension of the boat scale and cognate questions.

As regards the proposed amendment of the rules, so as to admit of decked lifeboats of an approved type being stowed one above another, or under an open lifeboat, I am to state that this question is now under consideration, and a communication will be addressed to you shortly on the subject.

With reference to the advisory committee's recommendation regarding the amendment of rule 12 of the general rules, the board desire me to state that the questions raised in the recommendation are of wide application and of such importance that the board do not think that they can be adequately considered except by a committee of equal standing to the committee which reported in 1891 on the spacing and construction of water-tight bulkheads in the mercantile marine. The board have the question of the appointment of a committee under consideration.

In connection with the advisory committee's recommendation that the depth of lifeboats shall not exceed 44 per cent. of their breadth, I am to transmit herewith, for their consideration, a draft amendment of rules Nos. 1, 2, and 3 of the general rules with reference to the construction of ships' boats.

The board have made full inquiry into the question of the construction of ships' boats, and obtained some useful information as to the average depth of boat which is deemed desirable for safety and utility, and the ratio of that depth to the breadth, and they attach so much importance to this element of boat construction that they think it should receive the careful attention of the committee. The board think that the committee, in the light of this additional information, may reconsider the opinions expressed on this point in their letter of July 4.

I am therefore to transmit herewith copies of memoranda by the professional adviser to the marine department and the acting principal ship surveyor.

The board desire me to state that they would be glad to be furnished with the advisory committee's views as to the application of the proposed new rules and boat scale, e. g., whether they should apply to ships already built, and if so, to what extent. They regard it as of great importance, on the one hand, that all British vessels should be provided with a proper and sufficient equipment of life-saving appliances, and, on the other, that regulations should not be enforced without notice which would necessitate important structural alterations and consequent heavy expense in vessels already built.

I am to add that in order to make the constitution of the committee, when considering this question, agree with that of the statutory life-saving appliances committee indicated in the seventeenth schedule to the merchant shipping act, 1894, the board have followed the course adopted on previous occasions, and have invited Lloyd's Register of British and Foreign Shipping and the Institute of London Underwriters to select a representative who will be available to sit on the advisory committee when the question is under consideration.

I am, etc.,

WALTER J. HOWELL.

The SECRETARY,
Merchant Shipping Advisory Committee,
7, Whitehall Gardens, S. W.

EXTENSION OF LIFE-SAVING APPARATUS TABLES.

It will be seen that I have given priority in importance to the form of ships' boats rather than to their number on the principle that a few reliable boats are of greater value than a large number of indifferent ones; but if the former desirable condition can be obtained by the proposed alterations in our rules as to measurement, etc., we are freer to approach the question of adding to the number of boats provided for in the existing tables.

As with the question of ratio D: B dealt with by the advisory committee last year, so with the question of boat increase and relative increase of cubic capacity dealt with by them on the same occasion, perhaps the board might inform the committee that they are not satisfied that a slightly different recommendation might not have been made had the matter been still further considered at the time.

Referring to the table of boat capacities computed by them particularly it might be helpful if the board laid before them for consideration the table, which I attach hereto and submit, as showing a more reasonable proportionate increase in capacity than appears so far, in my opinion, in the other papers before us. It will be seen in this statement that the number of boats recommended by the advisory committee is practically retained, but the unit of increase in capacity is put at 300 cubic feet.

Perhaps I should state here what actuated me in fixing upon this rate of increase. I realized that in all probability it would become the practice on these large liners to provide boats under davits which would contain the entire cubic feet required by the L. S. A. Rules, that is—the quantity required by rule under davits plus the addition of three-fourths and it occurred to me that if, after the figure 5,500 cubic feet the increase of capacity were uniform and moderate it would result in a total at 1-3/4 which would by incidence fit in with the scale of boats already recommended as requisite in the report of the advisory committee and in my own, i. e., assuming that the boats are of 500 cubic feet. Example: Take a vessel of 30,000 tons and under 35,000 tons, according to the table I submit she would be required to have by the 1-3/4 rule a total boat capacity of 12,500 cubic feet which at 500 cubic feet per boat equals 24 boats nearly. There should be no difficulty on the large ships in carrying this quantity under davits, i. e., 18 directly under davits and six boats inboard.

Please see incidental table attached.

(Mr. A. H. Young, professional adviser of the board of trade.)

MARCH 28, 1912.

Proposed extension of boat scale.

	Minimum total cubic contents of
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Gross tons.	Boats.	boats required to be carried under davits.
		<i>Cubic feet.</i>
10,000 and under 12,000	16	5,500
12,000 and under 15,000	18	5,800
15,000 and under 20,000	20	6,100
20,000 and under 25,000	22	6,400
25,000 and under 30,000	24	6,700
30,000 and under 35,000	24	7,000
35,000 and under 40,000	24	7,300
40,000 and under 45,000	24	7,600
45,000 and under 50,000	26	7,900
50,000 and upward	26	8,200

Please see the accompanying incidental table showing how this number of boats can provide for the three-quarters additional capacity also, if of about 500 cubic feet per boat to 600 cubic feet.

A. H. Y.

Table of incidence (informative).

Gross tons.	Number of boats.	Cubic feet.	Cubic feet additional.	Total cubic feet at 1-3/4.	Equivalent boats.	
					At 500 cubic feet.	At 600 cubic feet.
10,000 and under 12,000	16	5,500	4,125	9,625	19	16
12,000 and under 15,000	18	5,800	4,350	10,150	20	16
15,000 and under 20,000	20	6,100	4,575	10,675	21	18
20,000 and under 25,000	22	6,400	4,800	11,200	22	19
25,000 and under 30,000	24	6,700	5,025	11,725	24	20
30,000 and under 35,000	24	7,000	5,250	12,250	24	20
35,000 and under 40,000	24	7,300	5,475	12,775	25	21
40,000 and under 45,000	24	7,600	5,700	13,300	26	22
45,000 and under 50,000	26	7,900	5,925	13,825	27	23
50,000 and upward	26	8,200	6,150	14,350	28	24

One-fourth of the above boats may be carried inboard, but they should not exceed 500 cubic feet in capacity, so that they may be readily drawn up to the davits.

A. H. Y.

MARCH 30, 1912.

DRAFT AMENDMENT OF GENERAL RULES.

(1) *Boats.*—All boats shall be constructed and properly equipped as provided by these rules, and shall be of such form and proportions that they shall have sufficient freeboard, and ample stability in a seaway, when loaded with their full complement of persons and equipment.

All thwart and side seats must be fitted as low in the boat as practicable, and bottom boards must be fitted so that the thwarts shall not be more than 2 feet 9 inches above them.

All boats and other life-saving appliances are to be kept ready for use to the satisfaction of the board of trade. Internal buoyancy apparatus may be constructed of wood, or of copper or yellow metal of not less than 18 ounces to the superficial foot, or of other durable material.

SECTION (A). A boat of this section shall be a lifeboat of whaleboat form, properly constructed of wood or metal, having for every 10 cubic feet of her capacity, computed as in rule (2), at least 1 cubic foot of strong and serviceable inclosed air-tight compartments, so constructed that water can not find its way into them. In the case of metal boats an addition will have to be made to the cubic capacity of the air-tight compartments, so as to give them buoyancy equal to that of the wooden boat.

SEC. (B). A boat of this section shall be a lifeboat, of whaleboat form properly constructed of wood or metal, having inside and outside buoyancy apparatus together equal in efficiency to the buoyancy apparatus provided for a boat of section (A). At least one-half of the buoyancy apparatus must be attached to the outside of the boat.

SEC. (C). A boat of this section shall be a lifeboat, properly constructed of wood or metal, having some buoyancy apparatus attached to the inside and (or) outside of the boat, equal in efficiency to one-half of the buoyancy apparatus provided for a boat of section (A) or section (B). At least one-half of the buoyancy apparatus must be

attached to the outside of the boat.

SEC. (D). A boat of this section shall be a properly constructed boat of wood or metal.

SEC. (E). A boat of this section shall be a boat of approved construction, form, and material, and may be collapsible.

