Encyclopedia Titanica

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# True Course

**by Cathy Akers-Jordan and Capt. Charles B. Weeks Jr.**

The use of magnetic compasses, how to plot courses and how these procedures on the Titanic compared to their use other ships in 1912 is something of a mystery to many observers. Yet an clear understanding of the equipment and procedures is crucial to correctly interpret testimony in the American and British Inquires. This article shall endeavour to clarify the issues.

## True Course

A ship's true course is determined by the direction from the ship to the geographic north pole (also called true north). Navigation charts and the compass are labeled with true north, but setting a ship's course is not merely a matter of steering in relation to the north pole. The magnetic compasses, like those on Titanic, point to the earth's magnetic poles. Unfortunately the magnetic poles move around with time and do not line up with the earth's geographic poles. Currently the North Magnetic Pole is just north west of Baffin Island in Canada and the South Magnetic Pole is just north of Australia. In 1912 navigators relied on magnetic compasses so they had to calculate the difference between magentic north and true north in order to determine a ship's true course.

## Magnetic Compasses

Magnetic compasses have existed since the 11th century, according to article 111 of Bowditch's American Practical Navigator, 1995 Edition (2). They function because a magnetized needle floating freely will line up with the earth's magnetic field, which lines up with the earth's magnetic poles. The difference between true north and magentic north is called compass error. There are two kinds: variation, the difference between magnetic north and true north, and deviation, which is caused when the steel of the ship affects the magnetic compass. Both kinds of compass error must be taken into account when calculating a ship's course.

## Variation

Variation is the difference between the direction from a ship to geographic north and from a ship to magnetic north. It is named East or West depending on the ship's position relative to these two poles. In the North Atlantic Ocean variation is westerly, because when looking towards the North Pole, the North Magnetic Pole is to the left of the North Geographic Pole. Refer to Fig. 1 Illustration of Variation. If a ship's position were directly in line with both these poles then there wouldn't be any variation.

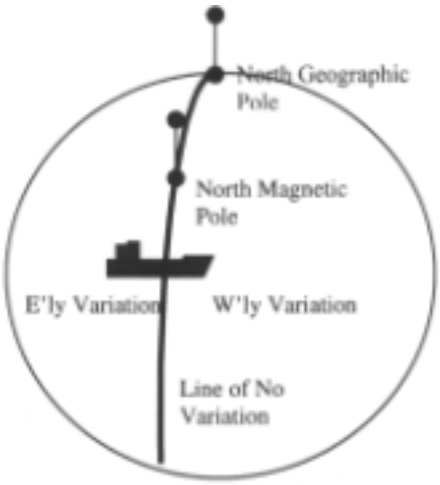
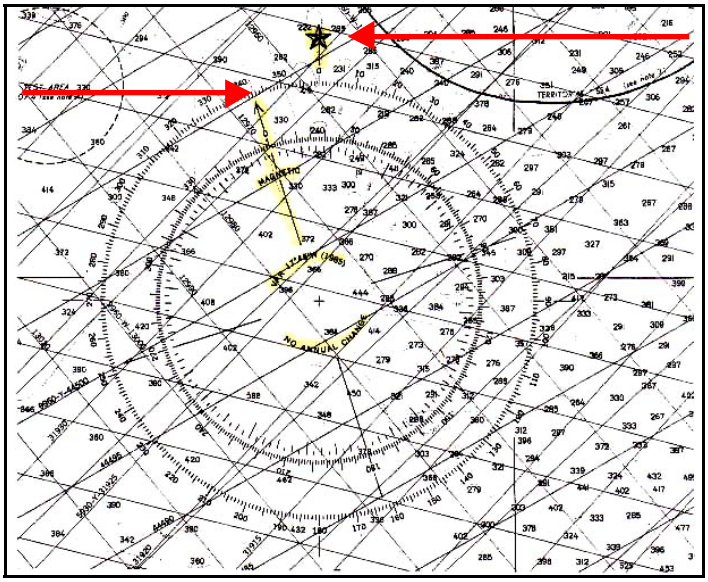



***Figure 1 Illustration of Variation*** *(by R. Pundt)*

The amount and name of the variation in any location can be picked off the chart for that area. Because the magnetic poles are always moving, variation changes from year to year. The amount of variation is indicated on navigation charts each year. Refer to Fig. 2 Charting Variation.

