Few historians of the magnetic compass carry their story beyond the period of the birth of ocean navigation. To those interested in this fascinating instrument there are, however, many interesting lines of enquiry to be traced in the centuries which followed. These notes are the result of an attempt to investigate the beginnings of just one branch of progress.

During the Sixteenth, Seventeenth, and Eighteenth Centuries, when there were many who tried to solve the problem of finding the longitude at sea, one of the favorite methods proposed was the use of the variation of the compass. Of those who proposed this method one of the last was Ralph Walker, a resident of Jamaica, who, in the year 1793, traveled to England to lay his proposals before the Board of Longitude. It is not intended here to discuss his variation theory but to point out that, in addition to producing this theory, he designed a compass to enable the variation to be observed with greater accuracy at sea. This compass was sent for trial in H. M. Ships Invincible, Glory, and Lynx and it was this trial in the Glory which introduced her master, Murdo Downie, to fame among those who have written on the magnetic compass. In his report on Walker’s compass Downie wrote [see 1 of “Authorities quoted” at end of paper]:

“It appears, that the variation observed at one view by Walker’s compass, and that observed by the ship’s compass by the bearing and altitudes, were generally very near the same. But it is evident, that the variations given by both compasses at different times and situations disagree very much: Whether any part of this disagreement may be owing to the time of the day the variations were taken, I cannot take on me to determine; but I am pretty well convinced, that the quantity and vicinity of iron in most ships has an effect in attracting the needle; for it is found by experience, that the needle

*Walker says that he took passage to England in H.M.S. Providence but I have been unable to find any record of him in her log or muster book. The Providence was commanded by the renowned Captain William Bligh and was then returning from his successful second bread-fruit voyage.

†Another compass was given by Walker to James Guthrie, the second lieutenant of the Providence.

‡Murdo Downie received an acting warrant as master to fill a vacancy in H.M.S. Champion in 1781. On the return of the ship to England three years later he passed as master of the fourth rate and his appointment was confirmed. He later, while still in the Champion, carried out surveys of the east coast of Scotland and, when publishing the results of these surveys, devoted a part of the introduction to his sailing directions to a warning against the evils of badly made compasses. He subsequently served in the Defence, Union, Duke, Glory, and Resolution and, in 1805, was reported medically unfit for sea.
will not always point in the same direction when placed in different parts of the ship: Also it is rarely found, that two ships steering the same course by their respective compasses will go exactly parallel to each other; yet these compasses, when compared on board the same ship, will agree exactly."

For the trials in the Glory the compass was usually placed five feet from "the iron stantions, or railing of the hatchway, leading to the wardroom" [1-a].

During the first half of the Nineteenth Century it was common for writers [2] to acclaim Downie as the first man to note that a compass might be deranged by the iron-work in a ship. However, an anonymous writer in the Nautical Magazine for 1837 [3] drew attention to a comment on the subject in the fourth (1700) edition of Captain Samuel Sturmy's Mariners Magazine and since that date others have come to light as the following quotations will show.

First in order of date we have the remarks of the great Portuguese navigator Dom João de Castro who, at Mozambique, on August 5, 1538* recorded the following:

"... o ferro do qual berço chamava a si as agulhas e as fazia desviar desta maneira..." [4].

Next we have Gerrit de Veer, the chronicler of William Barentz third and last voyage in search of the Northeast Passage. On August 4, 1597, he noted that:

"... we sailed along by the coast ... supposing that we held our course west and by north ... we were wholly deceived by our compass, that stood upon a Chest bound with iron bands, which made us vary at least 2 points, whereby we were much more southerly then we thought our course had bin, and also farre more easterly..." [5].

In 1669 Captain Sturmy, to whom I have already referred, wrote [6]:

"... The Points of the Needle or Wyres being touched by the Lodestone, are subject to be drawn aside by the guns in the Steer-age, or any Iron near it, and liable to Variation."

Another sea-captain, Daniel Newhouse, a great admirer of Sturmy, wrote in 1685 [9]:

"... you are to take great care there be no Iron at all near the Compass, nor to the Binnacle, and that your Compass be not placed near Iron Guns, or other Instruments of Iron."