(2) *Cubic capacity.*—The cubic capacity of an open boat and of a deck boat of section (D) or section (E) shall be ascertained by multiplying the product of the length, breadth, and depth by 6, subject, however, to the following provisions:

The length shall be measured from the foreside of the rabbet on the stem to the afterside of the rabbet on the sternpost, and the breadth shall be measured from the outside of plank to the outside of plank amidships. The actual depth shall be measured from the top of the gunwale to the top of the bottom plank next to the keel, but the depth used in calculating the cubic capacity shall not in any case exceed 3.6 feet; and if the actual depth measured is equal to or less than 3.6 feet, the depth used in calculating the cubic capacity shall not exceed 45 per cent of the breadth measured, as indicated above.

If the oars are pulled in rowlocks, the bottom of the rowlock is to be considered as the gunwale in measuring the depth of the boat.

If any question is raised requiring absolute accuracy, the cubic capacity of a boat shall be ascertained by Stirling's rule, subject to the foregoing provisions as to depth.

(3) *Number of persons for boats.*—(A) Subject to the provisions of paragraphs (b) (c) and (d) of this clause the number of persons^[5] an open boat of section (A) shall be deemed fit to carry shall be the number of cubic feet ascertained as in rule (2) divided by 10, and the number of persons^[6] an open boat of section (B) or section (C), or an open or decked boat of section (D) or section (E) shall be deemed fit to carry shall be the number of cubic feet ascertained as in rule (2) divided by 8. The space in the boat shall be sufficient for the seating of the persons carried in it and for the proper use of the oars.

(B) An open boat of section (A) or section (B) or section (C) or section (D) or section (E) shall not be deemed to be fit to carry the number of persons ascertained as in paragraph (A) of this clause unless the boat is so constructed that it has a mean sheer of at least half an inch for each foot of its length and that the boat's half-girth amidships measured outside the planking from the side of the keel to the top of the gunwale is at least equal to nine-tenths of the sum of the boat's depth inside and half its maximum breadth amidships, and that the mean of the half-girths measured in the same manner at two points, one-quarter of the length of the boat from the stem and sternpost, respectively, is at least equal to eight-tenths of the sum of the depth inside and half the maximum breadth amidships.

(C)—A decked boat of section (D) or section (E) shall not be deemed to be fit to carry the number of persons ascertained as in paragraph (A) of this clause, unless the top of the deck amidships is at a height above the water approved by the board of trade, when the boat is so loaded.

(D)—If the surveyor is doubtful as to the number of persons any open or decked boat is fit to carry, he may require the boat to be tested afloat with the intended number of persons on board.

(E)—The rules numbers 1, 2, and 3, as now amended, are not to be retrospective, and are to apply only to boats built after.

SHIP'S BOATS.

The salient feature of the reports of the board's officers on this subject is the consensus of opinion that the form of a boat is the chief factor to be considered in determining its value as a life-saving appliance.

It has been found that while there are many boats of good form supplied to ships, there is yet a large proportion where the boats are not only not so good, but which can only be regarded as unsafe if they had on board anything approaching the number of persons for which they measure.

It is the latter type we are chiefly concerned with; how is it that the form has so deteriorated as to create this concern in our minds? I think the cause is not far to seek; it appears to be the outcome of (1) the shipowner's desire to carry the maximum number of persons in the minimum number of boats; (2) in the efforts of the ship-builder, as a rule, to carry out the specification in which he has contracted to supply the owners with boats at a price, often very low, and naturally he does not sublet his contract with the boatbuilder at a loss; (3) the aim of the competing boatbuilder, which is to build his boats at as little cost price as possible, and yet to provide accommodation for the prescribed number of persons. He is probably limited as to length, and therefore relies on the breadth and depth; in this direction, he is unintentionally assisted by the board's rule for measurement, viz,

$$\frac{L \times B \times D \times .6}{10}$$

or 8; so long, therefore, as he can obtain his breadth at one point for measurement purposes, it is quite immaterial to him how soon he fines away to the ends, with the result that the stability of the boat becomes almost entirely dependent upon the form of a very limited midship section, or the still smaller proportion of same that would be under water when in the loaded condition.

The boatbuilder may be further restricted as to breadth, and, therefore, he again detracts from the form a boat should have by dispensing with sheer and increasing the depth from keel to gunwale amidships. This method of building boats enables him to obtain the capacity required by the owner at the expense of the boat's stability and utility.

No doubt when the life-saving appliances rules came into being the divisors 10 and 8 for the different sections were deemed safe on the supposition that the usual full form of boat would not be largely departed from. Experience has shown, however, that form is frequently sacrificed for the unworthy objects referred to above, and it follows, therefore, that either the form should be improved or a heavier divisor laid down.

It would, I think, be more effective to deal with form and devise a rule by which we can insure that a boat will be reasonably safe with its load, not merely in smooth water, as in our recent test, but in a seaway. It is essential, therefore, to draw the attention of the advisory committee to the value the board attach to form, and particularly to that part of it under water, emphasizing the great necessity there is for an increase to the bearing surface of the under-water portion of boats, and this end can, no doubt, be best attained by the putting into practice of the

suggestions made by the principal ship surveyor for amending the rules and which aim at prolonging the form or fullness of dimension of the midship body under water well toward the ends of the boat. It is well known that by extending the body in this way greater buoyancy and stability are secured without materially affecting the speed. It is often supposed that defective stability due to bad form can be rectified by the disposition of the persons or things, but anyone with real experience of boats in a seaway can not fail to realize that this is the wrong principle to work on. Granted, therefore, that the question of form must take priority, how can it be best attained? And if we refer to Mr. Archer's method of measurement, as stated in his amendment to the rules, it will be seen how simple and effective it is. For the purpose of illustration, we might take the model of a ship's boat obtained through the board's surveyors at Glasgow, the dimensions of which enlarged to scale represent a boat of

$$\frac{L}{30.0} \times \frac{B}{8.5} \times \frac{D}{3.5}$$

and is an embodiment of the proportions amidships and at quarter distance from each end proposed by Mr. Archer.

It can not be too strongly urged that for a ship's lifeboat to be fit to carry the number of persons it measures for in any degree of safety, whenever it may be required at sea, the under-water or bearing surface should be carried out to the ends as much as possible and all straight lines avoided. The bows of many of the existing types of boat are examples of the worst possible form for safety, and the counters are as bad, if they can be said to have any.

Depth.—It appears from the reports that the most generally approved ratio of depth to the breadth is $\frac{4}{10}$.

This has been established not only by our long experience, but by the numerous tests recently conducted by the board's surveyors at various ports, and the attention of the advisory committee might be drawn to this fact.

It is, of course, necessary also to have a good freeboard, but a well-proportioned boat does not require so much freeboard as the commoner type, as with proper sheer and under-water surface she is easy in a seaway. If the gunwale is too high, there is loss of power over the oars, which is serious when for the safety of the boat she is required to be kept head-on to sea, and with a fresh breeze, even in a good boat, this is not always an easy matter.

It is a matter for consideration that at the tests made by our surveyors the conditions were most favorable, being usually in smooth water of a sheltered dock, and, in not a few instances, considerable anxiety was felt for the safety of those on board when crowded in accordance to the existing rules. If it was thus in smooth water, one dare hardly contemplate the results in a seaway. If the shipowner does not see to it that a safe type of boat is provided, then the number of persons to be accommodated in boats which do not come up to the proportions deemed safe by the board of trade should be very considerably curtailed.

A. H. Y.

MARCH 23, 1912.

CONSTRUCTION OF SHIP'S BOATS.

It will, I think, be useful to consider the principal factors that govern the dimensions of boats forming part of the life-saving apparatus in merchant ships.

The minimum number and capacity of boats are determined by the regulations, and the capacity is determined by the product of the length, breadth, and depth of the boats. As the space on the ship in which to stow the boats is generally limited, it is generally found easier to increase their depth than the length or breadth, and this is further encouraged, I believe, by the cost of boats being quoted at so much per foot in length. The builder or owner determines the dimensions of the boat; the boatbuilder is concerned merely with the construction and, in most cases, usually their form or lines.

Attention has been called by the mark lane surveyors to the form and proportions of the boats used in the Royal navy. The proportion of depth to breadth is greater than is apparent from the particulars given, as all boats larger than a 30-foot gig have 6-1/2-inch washboards above the gunwale, and even the gigs and many of the smaller boats have portable washboards. It must also be remembered that all the navy boats are square-sterned, except the whaleboat, and are designed with easy lines so as to make good sailers; no air cases are fitted, and the seats are kept very low. The boats are not provided simply as life-saving appliances; as a matter of fact, the life-saving equipment of a warship is extremely small. It is true that each type of boat is given a certain "life-saving capacity," which is ascertained by crowding in as many men as practicable with boat in still water and all equipment on board.