Magnetic North



Geographic (True) North

***Figure 2 Charting Variation*** *(NOAA Chart 13288)*

Variation can not be corrected, but must be taken into account when figuring the actual course to steer. To compensate for variation one adds the value of the variation to the true course to get the magnetic course.

Capt. Lord testified on the 7th day of the British Inquiry that the Variation in the area of the sinking at that time was 24 degrees W (question 6782).

## Deviation

The other error found in a magnetic compass is called Deviation, which is caused by ferrous metal in close proximity to the compass. Deviation wasn't a problem until the advent of iron and steel ships. Because the amount of steel varies, deviation varies from ship to ship, and from one magnetic heading to another.

There are a couple of ways to reduce deviation error when calculating what course to steer. First, one can reduce the amount of steel in close proximity to the compass so it will give the most accurate reading. This is why ships like Titanic had a compass on the top deck, away from the steel of the ship. That compass was called the Standard Magnetic Compass. Refer to Fig 3 Magnetic Compass in its Binnacle and Fig. 4 Close Up of Magnetic Compass with Azimuth Circle. The other magnetic compasses onboard (such as the Steering Magnetic Compass in the Wheelhouse) were checked against it.

***Figure 3 Magnetic Compass in its binnacle*** *(Photo by C. Weeks).*
*Magnets go in the open door. The red and green iron spheres are Quadrantal Correctors. The magnets and Quadrantal Correctors correct for deviation.*

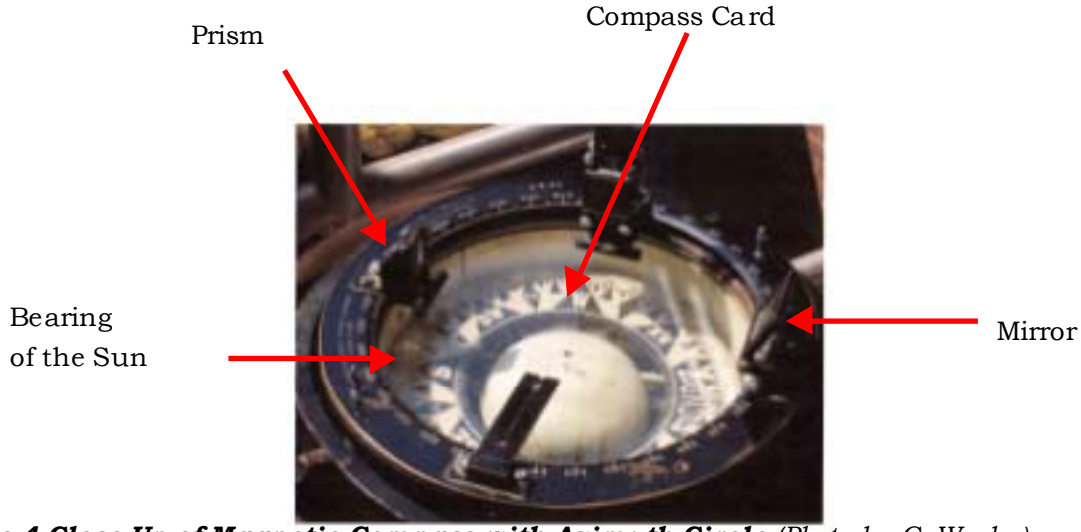



***Figure 4 Close Up of Magnetic Compass with Azimuth Circle*** *(Photo by C. Weeks).*
*The sun light is reflected off the mirror on the right into the prism on the left which bends it down onto the compass card. Note the thin light line on the compass card, that indicates the bearing of the sun.*

Second, a compass adjuster could, while swinging the ship on shoreside range marks, as depicted in Fig. 5 Shoreside Range Marks, arrange magnets and soft iron spheres around the compass to offset the effects of the ship's structure, then note the residual error (remaining deviation) when he was finished.

