The Mariner's Compass.

MORE than 300 years ago William Barlow, writing of the compasses of his day, said that, though the compass needle was "the most admirable and useful instrument of the whole world," yet nothing was more "bungerly and absurdly contrived." How little advance was made in the succeeding two centuries can be gathered from Peter Barlow's remark to the Lords of the Admiralty in 1820 that "the compasses in the British Navy were mere lumber, and ought to be destroyed." It was Barlow himself who made the first notable improvements in compasses during the nineteenth century, and his work was the prelude to the important investigations of Airy, Archibald Smith, Kelvin, and others. The practice of "swinging ship"—that is, turning a ship slowly round and noting the deviations of the compass in different positions by taken bearings—was introduced in 1810 by Matthew Flinders, who also invented the use of the "Flinders bar," a rod of soft iron placed near the compass to correct for changes in the magnetism of the ship due to the vertical component of the earth's magnetism.

The gradual increase in the employment of wrought-iron fittings in wooden ships; the use of iron cables instead of hempen; the placing aboard of ponderous iron boilers and engines; and, lastly, the construction of the vessel itself of iron, each in its turn added difficulties to the problems involved. Barlow, in his attempts in 1819 to find a remedy for the large deviation due to the extending use of iron in ships, made the first experimental investigation of the phenomena of induced magnetism. From his inquiry he was able to give a simple means of correcting ships' compasses by fixing soft iron discs in suitable places near the compass, and he afterwards introduced a type of compass having four or five parallel straight strips of magnetised steel fixed under a card, which remained the standard pattern until Kelvin brought out his famous patent in 1876.

The mathematical investigations of Poisson and of Airy about 1838 led to the introduction of methods of correction by the use of permanent magnets, and also of the well-known soft iron spheres. Many of Airy's experiments were made in the iron vessel *Rainbow* off the old Woolwich Dockyard.

The story of Kelvin's share in the improvement of the compass has often been told. Asked in 1871, by his friend Norman Macleod, to write an article for the newly founded magazine, *Good Words*, Kelvin chose as a topic the mariner's compass. The first part of his article appeared in 1874, and the second not until five years later. "When I tried," he said, "to write on the mariner's compass, I found I did not know nearly enough about it. So I had to learn my subject. I *have* been learning it these five years." The Admiralty standard compass, adopted in 1842, and in use when Kelvin took up the matter, had a card 7½ in. in diameter, and under it four needles, each of which was a long, straight bar of flat clock spring placed on edge. The card and the needles weighed about 1600 grains, and had a period of vibration of 19 sec. So considerable was the friction that the binnacle was often kicked by the sailors to make the card move. Kelvin's "gossamer structure" of eight small needles weighed about 170 grains, and had a period of about 40 sec. The cold reception Kelvin received from the then Hydrographer to the Navy, and Airy's remark on the compass, "It won't do," remind one of the reply made to Berthon in 1835: "The screw was a pretty toy which never would and never could propel a ship."

The ultimate adoption of the Kelvin compass was largely due to Lord Fisher, who had one on board the *Inflexible* at the bombardment of Alexandria in 1882. Torpedo craft, however, continued to be supplied with a form of compass in which the whole card floats in liquid, and improvements made in this type led to its being adopted as the standard compass about 1906. Since this has come the invention of, first, the Anschutz, then the Sperry, and, now, the Brown gyro-compasses, the introduction of which has taken place during the last ten years. As remarked by Mr. S. G. Brown in the Royal Institution discourse reproduced below, the gyro-compass is a necessity in a submarine, while in larger vessels it has the great advantages that it can be placed below the water-line more or less immune from gunfire, and lends itself to utilisation with fire-control apparatus and the torpedo director.

All the work on compasses for the Navy is to-day carried out at the new Admiralty compass observatory at Ditton Park, near Slough, where the work of the five departments—the gyro-compass branch, magnetic compass branch, optical branch, experimental branch, and air compass branch—is superintended by the director, Capt. F. O. Creagh-Osborne.

The Gyrostatic Compass.

By S. G. Brown, F.R.S.[1]

THE subject of this lecture is the gyrostatic compass, often called the gyro-compass. An engineer of my acquaintance was asked if he understood what a gyro-compass was, and he replied, "Of course I do; it is a magnetic compass mounted upon a gyroscope." Now the gyro-compass has nothing to do with magnetism or the magnetic compass. The

[1] Discourse delivered at the Royal Institution on Friday, January 30.