This number agrees closely with that obtained by the board's rule $\frac{L \times B \times D \times .6}{8}$.

These boats, moreover, have a much smaller freeboard than is considered desirable in the merchant navy; but the occupants are all under discipline and in charge of experienced seamen. In the mercantile marine it may, and often does, happen, that the boats are crowded with panic-stricken men, women, and children, and instances have occurred, I believe, wherein there has not been a single man in the boat who has ever handled an oar before. Having these points in view, I do not agree that the navy type of boat is the most suitable for our purpose.

The chief desiderata in a ship's boat as a life-saving appliance are, (1) to carry the maximum number of people without overcrowding; and with (2) a reasonable amount of stability and freeboard; (3) and without undue interference with the use of oars.

(1) Is almost wholly dependent on the length and breadth of the boat; provided (2) is satisfied; depth has very little influence on it. For example, take a boat $30 \times 9 \times 3.5$, 567 cubic feet by our rule, as a section (D) or (E) boat it should carry

$$\frac{567}{8} = 72$$

people; such a boat should allow

$$30 \times 9 \times 8$$

square feet of area per person at the gunwale, which should be ample if all sit in the bottom who can not find seating room on the side benches or thwarts.

(2) Stability and freeboard are dependent upon the boat's breadth, depth, and form. The element of length does not enter into it, and it would be most unreasonable to limit the ratio of length to breadth, as suggested from Liverpool, or to limit the depth to the cube root of the length, as proposed by one of the London surveyors. Mr. Gemmell gives particulars, M. 26,298, of four boats tested, which proved to have ample accommodation and stability for the complements allowed by the regulations; the ratio of depth to breadth varied from 0.41 to 0.45.

Capt. O'Sullivan also reported five boats which he tested with ratios of D to B, varying from 0.4 to 0.44, all except one being satisfactory, the exception being rather tender and overcrowded, due to poor lines. The freeboards of all these boats when loaded were, I think, sufficient. The depth in no case exceeded 3.6, and only in one case did the ratio exceed 0.44.

The surveyors, Liverpool, tested a boat 3.75 deep and having a ratio of $D/b = 0.41$, which proved satisfactory.

Capt. Griffiths tested a boat 4.1 deep, having a ratio $D/b = 0.455$, which he considered to be unsafe with the full complement on board.

The consensus of opinion is that the depth should not exceed 3 feet 5 inches or 3 feet 6 inches, and the ratio of D/b should not exceed 0.44. This, however, is not sufficient to guarantee sufficient seating and stability. Capt. Clarke tested a boat $24.4 \times 6.55 \times 2.45$, which was very unsafe with the rule complement on board. The ratio D/b is only 0.38 in this case. It will be seen, however, that this craft has exceptionally fine lines and is evidently quite unsuited to carry the rule complement. It is quite evident that the form of the boat must be taken into account.

The dimensions of boats vary so greatly that generally the boat builder builds his boats "to the eye," using only a midship mold; it follows that the forms of boats of the same dimensions will vary considerably and with different workmen. Something more is required than a limitation in the ratio of depth to breadth. It is desirable that the sheer should be ample, and the form not unduly fined away within the midship half length. From consideration of the particulars and lines of the boats mentioned in the surveyor's reports, I think a simple rule to regulate the form may be devised such as I will indicate later.

It is, I think, necessary to limit the depth as a factor for ascertaining the number to be accommodated. The increase of depth beyond a certain point, while unduly increasing the number of people that may be carried, increases proportionately the required air case capacity, to meet which the seats have to be raised with a corresponding increase in the height of the center of gravity and decrease in the stability and difficulty in rowing. A boat 3.6 deep would have the thwarts about 3 feet above the bottom, and any increase in this height makes it very difficult for any ordinary man to row when sitting down. In rough sea the men would have very little control over the oars if standing up. A further objection to the very deep boat is its small stability in the light condition. It is not, I believe, an unusual occurrence for such boats to capsize in rough weather, before the passengers or crew can be got into them, and I have myself seen such a boat capsize in dock with only two men in it; due to lumpy water and a stiff breeze catching it on the beam when coming out of the shelter afforded by the dock wall.

I do not think, however, any limit of depth should be imposed, except as a measure of capacity. Any rules that may be devised should be such as are of easy and ready application, and which will not bear harshly on the boats that have already been accepted. I therefore suggest that the present rules will sufficiently meet the case, with the following modification.

In no case should the depth to be used in general rule (2) exceed 3.6 feet and 45 per cent of the breadth. In all cases where the actual depth is 45 per cent of the breadth or less, the maximum number of persons, as ascertained by rule (3) should not be allowed unless the boat has been found capable of carrying that number by actual test in the water, or unless the boat has at least 1/2 inch of sheer per foot of length, and the half-girth amidships, measured outside the plank, from the side of the keel to the top of the gunwale, is at least 90 per cent of the sum of the depth and the half breadth, and the mean of the half girths as similarly measured at one quarter the boat's length from the stem and stern post are at least 80 per cent of the sum of the midship depth and half breadth.

The thwarts and side benches should be kept as low as practicable, and the bottom boards should be so fitted that the height of the thwarts above them will not exceed 2 feet 9 inches.

A. J. D.

JANUARY 27, 1912.

(Mr. A. J. Daniel, acting principal Ship Surveyor to the Board of Trade.)

It should be stated that the new committee on bulkheads mentioned in the paragraphs of this letter which deals with rule 12 has now been formed.

Subsequently Sir Walter Howell wrote and sent three letters to the Advisory Committee which were as follows:

BOARD OF TRADE, MARINE DEPARTMENT, 7 WHITEHALL GARDENS,
London, S. W., April 20, 1912.

SIR: With reference to previous correspondence between the department and your committee respecting the revision of the statutory rules for life-saving appliances on British ships, and particularly to the letter from this department of April 16, I am directed by the board of trade to state that as an entirely new situation has been created by the recent disaster to the steamship *Titanic* they assume that the committee, in reconsidering the matter in connection with the suggestions already put before them by the board will have full regard to this new situation, and the facts of the disaster so far as ascertained.

As you are doubtless aware, suggestions have been made in the House of Commons and elsewhere to the effect that, in view of the loss of the *Titanic*, action should be taken by the board of trade in regard to certain questions other than those expressly dealt with in the life-saving appliances rules, e.g., in regard to (1) steamship routes in the North Atlantic; (2) the speed of steamers where there may be dangers to navigation; and (3) the provision and use of searchlights on large passenger steamers; and the board would be glad to know the committee's views in regard to these, and any other suggestions which may have come to their knowledge, intended to diminish the risk, or to mitigate the effects of accidents to passenger vessels at sea.

I am, etc.,

WALTER J. HOWELL.

The SECRETARY,
Merchant Shipping Advisory Committee.

BOARD OF TRADE, MARINE DEPARTMENT,
7 Whitehall Gardens, London, S. W., April 24, 1912.

SIR: With reference to previous correspondence between this department and your committee respecting the revision of the statutory rules for life-saving appliances on British ships, and particularly to the letter from this department of April 16, in which you were informed that the question of the proposed amendment of the rules so as to admit of decked lifeboats being stowed one above another or one under an open lifeboat, was under consideration, I am directed by the board of trade to state, for the information of your committee, that the board of trade will be glad if the committee will consider whether any, and if so what, amendments of the rules, and in particular of the rule of April 19, 1910, and the rule of June 14, 1911, are, in their opinion, desirable with the object of supplementing the boats immediately under davits by as much additional boat accommodation as is practicable, having regard to the new situation which has been created by the recent disaster to the steamship *Titanic*.

A plan illustrating the principle is being prepared so as to be in readiness for your committee by Friday.

I am, etc.,

WALTER J. HOWELL.

The SECRETARY,
Merchant Shipping Advisory Committee.

BOARD OF TRADE, MARINE DEPARTMENT,
7, WHITEHALL GARDENS,

London, S. W., April 25, 1912.

SIR: With reference to previous correspondence respecting the proposed revision of the statutory regulations as to boats and life-saving appliances on ships, I am directed by the board of trade to state, for the information of the merchant shipping advisory committee, that, apart from the questions which have been raised regarding the boat accommodation on vessels over 10,000 tons, it seems desirable to consider whether the provision of boats and other life-saving appliances required by the rules in the case of vessels under 10,000 tons is satisfactory, or whether the rules or the boat scale should be altered in respect of their application to such vessels; and the board would be glad to be favored with the observations of the committee on this point in addition to those that have already been referred to them.