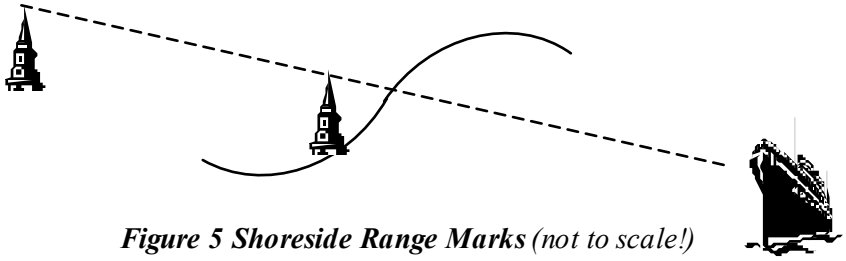


***Figure 5 Shoreside Range Marks*** *(not to scale!)*

He then made a chart (Deviation Card) of this residual error, which was posted in the chartroom or wheelhouse so that the appropriate value could be picked off and used in figuring the course to steer by applying the deviation from the Magnetic Compass heading**.**

Capt. Lord testified on the 7th day of the British Inquiry that the Variation in the area of the sinking at that time was 24 degrees W, with a Deviation of 2E, making a [compass] error of 22W (question 6782). 24W – 2E = 22W.

As an example of how Deviation varies from ship to ship, notice that Californian's Deviation was 2E; Titanic's was 1E.

**Applying Variation and Devation**

Courses laid down on navigation charts are labeled by their true heading, that is, their heading as regards Geographic (True) North. This is also represented by the meridians printed on the chart and the outer ring on the compass rose (refer to Figure 2 Charting Variation). By applying Variation, True plus Variation, one gets

what is called the Magnetic Course (True adjusted for Variation). This would be the compass course in a vessel that had no metal in it.

Next, one applies Deviation to the Magnetic Course to get the Compass Course, i.e., Magnetic with Deviation applied. This is the heading on the magnetic compass that indicates a certain Geographic heading on the chart.

For a chart to calculate Variation and Deviation, refer to Figure 8 Titanic's Variation and Deviation Matrix.

**Titanic's Compass and Procedures**

Standard procedure on Titanic was for the junior officer on watch to measure the sun's azimuth bearing on the standard compass once per watch. This measurement was compared to the calculated bearing to determine compass error.

According to the International Mercantile Marine's 1907 company book of regulations, captains were to "steady the ship on her course by standard [compass] every half hour, and must compare the compasses every Watch" (253). That meant the senior officer on watch had to compare the Standard Magnetic Compass (the most accurate) to the Steering Magnetic Compass every four hours.

Because Titanic's Standard Magnetic Compass was on a raised platform between the second and third funnels, comparing it to the Steering Magnetic Compass in wheelhouse was not easy. Refer to Fig. 6 Titanic's Boat Deck, which shows the distance from the magnetic compass to the bridge (approximately 230 feet). The officer had to walk to the compass platform and indicate when the course was correct by pulling a bell which would ring in the wheelhouse. When the helmsman heard the bell, he knew the ship was on True Course and noted what course to steer on the Steering Magnetic Compass to maintain that course.

This procedure was not only very tedious and rife for error, but may have played a part in events on Titanic just before the accident by drawing an officer and spare helmsman away from the bridge where they could have been watching for ice.

