EARLY HISTORY OF THE MARINER'S COMPASS AND EARLIEST
KNOWLEDGE OF THE MAGNETIC DECLINATION
ACCORDING TO BERTELLI.

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I. THE EARLY HISTORY OF THE MARINER'S COMPASS.¹

As early as 1866 P. Timoteo Bertelli began the study of the origin and early history of the mariner's compass. The results of his investigations were published in detail in 1893 in a paper entitled "Studi storici intorno alla bussola nautica." His conclusions met the approval of most scientific men; but there were some prominent men in Italy who took exception to his views as to the compass being of Chinese origin and who maintained that the compass was invented as well as perfected at Amalfi, Italy. Bertelli's later contributions to the subject, in reply to these opponents, present the results of his more recent investigations, and treat some phases of the subject in greater detail than was the case in the earlier publications. His conclusions are presented under four general heads.

1. A careful examination of the writings of more than seventy Greek and Latin authors covering the period from the sixth century B. C. to the tenth century A. D. failed to find any mention of the directive property of the lodestone, nor any suggestion from which one might conclude that this directive property was used either in navigation, astronomy, or surveying during that long period of time, though there are numerous descriptions of voyages and storms at sea, where mention of the compass would be expected, if it had been in general use at the time. Apparently the only facts about the lodestone which were known at that time were its property of attracting iron and of communicating that attractive power to iron. That the property of polarity was unknown before the tenth century is shown by the fact that Pliny and subsequent writers explained the phenomena of attraction, repulsion, and neutralization of magnetic action by ascribing them to three supposedly different minerals, *magnete*, *teamede*, and *adamas*. Another circumstance supporting the conclusion that the compass was not used in the Mediterranean before the tenth century, is the fact that all the early descriptions of it which we have (by Neckam, Guyot, etc.) speak of it as a new and wonderful thing.

¹ Sulle recenti controversie intorno all'origine della bussola nautica. P. TIMOTEO BERTELLI, Roma, 1902. 1g. 8°, 52 pp.

La Leggenda di Flavio Gioia, inventore della bussola. Osservazioni del P. T. BERTELLI, Barnabita, Firenze, 1903, 8°, 28 pp.

2. Leaving out of account everything which appears exaggerated or doubtful, it can not be denied that the directive property of the magnet was known to the Chinese before the beginning of the Christian era. In various Chinese and Japanese writings there are repeated descriptions of the so-called south-pointing carts, of which the distinctive feature was a doll attached to a magnet and mounted on a pivot, so that an outstretched arm was always directed toward the south. For instance, the Japanese history (*Nip-pon-ki*) gives an account of the first use of one of these carts in Japan in 658 A. D., and relates that in 666 A. D. one was presented to the emperor by a Chinese Buddhist priest. In fact these carts seem to have been reserved for the use of the emperors almost exclusively. There is also mention in Chinese books now generally accepted as authentic, of the early use of a rude compass with floating needle. As China looked upon all other nations as barbarians and therefore had no desire to enter in commercial nor political relations with them, her commerce was confined almost entirely to her own rivers and coast. There was therefore very little need for a compass, and probably very few vessels were provided with them. For that reason, also, there was no incentive for improving upon the original form of compass, and it was still in use by the Chinese even after the first voyages of the Portuguese to China.

3. One of these crude compasses with floating needle, as used in some Chinese vessel, was probably introduced into the Mediterranean by the Amalfians about the tenth century. There appears to be no direct evidence on this point, but as the Amalfians were very enterprising and were permitted by the Arabian Government to traffic with the extreme East, it seems not at all improbable that on some voyage a compass was brought home as a curiosity. They soon improved upon it by substituting a pivoted needle for the floating one, and by adding the graduated "Rose of the Winds" which moved with the needle. From Amalfi the use of the compass spread gradually to other parts of the Mediterranean and to the seas of the North.

The first European writer to mention the primitive compass with floating needle was the English monk Alexander Neckam, toward the end of the twelfth century. Peregrinus first describes the compass with pivoted needle, in his famous *Epistola*, written in 1269. Benjamin ascribes to him the invention of this improvement of the compass, but Bertelli concludes that the pivoted compass was in use as early as the end of the twelfth century.

4. The names of the various persons who between the tenth and fourteenth centuries introduced and perfected the compass are all unknown, and there is no foundation for the tradition which ascribes to a certain Flavio or Giovanni Gioia the invention and important improvements of the compass about the beginning of the fourteenth century.

This tradition appears to have originated during the last half of the sixteenth century, since a careful scrutiny of the writers of that and the preceding century who wrote about the compass failed to find any mention of the name of the inventor before that time, most of them stating that his name was unknown. The first writer to refer to the *first* use of the compass in the Mediterranean was the learned Flavio Biondo, who, about 1450, made a first attempt at a history of Italy. Speaking of the compass he says: "Sed fama est qua Amalphitanos audivimus gloriari, magnetis usum, cujus adminiculo navigantes ad arcton diriguntur, Amalphi fuisse inventum, quidquid vero habeat in ea re veritas, certum est id navigandi auxilium priscis omnino fuisse incognitum."