I am, etc.,

WALTER J. HOWELL.

The SECRETARY,
Merchant Shipping Advisory Committee.

To these letters the advisory committee sent the following answer:

MERCHANT SHIPPING ADVISORY COMMITTEE,
7, WHITEHALL GARDENS,
London, S. W., April 27, 1912.

SIR: We are desired by the merchant shipping advisory committee to inform you that your letters of the 16th, 20th, 24th, and 25th instant were brought before the committee at a meeting held yesterday.

The committee fully recognize that the proved impossibility of keeping such a vessel as the *Titanic* afloat after a collision with ice until the arrival of outside succor has created an entirely new situation which was neither in the contemplation of the board of trade nor of the committee in the consideration of the extension of the existing boat scale in regard to vessels of 10,000 tons and upward.

In advising on such extension in July last, the committee aimed at providing ample boat accommodation on large passenger vessels in accordance with the principles that were adopted by the original life-saving appliances committee, and which principles had apparently been fully justified by many years of experience. It is with satisfaction that the committee note that the board of trade, apart from the new possibilities demonstrated by the loss of the *Titanic*, agreed in the essentials with the recommendation of the committee.

In face of the new facts, the committee at their meeting yesterday reopened entirely the question of the revision of the boat scale for large passenger vessels with a view of providing the maximum of protection for the passengers and crew in the event of an overwhelming disaster, whilst at the same time maintaining the principles in regard to the stability and sea-going qualities of the ship itself, and to the prompt and efficient handling of the boats carried under the existing scale, which hitherto have proved not only essential to safety, but also adequate for all ordinary emergencies. The questions involved are not free from difficulty, but they will receive the immediate attention of the committee. Pending their consideration, the committee note that assurances have been received by the board of trade from representatives of most of the large passenger lines to the effect that every effort will be made to equip their vessels, at the earliest possible moment, with boats and rafts sufficient to accommodate all persons on board.

In regard to the recommendation forwarded with the committee's letter of July 4 last, that the board of trade should, having regard to the developments in ship building since the report of the committee of 1891 on spacing and construction of water-tight bulkheads, review the requirements designed to attain the standards at present enforced under rule 12, the advisory committee note that the board of trade have under consideration the appointment of a committee of equal standing to that of the committee of 1891. In view of the great importance of this question the advisory committee desire us respectfully to urge that such a committee be appointed at as early a date as possible.

The subject of the general revision of the statutory regulations as to boats and life-saving appliances on all ships, which, apart from the questions regarding the boat accommodation on vessels over 10,000 tons, is for the first time referred to the advisory committee by the letter of the 25th instant, together with the particular questions raised in the letters of the 16th, 20th, and 24th instant, are also receiving the immediate attention of the committee.

At yesterday's meeting subcommittees were appointed to give immediate consideration to the subjects requiring detailed examination. These subcommittees will pursue their inquiries concurrently, and we are desired by the advisory committee to inform you that their investigation into the revision of the life-saving appliances rules will be proceeded with as expeditiously as possible.

We are, etc.,

NORMAN HILL, *Chairman.*
R. W. MATTHEW, *Secretary.*

Sir WALTER J. HOWELL, K. C. B.,
Assistant Secretary Marine Department,
Board of Trade.

This letter was acknowledged by the board of trade on May 10, 1912, as follows:

BOARD OF TRADE, MARINE DEPARTMENT,
7, WHITEHALL GARDENS,
London, S. W., May 10, 1912.

SIR: I am directed by the board of trade to acknowledge the receipt of, and to thank you for, your letter of April 27, stating that their letters of April 16, 20, 24, and 25 have been considered by the merchant shipping advisory committee.

The board observes with satisfaction that, in view of the entirely new situation which has arisen, the advisory committee have decided to reopen the question of the revision of the table in the life-saving appliances rules in so far as it governs the boat accommodation in vessels over 10,000 tons gross. The board are further glad to observe that the question of a general revision of the life-saving appliances rules is also under consideration by the committee, and in this connection they presume that, in considering the question of a general revision of the rules including the table, the committee will consider the principles on which the requirements as to boat accommodation should be based, including, inter alia, whether the table should continue to be based on tonnage. Any conclusion reached by the committee on this question would naturally affect the revision of the present table as applying to vessels of more than 10,000 tons, upon which the committee has already been engaged.

The board agree with the view expressed by the advisory committee that the appointment of another committee on the spacing and construction of water-tight bulkheads is desirable. Steps have already been taken by the president to form such a committee, and he hopes to be able to announce the names within a few days. A further communication on this point will be addressed to the committee in the course of a few days.

The board are glad to note that subcommittees have been appointed to deal concurrently with the subjects requiring detailed consideration in connection with the revision of the life-saving appliances rules.

The board desire me to add that they assume that the committee, in considering the matters referred to them, will have regard to all important aspects of the question of life-saving appliances, whether expressly dealt with in the statutory rules or not, and in particular to the essential question of the adequacy of the provision for lowering and manning the boats and rafts carried by vessels.

I am, etc.,

WALTER J. HOWELL.

The SECRETARY,
Merchant Shipping Advisory Committee,
7, Whitehall Gardens, S. W.

This finishes the history of the action of the board of trade in relation to the provision of boat accommodation on emigrant ships. The outstanding circumstance in it is the omission, during so many years, to revise the rules of 1894 and this, I think, was blameable, notwithstanding the excuse or explanation put forward by Sir Alfred Chalmers. I am, however, doubtful whether even if the rules had been revised the change would have been such as to have required boat accommodation which would have increased the number of lives saved. Having regard to the recommendations of the advisory committee, the board of trade would probably not have felt justified in making rules which would have required more boat accommodation than that with which the *Titanic* was actually provided; and it is not to be forgotten that the *Titanic* boat accommodation was utilized to less than two-thirds of its capacity. These considerations, however, afford no excuse for the delay of the board of trade.

The gross tonnage of a vessel is not, in my opinion, a satisfactory basis on which to calculate the provision of boat accommodation. Hitherto, I believe, it has been accepted as the best basis by all nations. But there seems much more to be said in favor of making the number of lives carried the basis and for providing boat or raft accommodation for all on board. Rule 12 of the life-saving appliances rules of 1902, which deals with water-tight compartments and boat accommodation, ought to be abolished. The provision of such compartments is of supreme importance, but it is clear that it should not be sought at the expense of a decrease in boat accommodation. When naval architects have devised practical means for rendering ships unsinkable, the question of boat accommodation may have to be reconsidered, but until that time arrives boat accommodation should, where practicable, be carried for all on board. This suggestion may be thought by some to be extravagant. It has never been enforced in the mercantile marine of Great Britain, nor as far as I know in that of any foreign nation. But it appears, nevertheless, to be admitted by all that it is possible without undue inconvenience or undue interference with commerce to increase considerably in many cases the accommodation hitherto carried, and it seems, therefore, reasonable that the law should require an increase to be made. As far as foreign-going passenger and emigrant steamships are concerned, I am of opinion that, unless justification be shown for deviating from this course, such ships should carry boats or rafts for all on board.

With reference to the second branch of the complaint against the board of trade, namely that their officials had failed to exercise due care in the supervision of the vessel's plans and in the inspection of the work done upon her, the charges broke down. Suggestions were made that the board's requirements fell short of those of Lloyd's Registry; but no evidence was forthcoming to support the suggestions. The investigation of the charges took much time, but it only served to show that the officials had discharged their duties carefully and well.

POWERS OF THE BOARD OF TRADE AS REGARDS THE SUPERVISION OF DESIGNS OF VESSELS.

The *Titanic* was efficiently designed and constructed to meet the contingencies which she was intended to meet.

The bulkheads were of ample strength. They were sufficiently closely spaced and were carried up in the vessel to a height greater than sufficient to meet the requirements of the 1891 bulkheads committee.