*The date of this entry is given as July 3 by Harradon, Some early contributions to the history of geomagnetism, Terr. Mag., 49, p. 190 (1944).
I believe that there must have been some knowledge of the matter in France but the only passage of French origin which I have been able to trace occurs in a communication made to the Royal Society by de la Hire in 1687 [8]:

"Too much reliance must not be laid upon the observations of pilots, by reason of the gross errors which it is not easy for them to avoid. For it often happens that near the space where the compass is, there is much iron, which draws the needle, and causes it to show a point on the horizon much different from what it would were it farther from the iron: which makes it appear as if there is considerable variation, where perhaps there is none at all."

It is obvious, from my next quotation, that the mathematicians William Mountaine and James Dodson knew that iron-work in the ship might deflect the compass for, writing nearly a century later, in 1758, they say [9]:

"In making Observations, due regard should be had to the Station appointed for that purpose, that it may be as free as possible from the particular Attraction of contiguous Guns, Stantions or other Iron-Work."

These authors are almost certain to have been familiar with the work of William Whiston who, writing in 1721 [10] on the use of the dipping needle for finding the latitude and longitude, said that the instrument must be used in a place which "must have no Iron at all within a Foot or two; and no great Quantity of Iron within a Yard or two of it."

In the middle of the Eighteenth Century the Hamburgische Gesellschaft zur Beförderung der Künste und nützlichen Gewerbe was so dissatisfied with the German compasses of the day that it caused inexpensive copies to be made of the Gowin Knight compasses which had lately been introduced into the British Navy. With each compass it issued a leaflet of instructions and in this, probably issued in 1768, appears the statement [11]:

"Es wird den Schiffern bekannt sein, dass kein Eisen in der Nähe des Compasses sich befinden müsse."

"The mariner will already be aware of the fact that no iron must be situated near the compass."

The celebrated captains Cook and Bligh seem to have had some inkling of the fact that iron would affect the compass. The former wrote, in 1777 [12]:

"Whoever imagines he can find the variation within a degree, will very often see himself deceived. For besides the imperfection which may be in the construction of the instrument, or in the power of the needle, it is certain that the motion of the ship, or attraction of the ironwork, or some other cause not yet discovered, will frequently occasion far greater errors than this."
While at Teneriffe, in 1787, William Bligh recorded in the log of the *Bounty* [13]:

"I am sorry I had no opportunity of making more Observations for the Variation of the Compass, for I had led myself to believe it did not exceed 15 degs: I could not help being more particularly surprised to find we had made it full 20 degrees. The weather had been remarkably Cloudy the whole Passage which has prevented me from making the Number of Observations I otherwise would, and most likely could have determined the Value of these Observations; but it is to be remarked that in Lat. 30° 52' N. I found 22° Variation. Time and Opportunity therefore must determine how far my Compasses may be Affected by Iron in the Ship."

In spite of these remarks both officers appear to have been careless of their compasses for Captain Cook kept the keys of the leg irons in his binnacle [14] while Captain Bligh thought his binnacle a suitable stowage for a pair of pistols [15].

It is curious that the early commentators on Downie's report should have overlooked two other significant passages in Ralph Walker's pamphlet.

"... it is a fact well known, that on board of all armed vessels, where there are great quantities of iron, the current of polarity is deranged in a very great degree" [16].

If "there is a necessity for the binnacle being placed close to the commings of the after hatchway; where this is unavoidable, the bolts ought to be made of copper, because the iron bolts affect the needle of the compass. . . .

"At any distance from the magnetic equator, the upper end of all iron bolts, &c. become possessed of a polarity of a different name with the latitude . . ." [17].

The construction of binnacles—A more particularised warning than those given above was expressed by the Sieur de Guillet in the latter half of the Seventeenth Century. He wrote in his *Dictionnaire* [18]:

"HABITACLE . . . Il est fait avec des Planches assemblées par des chevilles de bois, sans qu'il y entre aucun ferrement, de peur que le fer n'ôte la direction naturelle de l'Aiguille aymantée du Compas de route, qui y est enfermé . . ."

"BINNACLE . . . It is made with the planks held together by wooden pins, without any iron-work in it for fear that the iron deflect the natural direction of the magnet needle of the steering compass which is kept in it . . ."