Giovanni Battista Pio, in his "Commentaries on Lucretius" (edition of 1511), makes the following remark in regard to the lodestone: "Amalphi in Campania veteri magnetis usus inventus a Flavio traditur: cuius adminiculo navigantes ad arcton diriguntur: quod auxilium priscis erat incognitum." By comparing this with the passage given above it will be seen that Pio quoted almost word for word from Flavio Biondo and in the clause "a Flavio traditur," he gives Flavio as his authority. Giambattista della Porta, also, in his "Magia Naturale" (First edition, Naples, 1589), uses almost the same words in referring to the origin of the compass, but leaves no doubt as to his meaning when he says, "*ut* a Flavio traditur." Giraldi, however (apparently from a misinterpretation of the passage from Pio, quoted above), gives the credit for the first use of the lodestone as an aid to navigation to an Amalfian named Flavius; for he says: (1580) "Amalphis in Campaniae oppido antiquis navigandi usus incognitus per magnetem et chalybem, quorum indicio nautae ad polos diriguntur, a Flavio quodam excogitatus traditur." Giraldi was the first writer to give the name Flavio to the inventor of the compass, and it is to him that the beginning of this erroneous tradition can be traced. Many writers subsequent to the fifteenth century have either left the question in doubt or have stated positively that the name of the inventor is unknown. Indeed, Lipenio, after mentioning the authors who ascribe the invention to a certain Flavius, says: "Boni isti viri inventoris et scriptoris nomina confundunt; Flavius enim non inventor erat, sed scriptor."

Bertelli shows that Mazzelli, who first (1586) gave Flavio di Gioia as the name of the inventor, and Ortelio, who (1596) used the name Giovanni Gioia, are both untrustworthy historians, at least in what they have to say about the compass. Of later writers, some have used one name and some the other, while some have given credit for the *invention* of the compass to Flavio, and for its *improvement* to Giovanni Gioia. Bertelli concludes, therefore, that there is no foundation in fact for the tradition which ascribes to a particular individual the invention or improvements of the compass.

II. WAS THE MAGNETIC DECLINATION KNOWN TO THE CHINESE BEFORE THE TIME OF COLUMBUS?¹

Some writers maintain that the fact that the compass needle does not in general point exactly to the pole of the heavens was known to the Chinese several centuries before its discovery by Columbus. In evidence of this they cite passages, of which the context is nearly the same, from two Chinese books; "*Pen-thsao-yan-i*," a natural history of the early part of the twelfth century, and "*Mung-khi-po-tan*," of about the same epoch, discovered and translated by Stanislaus Julien. The passage from the latter reads as follows: "The soothsayers rub a needle with the lodestone; it will then indicate the south. It declines constantly a little to the east, however; it does not indicate the south exactly. When this needle floats on water it is much agitated. If the finger-nails touch the edge of the basin in which it floats it is very much disturbed; it continues to slide, however, and easily falls to the bottom. In order to show its (directive) property to best advantage it should be suspended in the following manner: Take a single thread from a new skein of cotton and fasten one end of it to the exact middle of the needle by means of a bit of wax as small as a mustard seed. Suspend it in a place where there is no wind, and the needle will then continuously indicate the south." The other passage adds "that if the needle be made to float on water by means of a bit of reed, it will also show the south, but always with a declining toward the point 'ping.'" Ping is the first point to the east of south, each point being 15°.

Bertelli takes exception to the conclusion that these passages show a knowledge of the magnetic declination by the Chinese of that early day. He points out that in both passages it is clearly stated that the property of the needle is best shown when the needle is suspended by a fiber, and that then it points to the south, as though the writers considered its failure to point exactly south when floated to be due to the inferior method of suspension. This was the interpretation adopted by Biot, and he therefore concluded that the declination was very nearly zero at that time in China. Bertelli ascribes the "declining" of the needle when floated to the surface tension of the water, which would prevent the needle from turning freely under the influence of the horizontal component of the Earth's magnetic force. This would not account for its always declining to the east of south, however.

If the Chinese had known of the declination as early as the twelfth century, it is reasonable to presume that the knowledge would have

¹ Della declinazione magnetica presso i Cinesi. P. TIMOTEO BERTELLI, Roma, 1903, 8°, 10 pp.

Nuova conferma che la declinazione magnetica era ignota ai Cinesi prima di Cristoforo Colombo. P. TIMOTEO BERTELLI, Pavia, 1903, 8°, 6 pp.

been handed down from generation to generation. We find, however, that when at the beginning of the seventeenth century the Jesuit mathematician and astronomer, Matteo Ricci, and some of his fellow-missionaries were allowed by the emperor of China to take part in the so-called Tribunal of Mathematicians, it was with great difficulty and only by ocular demonstration that they were able to convince the Chinese scientists that the magnetic and astronomic meridians are not coincident. At that time the declination at Peking was about 2° west, as determined by Ricci. Nearly two centuries later Amiot found that the Chinese still assumed the declination as 2° west in placing their sundials, showing that the knowledge of the fact was preserved for two centuries after its demonstration by Ricci.

Bertelli concludes, therefore, that Columbus and not the Chinese, was the discoverer of the magnetic declination.