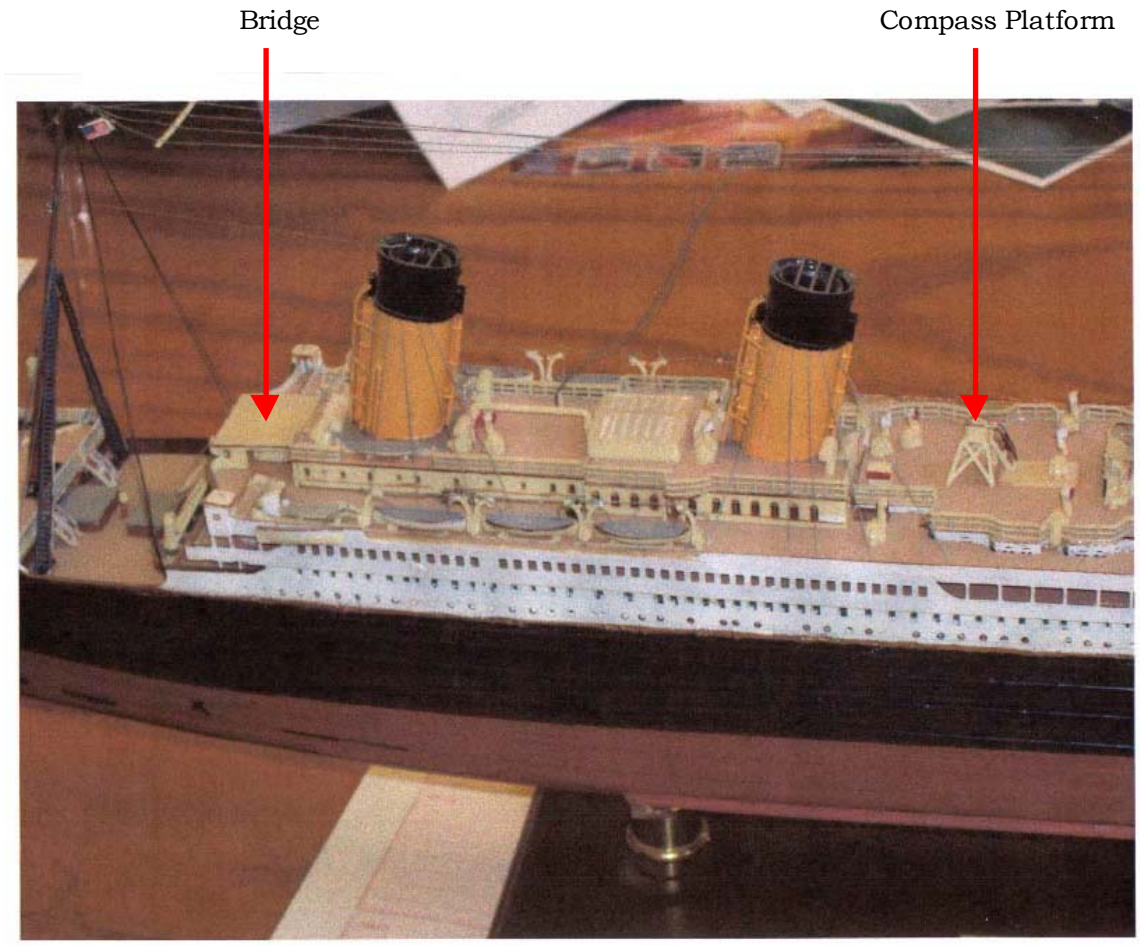



***Figure 6 Titanic's Boat Deck*** *(Photo by C. Weeks)*
*The distance from the compass platform to the bridge is approximately 230 feet.*

The compass arrangement on Olympic class ships was different from other ships which had the Standard Magnetic Compass on the top of the Wheelhouse, fairly convenient to the Wheelhouse. Refer to Fig. 6 Titanic's Boat Deck, which shows the distance from the compass platform to the bridge, and Fig 7 Titanic and Lusitania, which shows Lusitania's magnetic compass on the flying bridge and Titanic's magnetic compass platform between the second and third funnels.