Aubin, in his *Dictionnaire de Marine* of 1702, repeats this almost word for word and is followed by Saverien in his *Dictionnaire* of 1758 [19]. Their entries are curious in view of what they say on other pages and appear to indicate some confusion of thought. Aubin writes, and is closely followed by Saverien [20]:

HISTORICAL NOTES ON DEVIATION OF COMPASS

“Balancier de Lampe. This is a moving iron ring which keeps the lamp of the binnacle in equilibrium.”

LAMP GIMBEL. This is a moving iron ring which keeps the lamp of the binnacle in equilibrium.

The British Navy Board was also concerned with the possible presence of iron in binnacles. On July 20, 1739, they issued an order to all dockyards that [21]: “The (compass) Boxes to be examined and in case any iron is found about them it is to be taken out and fastenings to be of brass”.

Twenty years earlier the same Board had issued a rather similar order for the preservation of compasses when not in use [22]: “To be laid as far as possible from iron and in a dry place and to make a chest or box in ships to preserve them.”

In 1749, Dr. Gowin Knight, whose compasses were soon to become the standard design for the Royal Navy, was consulted concerning the damage to the compasses of the ship Dover which had been struck by lightning. In discussing the case he said [23]: “It was natural to inquire if there was any iron about the binnacle; but the Captain said he had given strict charge to the maker not to put so much as a single nail in it.”

Interaction of compasses—Some writers mention that compasses will deflect each other if placed too close. In this connexion I quote Joseph Harris, a blacksmith turned teacher of navigation who had himself apparently served at sea [24]:

“In large Ships where there are commonly two Men at the Helm, there is also placed two Compasses in the Bittacle: but I often observed that these two Compasses (when rightly placed) would differ from one another about ½ Point; which Difference the Sailors attributed to one being touched with a better Load-Stone than the other. But it is well known, that all Needles being rightly touched by any Load-Stone . . . will point exactly the same way; . . .”

The same fact is also mentioned, in 1768, in the German instructions for the use of compasses already quoted [25]:

“Die Schiffer haben die Gewohnheit zween Kompass beym Steurruder in einem Gehäuse neben einander zu setzen, dadurch sie meinen desto sicherer zu fahren. Es haben uns aber verschiedene Proben gezeigt, dass ein Kompass noch in zeimlicher Entfernung auf den andern würde, und dadurch beyde aus ihrer Richtung gebracht wurden.”

“It is a custom amongst mariners to use two compasses placed side by side whilst piloting a ship; it is thought that the course steered is then more accurate. But a large number of experiments have shown us that one compass affects the other even when at an appreciable distance; such that neither can be regarded as reliable.”
A similar statement was made by William Hutchinson in 1794. This man, who had served in privateers and was dock master at Liverpool for many years, wrote [26]:

"Some late observations, and several experiments which I have made myself relative to them, prove, that a very material error in the course may be occasioned by having two compasses, with needles of strong magnetic power, at the same time in the binnacle. For it is found by their action one upon the other, that they will vary, from two to three points from the truth, when suffered to stand too near to each other, a circumstance which it is very necessary a commander of a ship be apprized of, that he may be upon his guard."

*Observers in the dark*—The majority of the authorities I have quoted had, at one time or other, followed the sea and it might be assumed that the fact that proximity of iron to a compass would cause it to deviate was well known to the more skilful of the navigators of the Seventeenth and Eighteenth Centuries. Charles T. Beke, in a footnote in his edition of Gerrit de Veer's work, implies that this was so and that had Barentsz been still alive on August 4, 1597, so experienced a seaman would not have committed the error of trusting to a compass "that stood upon a chest bound with yron bands" [27]. There is, however, ample evidence that the fact of the existence of deviation was noted by several distinguished navigators without their associating it with the presence of magnetic materials.* It is possible that some movement of arms or suchlike cause was responsible for the sudden change in the variation experienced by Columbus on August 16, 1498, but he seems to have accepted it as just one of those things that happen at sea. His son recorded the incident [29]:

"Medisimamenta dice, che quella stessa notte, che fu il Giovedi a XVI di Agosto non avendo fino allora norvestato, le aguglia norvestarono in fretta piu d'una quarta e mezza, e alcune mezzo vento, senza che in cio vi potesse essere errore, perdre sempre erano stati molto vigilanti per notar cio."