But I am advised that the ship could have been further subdivided so that she would probably have remained afloat longer than she did. The board of trade have, however, apparently no power to exercise any real supervision in the matter of subdivision. All they have express power to insist upon in this connection with respect to any steam vessel is that there shall be four water-tight bulkheads—a provision quite inadequate for safety in a collision damaging the vessel abaft the collision bulkhead. They can also, if invited by the shipowner (but not otherwise), exercise supervision under rule 12. This supervision, I am told, they have been invited to exercise in only 103 cases over a period of 18 years. In 69 of these cases the board have expressed their satisfaction with the subdivision provided. It seems to me that the board should be empowered to require the production of the designs of all passenger steamers at an early period of their construction and to direct such alterations as may appear to them to be necessary and practicable for the purpose of securing proper water-tight subdivision.

VII. FINDING OF THE COURT.

It is now convenient to answer the 26 questions submitted by the board of trade.

1. When the *Titanic* left Queenstown on or about April 11 last: (a) What was the total number of persons employed in any capacity on board her, and what were their respective ratings? (b) What was the total number of her passengers, distinguishing sexes and classes, and discriminating between adults and children?

Answer. (a) The total number of persons employed in any capacity on board the *Titanic* was 885.

The respective ratings of these persons were as follows:

Deck department	66
Engine department	325
Victualing department	<u>494</u>
	885

N. B.—The eight handsmen are not included in this number, as their names appear in the second class passenger list.

(b) The total number of passengers was 1,316. Of these:

	Male.	Female.	Total.
First class	180	145	325
Second class	179	106	285
Third class	510	196	706
			1,316

Of the above, 6 children were in the first class, 24 in the second class and 79 in the third class. Total, 109.

2. Before leaving Queenstown on or about April 11 last did the *Titanic* comply with the requirements of the merchant shipping acts, 1894-1906, and the rules and regulations made thereunder with regard to the safety and otherwise of "passenger steamers" and "emigrant ships?"

Answer. Yes.

3. In the actual design and construction of the *Titanic* what special provisions were made for the safety of the vessel and the lives of those on board in the event of collisions and other casualties?

Answer. These have been already described.

4. (a) Was the *Titanic* sufficiently and efficiently officered and manned? (b) Were the watches of the officers and crew usual and proper? (c) Was the *Titanic* supplied with proper charts?

Answer. (a) Yes. (b) Yes. (c) Yes.

5. (a) What was the number of the boats of any kind on board the *Titanic*? (b) Were the arrangements for manning and launching the boats on board the *Titanic* in case of emergency proper and sufficient? (c) Had a boat drill been held on board, and if so, when? (d) What was the carrying capacity of the respective boats?

Answer. (a) 2 Emergency boats, 14 lifeboats, 4 Engelhardt boats. (b) No, but see page 38. (c) No. (d) The carrying capacity of the 2 emergency boats was for 80 persons; 14 lifeboats was for 910 persons; 4 Engelhardt boats was for 188 persons; or a total of 1,178 persons.

6. (a) What installations for receiving and transmitting messages by wireless telegraphy were on board the *Titanic*? (b) How many operators were employed on working such installations? (c) Were the installations in good and effective working order, and were the number of operators sufficient to enable messages to be received and transmitted continuously by day and night?

Answer. (a) A Marconi 5-kilowatt motor generator with two complete sets of apparatus supplied from the ship's dynamos, with an independent storage battery and coil for emergency, was fitted in a house on the boat deck. (b) Two. (c) Yes.

7. (a) At or prior to the sailing of the *Titanic* what, if any, instructions as to navigation were given to the master or known by him to apply to her voyage? (b) Were such instructions, if any, safe, proper, and adequate, having regard to the time of year and dangers likely to be encountered during the voyage?

Answer. (a) No special instructions were given, but he had general instructions contained in the book of Rules and Regulations supplied by the company. (See p. 24.) (b) Yes, but having regard to subsequent events they would have been better if a reference had been made to the course to be adopted in the event of reaching the region of ice.

8. (a) What was in fact the track taken by the *Titanic* in crossing the Atlantic Ocean? (b) Did she keep to the track usually followed by liners on voyages from the United Kingdom to New York in the month of April? (c) Are such tracks safe tracks at that time of the year? (d) Had the master any, and if so, what discretion as regards the track to be taken?

Answer. (a) The outward southern track from Queenstown to New York, usually followed in April by large steam vessels. (See page 24.) (b) Yes, with the exception that instead of altering her course on approaching the position 42° N. 47° W., she stood on on her previous course for some 10 miles farther southwest, turning to S. 86° W. true at 5.50 p.m. (c) The outward and homeward bound southern tracks were decided on as the outcome of many years' experience of the normal movement of ice. They were reasonably safe tracks for the time of year, provided, of course, that great caution and vigilance when crossing the ice region were observed. (d) Yes. Capt. Smith was not fettered by any orders to remain on the track should information as to the position of ice make it, in his opinion, undesirable to adhere to it. The fact, however, of lane routes having been laid down for the common safety of all would necessarily influence him to keep on (or very near) the accepted route, unless circumstances as indicated above should induce him to deviate largely from it.

9. (a) After leaving Queenstown on or about the 11th April last, did information reach the *Titanic* by wireless messages or otherwise by signals of the existence of ice in certain latitudes? (b) If so, what were such messages or signals and when were they received, and in what position or positions was the ice reported to be, and was the ice reported in or near the track actually being followed by the *Titanic*? (c) Was her course altered in consequence of receiving such information, and, if so, in what way? (d) What replies to such messages or signals did the *Titanic* send, and at what times?

Answer. (a) Yes. (b) See particulars of ice messages already set out (pp. 26-28). (c) No; her course was altered as hereinbefore described, but not in consequence of the information received as to ice. (d) The material answers were—

At 12.55 p.m. steamship *Titanic*:

To COMMANDER, *Baltic*.

Thanks for your message and good wishes. Had fine weather since leaving.

SMITH.

At 1.26 p.m. steamship *Titanic*:

To CAPTAIN, *Caronia*.

Thanks for message and information. Have had variable weather throughout.

SMITH.

10. (a) If at the times referred to in the last preceding question or later the *Titanic* was warned of or had reason to suppose she would encounter ice, at what time might she have reasonably expected to encounter it? (b) Was a good and proper lookout for ice kept on board? (c) Were any, and, if so, what, directions given to vary the speed—if so, were they carried out?

Answer. (a) At, or even before, 9.30 p.m. ship's time, on the night of the disaster. (b) No. The men in the crow's nest were warned at 9.30 p.m. to keep a sharp lookout for ice; the officer of the watch was then aware that he had reached the reported ice region, and so also was the officer who relieved him at 10 p.m. Without implying that those actually on duty were not keeping a good lookout, in view of the night being moonless, there being no wind and perhaps very little swell, and especially in view of the high speed at which the vessel was running, it is not considered that the lookout was sufficient. An extra lookout should, under the circumstances, have been placed at the stemhead, and a sharp lookout should have been kept from both sides of the bridge by an officer. (c) No directions were given to reduce speed.

11. (a) Were binoculars provided for and used by the lookout men? (b) Is the use of them necessary or usual in such circumstances? (c) Had the *Titanic* the means of throwing searchlights around her? (d) If so, did she make use of them to discover ice? (e) Should searchlights have been provided and used?

Answer. (a) No. (b) No. (c) No. (d) No. (e) No; but searchlights may at times be of service. The evidence before the court does not allow of a more precise answer.

12. (a) What other precautions were taken by the *Titanic* in anticipation of meeting ice? (b) Were they such as are usually adopted by vessels being navigated in waters where ice may be expected to be encountered?

Answer. (a) Special orders were given to the men in the crow's nest to keep a sharp lookout for ice, particularly small ice and growlers. The fore-scuttle hatch was closed to keep everything dark before the bridge. (b) Yes; though there is evidence to show that some masters would have placed a lookout at the stemhead of the ship.

13. (a) Was ice seen and reported by anybody on board the *Titanic* before the casualty occurred? (b) If so, what measures were taken by the officer on watch to avoid it? (c) Were they proper measures and were they promptly taken?

Answer. (a) Yes; immediately before the collision. (b) The helm was put hard astarboard and the engines were stopped and put full speed astern. (c) Yes.

14. (a) What was the speed of the *Titanic* shortly before and at the moment of the casualty? (b) Was such speed excessive under the circumstances?

Answer. (a) About 22 knots. (b) Yes.

15. (a) What was the nature of the casualty which happened to the *Titanic* at or about 11.45 p.m. on April 14 last? (b) In what latitude and longitude did the casualty occur?