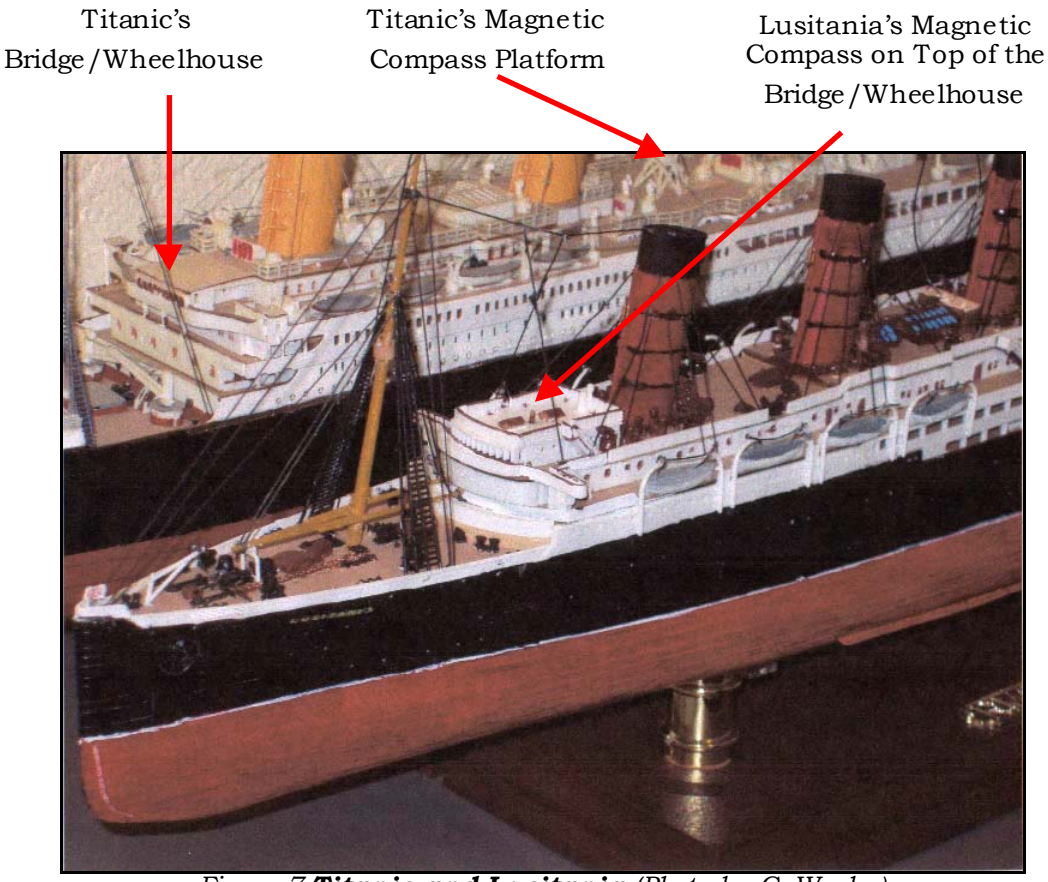



*Figure 7* ***Titanic and Lusitania*** *(Photo by C. Weeks)*
Lusitania's Magnetic Compass on the Flying Bridge (between brown barrels). Compare to Titanic, behind Lusitania. Also compare to Fig. 6.

**Navigation After 1912**

Just before World War I the gyroscopic compass appeared on the scene. The gyro compass is an electro mechanical device which basically functions like a gyroscopic top. When spinning and lined up with the meridian it holds that position regardless how the the ship moves around. It is not affected by deviation and variation and there is only one error, called gyro error. It is determined periodically by use of shoreside ranges or bearings of celestial bodies. These bearings are called Azimuths or, in special circumstances, Amplitudes. In either case one must compare the bearing as observed against the bearing as calculated. The difference is the gyro error. It is named East or West and has an amount, usually less than a degree. Thus the gyro compass comes closest to indicating Geographic North.

The Royal Navy Battle cruisers, HMS Invincible and the HMS Inflexible had gyro compasses in December of 1914 when they fought at the Falklands; however, due to cost, most merchant ships did not have gyro compasses until after World War II.