Some noticed that unexplained changes of variation seemed to have something to do with the course of the ship. Norwood may have intended to hint at this when he wrote, in 1636, of the variation [30]:

*Edmund Halley, the great astronomer, stated that a ship's guns had no effect on the compass [28].
Dampier wrote, in 1699, during his New Holland voyage [31]:

"Another thing that stumbled me here was the Variation, which, at this Time, by the last Amplitude I had I found to be but 7 deg. 38 min. W.; whereas the Variation at the Cape [of Good Hope]... was then computed, and truly, about 11 deg. or more: And yet a while after this, when I was got 10 Leagues to the Eastward of the Cape, I found the Variation but 10 deg. 45 min. W. whereas it should have been rather more than at the Cape. These Things, I confess, did puzzle me: ..."

Wales, who served as astronomer to Captain Cook during his second voyage of 1772-1775, also noted the existence of errors but though he gave some thought to the matter did not penetrate the truth. This is the more extraordinary in view of Cook's remarks quoted above. Wales wrote [32]:

"In the Channel of England, the extremes of the observed variation were from 19½° to 25°; and all the way from England to the Cape of Good Hope, I frequently observed differences nearly as great, without being able, any way, to account for them, the difference in situation being by no means sufficient. These irregularities continued after leaving the Cape, which, at length, put me on examining into the circumstances under which they were made. In this examination it soon appeared, that when most of these observations were made, wherein the greatest West variations happened, the ship's head was North and Easterly; and that when those, where it was least, had been observed, it was South and Westerly. I mentioned this to Captain Cook and some of the Officers, who did not at first seem to think much of it; but as opportunities happened, some observations were made under those circumstances; and very much contributed to confirm my suspicions; and throughout the whole voyage I had great reasons to believe, that variations observed with the ship's head in different positions, and even in different parts of her, will differ very materially from one another; and much more will observations on board different ships, which I now find fully verified, on comparing those made on board the Adventure, with my own made about the same time."

That these were not isolated cases is shown by yet another passage in Walker's pamphlet of 1794 and by a remark made by Admiral Sir John Ross, which, though made at a much later date, was written of the same period.

"The present Admiral Murray, and Captain Penrose, when cruising off the Ness of Norway, found that when the ship's head was in

*The italics are mine
shore, it made a difference of nearly a point in the compass, from what it was when the ship’s head was off shore; and as many navigators as have been accurate in their observations, have taken notice of the same phenomenon in different parts of the world. By this remark it is not meant to insinuate, that such change in the direction of the needle was owing to any effect that the shore had upon it, but only, that by being in sight of the shore, an opportunity was had of ascertaining the fact.” [33].

"... in the year 1799... in... H. M.’s ship Weazle. I could not satisfactorily account for the pilot constantly making an allowance for what he called in-draft when the ship’s head was standing to the south-west, and none when the ship’s head was standing to the north, with the wind in both cases from W.N.W.; yet he was always right in his reckoning.” [34].

Compass errors attributed to load-stones—Many seamen observed apparent errors and concluded that different load-stones caused the needles with which they had been “touched” to point in different directions. Roger Bacon had put forward such a theory in his Opus Minus, in 1266 [35], and another instance of this belief is expressed by Fernando Columbus who says [36]:

"E, quanto al norvestare, io credo che la stella abbia la proprietà dei quattro venti, come l’ha ancora la calamita; che, se toccano col Levante, dimostrerà il Levante e altresì il Ponente, o il Settentrione, o l’Ostro; e pero colui che fa le aguglie copie con panno la calamita in modo che non resti di fuori, eccetto che la parte settentrionale, cioè quella che ha virtù di condurre l’acciaio a percorrere la Tramontana.”

"As to the northwesting, I believe that the pole star has the properties of the four winds, as has the lodestone; that when it touches the east, it will point to the east, and in like manner the west, north, and south; and for that reason, he who makes the compass-needle covers the lodestone with a cloth, all but the north point of it; namely, that which has the virtue of making the steel point to the north.”

The same point of view was advanced by Richard Polter in his book The pathway to perfect sailing, written in 1586 but not published until 58 years later, while Joseph Harris refers to the belief as erroneous in the quotation given above.