Answer. (a) A collision with an iceberg which pierced the starboard side of the vessel in several places below the water line between the forepeak tank and No. 4 boiler room. (b) In latitude 41° 46' N., longitude 50° 14' W.

16. (a) What steps were taken immediately on the happening of the casualty? (b) How long after the casualty was its seriousness realized by those in charge of the vessel (c) What steps were then taken? (d) What endeavors were made to save the lives of those on board, and to prevent the vessel from sinking?

Answer. (a) The 12 water-tight doors in the engine and boiler rooms were closed from the bridge, some of the boiler fires were drawn, and the bilge pumps abaft No. 6 boiler room were started. (b) About 15 to 20 minutes. (c) and (d) The boats were ordered to be cleared away. The passengers were roused and orders given to get them on deck, and life belts were served out. Some of the water-tight doors, other than those in the boiler and engine rooms, were closed. Marconigrams were sent out asking for help. Distress signals (rockets) were fired, and attempts were made to call up by Morse a ship whose lights were seen. Eighteen of the boats were swung out and lowered, and the remaining two floated off the ship and were subsequently utilized as rafts.

17. Was proper discipline maintained on board after the casualty occurred?

Answer. Yes.

18. (a) What messages for assistance were sent by the *Titanic* after the casualty, and at what times respectively? (b) What messages were received by her in response, and at what times respectively? (c) By what vessels were the messages that were sent by the *Titanic* received, and from what vessels did she receive answers? (d) What vessels other than the *Titanic* sent or received messages at or shortly after the casualty in connection with such casualty? (e) What were the vessels that sent or received such messages? (f) Were any vessels prevented from going to the

assistance of the *Titanic* or her boats owing to messages received from the *Titanic* or owing to any erroneous messages being sent or received? (g) In regard to such erroneous messages, from what vessels were they sent and by what vessels were they received, and at what times respectively?

(a) (b) (c) (d) and (e) are answered together. (f) Several vessels did not go, owing to their distance. (g) There were no erroneous messages.

New York time.	Titanic time (approximated).	Communications.
10.25 p. m.	12.15. a. m.	La Provence receives Titanic distress signals.
Do	do	Mount Temple heard Titanic sending CQD. Says require assistance. Gives position. Can not hear me. Advise my captain his position 41.46 N., 50.24 W.
Do	do	Cape Race hears Titanic giving position on CQD. 41.44 N., 50.24 W.
10.28 p. m.	12.18. a. m.	Ypiranga hears CQD. from Titanic. Titanic gives CQD. here. Position 41.44 N., 50.24 W. Require assistance (calls about 10 times).
10.35 p. m.	12.25. a. m.	CQD. call received from Titanic by Carpathia. Titanic said, "Come at once. We have struck a berg. It's a CQD. OM. Position 41.46 N., 50.14 W."
Do	do	Cape Race hears M. G. Y. (Titanic) give corrected position 41.46 N., 50.14 W. Calling him; no answer.
10.36 p. m.	12.25. a. m.	M. G. Y. (Titanic) says CQD. Here corrected position 41.46 N., 50.14 W. Require immediate assistance. We have collision with iceberg. Sinking. Can nothing hear for noise of steam. Sent about 15 to 20 times to Ypiranga.
10.37 p. m.	12.27. a. m.	Titanic sends following: "I require assistance immediately. Struck by iceberg in 41.46 N., 50.14 W."
10.40 p. m.	12.30. a. m.	Titanic gives his position to Frankfurt, and says, "Tell your captain to come to our help. We are on the ice."
Do	do	Caronia sent CQ message to M. B. C. (Baltic) and CQD: M. G. Y. (Titanic) struck iceberg, require immediate assistance.
Do	do	Mount Temple hears M. G. Y. (Titanic) still calling CQD. Our captain reverses ship. We are about 50 miles off.
10.46 p. m.	12.36. a. m.	D. K. F. (Prinz Friedrich Wilhelm) calls M. G. Y. (Titanic) and gives position at 12 a. m. 39.47 N., 50.10 W. M. G. Y. (Titanic) says, "Are you coming to our?" D. F. T. (Frankfurt) says, "What is the matter with u?" M. G. Y. (Titanic) "We have collision with iceberg. Sinking. Please tell captain to come." D. F. T. (Frankfurt) says, "O. K. will tell."
10.48 p. m.	12.38. a. m.	Mount Temple hears Frankfurt give M. G. Y. (Titanic) his position, 39.47 N., 52.10 W.
10.55 p. m.	12.45. a. m.	Titanic calls Olympic SOS.
11 p. m.	12.50. a. m.	Titanic calls CQD. and says, "I require immediate assistance. Position 41.46 N., 50.14 W." Received by Celtic.
11.03 p. m.	12.53. a. m.	Caronia to M. B. C. (Baltic) and SOS., M. G. Y. (Titanic) CQD. in 41.46 N., 50.14 W. Wants immediate assistance."
11.10 p. m.	1 a. m.	M. G. Y. gives distress signal. D. D. C. replies. M. G. Y.'s position 41.46 N., 50.14 W. Assistance from D. D. C. not necessary, as M. K. C. shortly afterwards answers distress call.
Do.	do.	Titanic replies to Olympic, and gives his position as 41.46 N., 50.14 W., and says, "We have struck an iceberg."
11.12 p. m.	1.02. a. m.	Titanic calls Asian and said, "Want immediate assistance." Asian answered at once and received Titanic's position as 41.46 N., 50.14 W., which he immediately takes to the bridge. Captain instructs operator to have Titanic's position repeated.
Do.	do.	Virginian calls Titanic, but gets no response. Cape Race tells Virginian to report to his captain the Titanic has struck iceberg and requires immediate assistance.
11.20 p. m.	1.10. a. m.	Titanic to M. K. C. (Olympic), "We are in collision with berg. Sinking head down; 41.46 N., 50.14 W. Come soon as possible."
Do.	do.	Titanic to M. K. C. (Olympic), captain says, "Get your boats ready. What is your position?"
11.25 p. m.	1.15. a. m.	Baltic to Caronia, "Please tell Titanic we are making toward her."
11.30 p. m.	1.20. a. m.	Virginian hears M. C. E. (Cape Race) inform M. G. Y. (Titanic) "that we are going to his assistance. Our position 170 miles north of Titanic."
11.35 p. m.	1.25. a. m.	Caronia tells Titanic, "Baltic coming to your assistance."
Do.	do.	Olympic sends position to Titanic 4.24 a. m. GMT. 40.52 N., 61.18 W. "Are you steering southerly to meet us?" Titanic replies, "We are putting the women off in the boats."
Do.	do.	Titanic and Olympic work together.
11.37 p. m.	1.27. a. m.	M. G. Y. (Titanic) says, "We are putting the women off in the boats."
11.40 p. m.	1.30. a. m.	Titanic tells Olympic, "We are putting passengers off in small boats."
11.45 p. m.	1.35. a. m.	Olympic asks Titanic what weather he had. Titanic replies, "Clear and calm."
Do.	do.	Baltic hears Titanic say "Engine room getting flooded."
Do.	do.	Mount Temple hears DFT. (Frankfurt) ask "Are there any boats around you already." No reply.
11.47 p. m.	1.37. a. m.	Baltic tells Titanic, "We are rushing to you."
11.50 p. m.	1.40. a. m.	Olympic to Titanic, "Am lighting up all possible boilers as fast as can."
Do.	do.	Cape Race says to Virginian: "Please tell your captain this: 'The Olympic is making all speed for Titanic, but his (Olympic's) position is 40.32 N., 61.18 W. You are much nearer to Titanic. The Titanic is already putting women off in the boats, and he says the weather there is calm and clear.' The Olympic is the only ship we have heard say, 'Going to the assistance of the Titanic. The others must be a long way from the Titanic.'"
11.55 p. m.	1.45. a. m.	Last signals heard from Titanic by Carpathia, "Engine-room full up to boilers."
Do.	do.	Mount Temple hears DFT. (Frankfurt) calling MGY. (Titanic). No reply.
11.57 p. m.	1.47. a. m.	Caronia hears MGY. (Titanic), though signals unreadable still.
11.58 p. m.	1.48. a. m.	Asian heard Titanic call SOS. Asian answers Titanic but receives no answer.
Midnight.	1.50. a. m.	Caronia hears Frankfurt working to Titanic. Frankfurt according to position 172 miles from MGY. (Titanic) at time first SOS. sent out.
12.05 a. m.	1.55. a. m.	Cape Race says to Virginian "We have not heard Titanic for about half an hour. His power may be gone."
12.10 a. m.	2 a. m.	Virginian hears Titanic calling very faintly, his power being very greatly reduced.
12.20 a. m.	2.10. a. m.	Virginian hears 2 v's signaled faintly in spark similar to Titanic's, probably adjusting spark.