Unfortunately, Titanic didn't have a gyro compass, only magnetic compasses. As a matter of fact, in addition to the Standard Magnetic Compass she had three Steering Magnetic Compasses: one in the Wheelhouse, one on the Captain's

Bridge, and one at the Emergency Steering Station on the After Docking Bridge. It needs to be understood that a more accurate compass would not necessarily have prevented the accident, which was primarily caused by not seeing the iceberg in time to avoid it.

More recently the use of GPS (Global Positioning System) has taken over for the compass. Because GPS receives fixes so frequently and compares them to the direction to the next waypoint it effectively shows what direction to head in. When hitched up to the steering control it will alter the ship's heading to be headed towards that next waypoint automatically. This is what most modern ships do, although the officers do know how to correct True Course to Compass Course.

**Modern Courses vs. Quadrant Courses**

In 1912 Quadrant Named Courses were used; now 360 degree courses are used. Readers who are familiar with 360 degree courses might not understand the testimony of Titanic's surviving officers regarding her course.

For example, in questions 13498 – 13501 of the British Inquiry Second Officer Lightoller said Titanic's True Course was S 86 W, and that corresponded to N 71 W per the steering compass.

Quadrant Named Courses named their course first, from North (000 degrees) or South (180 degrees), then East or West

| Quadrant Course | Conversion | 360 Degree Course |
|---|---|---|
| N 45 E | 000 + 45 | 045 |
| S 45 E | 180 – 45 | 135 |
| S 45 W | 180 + 45 | 225 |

Therefore, Lightoller's S 86 W is 180 + 86 = 266 degrees, so Titanic's officers were steering 289 on the steering compass to make 266 true.

When a mariner wants to convert the True Course on the chart to his compass courses he uses a matrix like this to calculate the algebraic sum of deviation and variation:

| W+ → True | Var. | Magnetic | Dev. | W- ← Compass |
|---|---|---|---|---|
| 242 | 24W | 266 | 1E | 265 |
| 266 | 24W | 290 | 1E | 289 |

***Figure 8 Titanic's Variation and Deviation Matrix*** *(calculated by C. Weeks)*

The top line of figures is the course before the course change at the "The Corner" (Lat. 42 N, Long. 47 W, where Titanic altered course from a Great Circle to head directly to NY); the second line is from after The Corner. The headings across the top indicate:

| | |
|---|---|
| **True** | The course laid down on the chart |
| **Var.** | Variation |
| **Magnetic** | Magnetic = True plus Variation |
| **Dev.** | Deviation |
| **Compass** | The Steering Magnetic Compass (directly in front of the Helmsman) = Magnetic minus Deviation |

Compass is what Titanic's officers were actually steering. Compass error is the algebraic sum of deviation and variation. Specifically:

| | |
|---|---|
| 266 | (Standard Magnetic Compass = True plus Variation) |
| - 265 | (Steering Magnetic Compass = Magnetic minus Deviation) |
| 1 East | (Titanic's Deviation) |

To summarize, in order to understand the testimony of Titanic's deck officers, readers need to understand the difference between the Steering Magnetic Compass and the Standard Magnetic Compass, how to account for Variation and Deviation, and the difference between Quadrant Named Courses and 360 degree courses.

**References**

Bowditch, Nathaniel. American Practical Navigator: an Epitome of Navigation. Washington: Defense Mapping Agency Hydrographic Center, 1995.
Internatiional Mercantile Marine Company. Ship's Rules and Uniform Regulations. Issued July 1st, 1907.
"Chart 13288: Monhegan Island to Cape Elizabeth." Washington: National Oceanographic and Atmospheric Administration, Aug. 17, 1985.
Pundt, Ralph, Capt. Assistant Professor of Marine Transportation and Nautical Science. "Illustration of Variation." Maine Maritime Academy. Castine, MA, Sept. 8, 2003.
"Wreck Commissioners' Court Proceedings." Titanic Inquiry Project. Rob Ottmers, ed. Copyright © 1999-2002: Titanic Inquiry Project. 5 Sept. 2003 <http://www.titanicinquiry.org/BOTInq/BOT01.html>.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