Bad workmanship by compass makers—Of course many of the errors which were attributed to the use of different load-stones were really due to the infamous manner in which compasses were made. In 1750 Dr. Gowin Knight stated that of twenty cards [37]:

"He found them all to vary more or less, either to the east or west; and some of them as far as 8°. Few of them came to the same degree twice together; and when they did, that was never the true point.”
This is by no means an isolated complaint. In 1616 Barlowe had written [38]:

"The Compasse needle, being the most admirable and usefull instrument of the whole world, is both amongst ours and other nations for the most part, so bunterly and absurdly contrived, as nothing more."

Croker, in 1764, says much the same thing [39]:

"The compass being of the utmost consequence in navigation, it is reasonable to expect that the greatest care and attention should be used in its construction, and every attempt to improve it carefully examined, and, if proper, adopted. But so careless are the generality of commanders of this most useful instrument, that almost all the compasses used on board merchant ships have their needles formed of two pieces of steel wire... if we examine a number of these cards, we shall rarely, if ever, find them all in the same direction, but they will all vary more or less, not only with regard to the true direction but with each other."

Flinders, in 1814 [40], described naval compasses as: "... the worst constructed instruments of any carried to sea," while even as late as 1820 we find Peter Barlow writing [41]:

"Upon my examining the compasses in store in Woolwich dockyard, ... I could scarcely bring myself to believe that the instruments exhibited to me were those actually employed in his Majesty's vessels: the cards, bowls, needles &c. seem all worthy of each other, equally clumsy and imperfect ... they are, generally speaking, wretchedly defective, ... and it does appear to me very unaccountable that vessels of such immense value, and the safety of so many valuable lives, should be endangered by the employment of instruments that would have disgraced the arts as they stood in the beginning of the 18th century."

Under such conditions few noticed any errors and in spite of the general knowledge that compasses were poor many trusted to them implicitly with disastrous results. A case in point was the tragic loss of H. M. S. Apollo and more than half of her convoy of 69 ships in the year 1804.

Lack of education among early navigators—The truth is that all through the centuries when British sea power was being consolidated navigators were a very ignorant lot. Few really knew more than the rudiments of their art. There were many treatises on the subject which should have helped them but the authors of these were mostly teachers of mathematics few of whom had any practical knowledge of the sea and who, rather than produce a serviceable little manual, preferred to pack out a bulky volume with numerous examples of mathematical calculations which, while quite useless to the mariner, served to testify to the apparent erudition of their authors. William Mountaine is particularly deserving of
censure for though he knew of possible compass errors not one word of warning did he insert into the several books of navigation which he revised [42].

It is a great pity that some of these writers did not take to heart Sir William Petty's notes on What a complete treatise of navigation should contain, which he wrote in 1685 [43]. Sir William had followed the sea in his youth and was, at one time, a Commissioner of the Navy. Among other details which a navigation manual should contain he lists: "The whole skill of the magnet, as to its directive virtues, and on the accidents which may befall it." It seems most probable from this that he knew that the compass needle might be deviated by the iron in a ship.

An occurrence narrated by Lionel Wafer illustrates the ignorance and superstition of many sailors in his age. In 1687 the Batchelor's Delight, a privateer commanded by Edward Davis and carrying Wafer as surgeon, called at Vermejo (Huarmey) in Peru. There they found a great cemetery of desiccated bodies and Wafer remarks [44]:

"Of these Bodies I brought on board a Boy of about 9 or 10 Years of Age, with an intent to bring him home for England, but was frustrated of my purpose by the Sailors, who having a foolish Conceit, that the Compass would not traverse aright, so long as any dead Body was on board, threw him overboard, to my great Vexation."

It is not clear whether the throwing overboard of the body happened immediately or some time later but I think it likely that it may have been linked with what followed. Towards the end of the year Davis started to return round the Horn and in the latitude of 62° 30' south turned northwards again, steering east-northeast and east by north as he was allowing three points westerly variation. Sights showed him that he was still making southing so he concluded that the variation was really easterly and altered course four points to port. Even then he was so far out in his reckoning that he made the latitude of the river Plate 500 leagues too far to the eastward and frightened his crew into thinking that they were still on the wrong side of South America and steering away across the Pacific. It is possible that it was during the uncertainty of the long run to the westward, in search of the land, that Wafer's curio was sacrificed to superstition. The variation south of the Horn was, at this date, about 2½ points east and as Davis had come from the Pacific where the variation had always been easterly it is difficult to see how he had made his mistake otherwise than by sheer incompetence.