12.27 a. m.	2.17. a. m.	Virginian hears Titanic call CQ, but unable to read him. Titanic's signals end very abruptly, as power suddenly switched off. His spark rather blurred or ragged. Called MGY. (Titanic) and suggested he should try emergency set, but heard no response.
12.30 a. m.	2.20. a. m.	Olympic, his sigs. strong, asked him if he had heard anything about MGY. (Titanic). He says, "No. Keeping strict watch, but hear nothing more from MGY. (Titanic)." No reply from him.
12.52 a. m.		This was the official time the Titanic foundered 41.46 N., 50.14 W., as given by the Carpathia in message to the Olympic; about 2.20 a. m.
1.15 a. m.		Virginian exchanges signals Baltic. He tries send us MSG. for MGY. (Titanic), but his signals died utterly away.
1.25 a. m.		Mount Temple hears MPA. (Carpathia) send, "If you are there we are firing rockets."
1.35 a. m.		Baltic sent 1 MSG, to Virginian for Titanic.
1.40 a. m.		MPA. (Carpathia) calling MGY. (Titanic).
1.58 a. m.		SBA. (Birma) thinks he hears Titanic so sends, "Steaming full speed for you. Shall arrive you 6 in morning. Hope you are safe. We are only 50 miles now."
2 a. m.		MPA. (Carpathia) calling MGY. (Titanic).
Do.		Have not heard Titanic since 11.50 p. m. Received from Ypiranga.
2.28 a. m.		La Provence to Celtic, "Nobody has heard the Titanic for about 2 hours."
3.24 a. m.		SBA. (Birma) says we are 30 miles S. W. off Titanic.
3.36 a. m.		Celtic sends message to Caronia for the Titanic. Caronia after trying for two hours to get through to the Titanic tells the Celtic impossible to clear his message to Titanic. Celtic then cancels message.
3.45 a. m.		Californian exchanges signals with MLQ. (Mount Temple). He gave position of Titanic.
4.10 a. m.		Californian receives MSG. from MGN. (Virginian).
5.5 a. m.		Baltic signals MPA. (Carpathia).
5.40 a. m.		Parisian hears weak signals from MPA. (Carpathia) or some station saying Titanic struck iceberg. Carpathia has passengers from lifeboats.
Do.		Olympic Tr Asian, with German oil tank in tow for Halifax asked what news of MGY. (Titanic). Sends service later saying heard MGY. (Titanic) v. faint wkg. C. Race up to 10 p. m., local time. Finished calling SOS. midnight.
6.5 a. m.		Parisian exchanges TRs Virginian O. K. nil. Informed Capt. Haines what I heard passing between ships regarding Titanic, and he decided not to return as M. P. A. (Carpathia) was there, and Californian was 50 miles astern of us, but requested me to stand by in case required.
6.45 a. m.		Mount Temple hears M. P. A. (Carpathia) report rescued 20 boat loads.
7.7 a. m.		Baltic sends following to Carpathia: "Can I be of any assistance to you as regards taking some of the passengers from you? Will be in position about 4.30. Let me know if you alter your position."
7.10 a. m.		Baltic in communication with M. P. A. (Carpathia). Exchanged traffic <i>re</i> passengers, and get instructions to proceed to Liverpool.
7.15 a. m.		Baltic turns round for Liverpool, having steamed 134 miles W. toward Titanic.
7.40 a. m.		Mount Temple hears M. P. A. (Carpathia) call CQ. and say, "No need to std. bi him. Advise my captain, who has been cruising round the icefield with no result. Ship reversed."
7.45 a. m.		Olympic sent M. S. G. to owners, New York via Sable Island, saying "Have not communicated with Titanic since midnight."
7.55 a. m.		Carpathia replies to Baltic, "Am proceeding to Halifax or New York full speed. You had better proceed to Liverpool. Have about 800 passengers on board."
8 a. m.		Carpathia to Virginian: "We are leaving here with all on board about 800 passengers. Please return to your northern course."

19. (a) Was the apparatus for lowering the boats on the *Titanic* at the time of the casualty in good working order? (b) Were the boats swung out, filled, lowered, or otherwise put into the water and got away under proper superintendence? (c) Were the boats sent away in seaworthy condition and properly manned, equipped, and provisioned? (d) Did the boats, whether those under davits or otherwise, prove to be efficient and serviceable for the purpose of saving life?

Answer. (a) Yes. (b) Yes. (c) The 14 lifeboats, 2 emergency boats, and C and D collapsible boats were sent away in a seaworthy condition, but some of them were possibly undermanned. The evidence on this point was unsatisfactory. The total number of crew taken on board the *Carpathia* exceeded the number which would be required for manning the boats. The collapsible boats A and B appear to have floated off the ship at the time she foundered. The necessary equipment and provisions for the boats were carried in the ship, but some of the boats, nevertheless, left without having their full equipment in them. (d) Yes.

20. (a) What was the number of (a) passengers, (b) crew taken away in each boat on leaving the vessel? (b) How was this number made up, having regard to (1) sex, (2) class, and (3) rating? (c) How many were children and how many adults? (d) Did each boat carry its full load and, if not, why not?

Answer. (a) (b) (c) It is impossible exactly to say how many persons were carried in each boat or what was their sex, class, and rating, as the totals given in evidence do not correspond with the numbers taken on board the *Carpathia*. The boats eventually contained in all 712 persons, made up as shown in the answer to question 21. (d) No. At least 8 boats did not carry their full loads for the following reasons: (1) Many people did not realize the danger or care to leave the ship at first. (2) Some boats were ordered to be lowered with an idea of their coming around to the gangway doors to complete loading. (3) The officers were not certain of the strength and capacity of the boats in all cases (and see p. 39).

21. (a) How many persons on board the *Titanic* at the time of the casualty were ultimately rescued and by what means? (b) How many lost their lives prior to the arrival of the steamship *Carpathia* in New York? (c) What was the number of passengers, distinguishing between men and women and adults and children of the first, second, and third classes, respectively, who were saved? (d) What was the number of the crew, discriminating their ratings and sex, that were saved? (e) What is the proportion which each of these numbers bears to the corresponding total number on board immediately before the casualty? (f) What reason is there for the disproportion, if any?

Answer. (a) Seven hundred and twelve, rescued by *Carpathia* from the boats. (b) One. (c) (d) and (e) are

answered together.

The following is a list of the saved:

First class:

Adult males	57 out of 175, or 32.57 per cent.
Adult females	140 out of 144, or 97.22 per cent.
Male children (all saved)	5
Female children (all saved)	<u>1</u>
	<u>203</u> out of 325, or 62.46 per cent.

Second class:

Adult males	14 out of 168, or 8.33 per cent.
Adult females	80 out of 93, or 86.02 per cent.
Male children (all saved)	11
Female children (all saved)	<u>13</u>
	<u>118</u> out of 285, or 41.40 per cent.

Third class:

Adult males	75 out of 462, or 16.23 per cent.
Adult females	76 out of 165, or 46.06 per cent.
Male children	13 out of 48, or 27.08 per cent.
Female children	14 out of 31, or 45.16 per cent.
	<u>178</u> out of 706, or 25.21 per cent.

Total passengers 499 out of 1,316, or 37.94 per cent.

Crew saved:

Deck department	43 out of 66, or 65.15 per cent.
Engine-room department	72 out of 325, or 22.15 per cent.
Victualing department	97 out of 494, or 19.63 per cent.
Including women	<u>20</u> out of 23, or 86.95 per cent.
	<u>212</u> out of 885, or 23.95 per cent.

Total on board saved 711 out of 2,201, or 32.30 per cent.

(f) The disproportion between the numbers of the passengers saved in the first, second, and third classes is due to various causes, among which the difference in the position of their quarters and the fact that many of the third-class passengers were foreigners, are perhaps the most important. Of the Irish emigrants in the third class a large proportion was saved. The disproportion was certainly not due to any discrimination by the officers or crew in assisting the passengers to the boats. The disproportion between the numbers of the passengers and crew saved is due to the fact that the crew, for the most part, all attended to their duties to the last, and until all the boats were gone.