It remains an extraordinary fact that nearly 300 years elapsed between João de Castro's note on the effect of a ship's guns on the compass and the publication of Poisson's celebrated memoir on the theory of magnetism. During this period very few seamen knew that compass errors could be
caused by anything but the bad construction of the instruments. The
individual errors of these were taken for granted.

The dawn of modern knowledge—It was left to Captain Matthew Flinders
of the Royal Navy, at the beginning of the Nineteenth Century, to be the
first individual to make a scientific investigation into the causes of the
apparently extraordinary changes of variation which were encountered at
sea. His conclusions were not entirely correct for he attributed the whole
error to the effect of induction in vertical soft iron. All the same, his
remarks on the subject were of the greatest value as he was the first to
propose that navigation should be controlled, in each ship, from one par-
ticular fixed compass,* to lay down instructions for ascertaining the errors
of the compass and to propose a method of correcting some part, at least,
of the deviations.

The results of Captain Flinders’ investigations were widely published
and were commented on by many writers. In view of this publicity it is
all the more extraordinary to note that there were still many who, either
never suspected the errors to which their compasses might be subject, or
were careless of them.

Bain, in 1817, quotes from a morning paper [46]:

"Caution to Navigators. A Captain of a ship, lately on her passage
from Bristol to Milford Haven, was much surprised to find that the
course he was steering by compass was at variance with the well-
known landmarks of the coast he was traversing. Several compasses
were tried, but not one could be found that pointed north by two or
three points. It was surmised by one of the passengers, that as the
ship was laden with iron, it might have an effect on the needle. The
compasses were moved to another part of the ship, and the experi-
ment confirmed the surmise."

This quotation is all the more interesting as showing the merchant
ship captain immediately attributing the error, when it was discovered, to
bad manufacture of the compass instead of to any other* cause.

Purdy, in his sixth edition of his Atlantic Memoir, published in 1829,
says [47]:

"In one of the letters of our friend Captain Livingstone, we find
the following remarks:—

'It is strange with what pertinacity many maintain that iron will
not attract the needle of a compass, provided the iron is covered with
wood or puttiéd up. For my part, I am well convinced that many a
fine ship has owed her loss to iron near the compass. It seems hardly
credible, but it is nevertheless true, that I have seen more than one
vessel with copper-nailed decks, and an iron-fastened binnacle!'"

*Some may cavil at this statement as Captain Bligh always made his observations
for variation from one spot, the top of the binnacle [45]. There is, however, no evidence
that he shaped his courses by other than the steering compass.
Captain E. Johnson, the first Superintendent of the Compass Department of the Admiralty, wrote [48]:

"On inspecting a merchant steam-vessel which had been bought into her Majesty's service, finding the compasses were placed in a binnacle so closely together that they could not fail to produce serious errors by their reciprocal action upon each other, I requested the binnacle might be cut in two and the compasses separated. In this operation it was found that the binnacle itself had been put together with iron nails and screws; three quarters of a pound of the same having been extracted, and which are now in my possession; and in one instance the very box of the compass itself, which is placed inside the binnacle, had been repaired with iron nails!!"

Finally, in a footnote to an article in the *Nautical Magazine* of 1843 [49] discussing the wreck of the *Reliance*, an event rather famous in compass history which occurred in that year, the writer quotes a number of extracts from the press to show that merchant seamen were at last beginning to realise the danger of having iron near a compass. Truly, seamen in general had taken a very long time to appreciate the fact.

**Deviation**—It is not known when and by whom the expression “deviation” was first used to denote the error of the compass due to the magnetic effects of the ship. The earliest use which I have been able to find is by Captain John Ross, in 1819 [50]. Other writers of the period use such clumsy terms as “effect of ship’s attraction”, “effect of local attraction” (often shortened to the inaccurate term “local attraction”), “difference of variation”, “deviated variation”, and “aberration of the needle”. By about 1840 the word “deviation” would seem to have become firmly established although Raper, in that year, tried to popularise the form “local deviation”, discussing the matter in the following words [51]:

"The term *local* is proper, because the needle is differently affected in different parts of the same ship, and in different places on the earth. The deviation is sometimes called *local attraction*, but the attraction is the cause, and the deviation is the effect, which alone is concerned in the practical result. The term local deviation is preferable to local variation, because the word *deviation* here relates solely to the action of the ship on the natural position of the magnetic needle; whereas, the term *local variation*, in strictness, implies the total magnetic variation of the compass at the time, which is made up of the true magnetic variation and the local deviation together."