22. What happened to the vessel from the happening of the casualty until she foundered?

Answer. A detailed description has already been given (see pp. 32-34).

23. Where and at what time did the *Titanic* founder?

Answer. Two twenty a. m. (ship's time) April 15. Latitude 41° 46' N., longitude 50° 14' W.

24. (a) What was the cause of the loss of the *Titanic* and of the loss of life which thereby ensued or occurred? (b) What vessels had the opportunity of rendering assistance to the *Titanic* and, if any, how was it that assistance did not reach the *Titanic* before the steamship *Carpathia* arrived? (c) Was the construction of the vessel and its arrangements such as to make it difficult for any class of passenger or any portion of the crew to take full advantage of any of the existing provisions for safety?

Answer. (a) Collision with an iceberg and the subsequent foundering of the ship. (b) The *Californian*. She could have reached the *Titanic* if she had made the attempt when she saw the first rocket. She made no attempt. (c) No.

25. When the *Titanic* left Queenstown on or about April 11 last was she properly constructed and adequately equipped as a passenger steamer and emigrant ship for the Atlantic service?

Answer. Yes.

26. The court is invited to report upon the rules and regulations made under the merchant shipping acts, 1894-1906, and the administration of those acts and of such rules and regulations, so far as the consideration thereof is material to this casualty, and to make any recommendations or suggestions that it may think fit, having regard to the circumstances of the casualty, with a view to promoting the safety of vessels and persons at sea.

Answer. An account of the board of trade's administration has already been given and certain recommendations are subsequently made.

VIII. RECOMMENDATIONS.

The following recommendations are made. They refer to foreign-going passenger and emigrant steamships:

WATER-TIGHT SUBDIVISION.

1. That the newly appointed bulkhead committee should inquire and report, among other matters, on the desirability and practicability of providing ships with (a) a double skin carried up above the water line, or, as an alternative, with (b) a longitudinal, vertical, water-tight bulkhead on each side of the ship, extending as far forward and aft as convenient, or (c) with a combination of (a) and (b). Any one of the three (a), (b), and (c) to be in addition to water-tight transverse bulkheads.

2. That the committee should also inquire and report as to the desirability and practicability of fitting ships with (a) a deck or decks at a convenient distance or distances above the water line which shall be water-tight throughout a part or the whole of the ship's length; and should in this connection report upon (b) the means by which the necessary openings in such deck or decks should be made water-tight, whether by water-tight doors or water-tight trunks or by any other and what means.

3. That the committee should consider and report generally on the practicability of increasing the protection given by subdivision, the object being to secure that the ship shall remain afloat with the greatest practicable proportion of her length in free communication with the sea.

4. That when the committee has reported upon the matters before mentioned, the board of trade should take the report into their consideration and to the extent to which they approve of it should seek statutory powers to enforce it in all newly built ships, but with a discretion to relax the requirements in special cases where it may seem right to them to do so.

5. That the board of trade should be empowered by the legislature to require the production of the designs and specifications of all ships in their early stages of construction and to direct such amendments of the same as may be thought necessary and practicable for the safety of life at sea in ships. (This should apply to all passenger-carrying ships.)

LIFEBOATS AND RAFTS.

6. That the provision of lifeboat and raft accommodation on board such ships should be based on the number of persons intended to be carried in the ship and not upon tonnage.

7. That the question of such accommodation should be treated independently of the question of the subdivision of the ship into water-tight compartments. (This involves the abolition of rule 12 of the Life Saving Appliances Rules of 1902.)

8. That the accommodation should be sufficient for all persons on board with, however, the qualification that in special cases where, in the opinion of the board of trade, such provision is impracticable, the requirements may be modified as the board may think right. (In order to give effect to this recommendation changes may be necessary in the sizes and types of boats to be carried and in the method of stowing and floating them. It may also be necessary to set apart one or more of the boat decks exclusively for carrying boats and drilling the crew, and to consider the distribution of decks in relation to the passengers' quarters. These, however, are matters of detail to be settled with reference to the particular circumstance affecting the ship.)

9. That all boats should be fitted with a protective continuous fender, to lessen the risk of damage when being lowered in a seaway.

10. That the board of trade should be empowered to direct that one or more of the boats be fitted with some form of mechanical propulsion.

11. That there should be a board of trade regulation requiring all boat equipment (under secs. 5 and 6, p. 15, of the rules, dated February, 1902, made by the board of trade under sec. 427, merchant shipping act, 1894) to be in the boats as soon as the ship leaves harbor. The sections quoted above should be amended so as to provide also that all boats and rafts should carry lamps and pyrotechnic lights for purposes of signaling. All boats should be provided with compasses and provisions, and should be very distinctly marked in such a way as to indicate plainly the number of adult persons each boat can carry when being lowered.

12. That the board of trade inspection of boats and life-saving appliances should be of a more searching character than hitherto.

MANNING THE BOATS AND BOAT DRILLS.

13. That in cases where the deck hands are not sufficient to man the boats enough other members of the crew should be men trained in boat work to make up the deficiency. These men should be required to pass a test in boat work.

14. That in view of the necessity of having on board men trained in boat work, steps should be taken to encourage the training of boys for the merchant service.

15. That the operation of section 115 and section 134 (a) of the merchant shipping act, 1894, should be examined, with a view to amending the same so as to secure greater continuity of service than hitherto.

16. That the men who are to man the boats should have more frequent drills than hitherto. That in all ships a boat drill, a fire drill, and a water-tight door drill should be held as soon as possible after leaving the original port of departure and at convenient intervals of not less than once a week during the voyage. Such drills to be recorded in the official log.

17. That the board of trade should be satisfied in each case before the ship leaves port that a scheme has been devised and communicated to each officer of the ship for securing an efficient working of the boats.

GENERAL.

18. That every man taking a lookout in such ships should undergo a sight test at reasonable intervals.

19. That in all such ships a police system should be organized so as to secure obedience to orders, and proper control and guidance of all on board in times of emergency.

20. That in all such ships there should be an installation of wireless telegraphy, and that such installation should be worked with a sufficient number of trained operators to secure a continuous service by night and day. In this connection regard should be had to the resolutions of the International Conference on Wireless Telegraphy recently held under the presidency of Sir H. Babington Smith. That where practicable a silent chamber for "receiving" messages should form part of the installation.

21. That instruction should be given in all steamship companies' regulations that when ice is reported in or near the track the ship should proceed in the dark hours at a moderate speed or alter her course so as to go well clear of the danger zone.

22. That the attention of masters of vessels should be drawn by the board of trade to the effect that under the maritime conventions act, 1911, it is a misdemeanor not to go to the relief of a vessel in distress when possible to do so.

23. That the same protection as to the safety of life in the event of casualty which is afforded to emigrant ships by means of supervision and inspection should be extended to all foreign-going passenger ships.

24. That (unless already done) steps should be taken to call an international conference to consider and as far as possible to agree upon a common line of conduct in respect of (a) the subdivision of ships; (b) the provision and working of life-saving appliances; (c) the installation of wireless telegraphy and the method of working the same; (d) the reduction of speed or the alteration of course in the vicinity of ice; and (e) the use of searchlights.

MERSEY,
Wreck Commissioner.

We concur.

ARTHUR GOUGH-CALTHORPE,
A. W. CLARKE,
F. C. A. LYON,
J. H. BILES,
EDWARD C. CHASTON,

Assessors.

JULY 30, 1912.

FOOTNOTES:

[1] There was another water-tight door at the after end of the water-tight passage through the bunker immediately aft of D bulkhead. This door and the one on the D bulkhead formed a double protection to the forward boiler room.

[2] The water-tight doors for these bulkheads were not on them, but were at the end of a water-tight passage (about 9 feet long), leading from the bulkhead through the bunker into the compartment.

[3] Floated off when the ship sank and was utilized as a raft.

[4] It may be mentioned that Mr. Archer stated in the witness box that since the disaster to the Titanic he had modified his views and thought that rule 12 should be discontinued.

[5] See rule of June 14, 1911.

[6] See rule of June 14, 1911.

*** END OF THE PROJECT GUTENBERG EBOOK LOSS OF THE STEAMSHIP "TITANIC" ***

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