The term “local attraction” is now sometimes used for the irregularity of the variation due to local causes met with in certain parts of the world [52].

**Conclusions**—From a study of the quotations given in this article I have come to the following conclusions:
Downie was not, as was at one time supposed, the first man to discover that a ship's compass might be deflected by the iron in her; the fact had been known since 1538, if not earlier.

Though this knowledge was fairly widespread it was not general, errors found being usually attributed to badly made compasses, use of varying types of load-stones, the attraction of the land, or simply to inexplicable causes.

Compasses were usually so badly made that instrumental errors often masked the existence of deviation except from the most scientific type of observer.

Of those who knew that iron might deflect a compass many thought that it could only act at a very short distance and then only if no other substance intervened.

The writers of books on navigation in the Eighteenth Century usually cared more for a display of mathematics than for the practical application of the art; hence, such knowledge as was available was not published.

The term "deviation" was adopted within a few years of the first investigations by Flinders having been made known and, in spite of alternatives, soon became general.

**Authorities quoted**


   (b) R. Walker, The memorial of Ralph Walker to the honourable the Board of Longitude, pp. 7 and 8, (1794).


   (b) Directions for ascertaining the amount of the local attraction of a vessel on the compass. Naut. Mag., p. 248* (1837).

   (c) F. J. Evans, Notes on the magnetism of ships. J. United Serv. Inst., 3, p. 92 (1860).

   (d) Darondeau, Notice sur les erreurs des compas dues aux attractions locales à bord des navires en bois et en fer, p. 6 (1858).


   (b) Samuel Purchas, Hakluytus posthumus or Purchas his pilgrimes, 1625, III, iii, p. 514 (Hakluyt Soc. ed. 1905, 13, p. 152).


*The author of this paper gives the date of Downie's report on Ralph Walker's compass as 1790 instead of 1794, an error in which he has been followed by W. Walker in 1843, by E. Johnson in 1847, and by P. F. Mottelay in 1922.*


[9] William Montaigne and James Dodson, An account of the methods used to describe the lines on Dr. Halley’s chart of the terraqueous globe showing the variations of the magnetic needle about the year 1756 (1758).


[12] James Cook and J. King, A voyage to the Pacific Ocean: Undertaken by the Command of His Majesty, for making discoveries in the Northern Hemisphere; performed under the direction of Captains Cook, Clerke, and Gore, in His Majesty’s Ships the Resolution and Discovery in the years 1776, 1777, 1778, 1779 and 1780, 1st ed., 1, p. 50 (1784).


(b) Saverien, Dictionnaire historique, théorique et pratique de marine, 1st ed., 2, p. 50 (1758).

[20] (a) See [19](a), p. 60.

(b) See [19](b), 1, p. 89.


[22] See [21], May 15, 1719.

[23] Gowin Knight, Of the Mariner’s Compass, that was struck with Lightning, as related in the foregoing paper; with some further particulars relating to that Accident, Phil. Trans. R. Soc., 46 (1749) (Hutton’s Abridged edition, 1809, 10, p. 654 (1809).


(The passage does not appear in the 1st ed., published in 1777 under the title of Treatise on practical seamanship.)


HISTORICAL NOTES ON DEVIATION OF COMPASS

[32] William Wales, The original Astronomical Observations made in the course of a Voyage towards the South Pole and round the World in His Majesty's Ships the Resolution and Adventure in the years MDCCCLXXII, MDCCCLXXIII, MDCCCLXXIV, MDCCCLXXV, pp. xlix-l (1777).


[34] John Ross, A short treatise on the deviation of the mariner's compass, p. 5 (1849).


[37] Description of a mariner's compass contrived by Gowin Knight, M.B., F.R.S., Phil. Trans. R. Soc., 46, 1750, p. 505 (1750) (Hutton's abridged ed., 10, 64 (1809).)

[38] Barlowe, Magnetic advertisements (1616). (Quoted in Encyclopaedia Britannica, 11th ed., 6, p. 809, Art. "Compass.")


[40] Matthew Flinders, Voyage to Terra Australis, 2, p. 524 (1814).

[41] Peter Barlow, An essay on magnetic attractions, pp. 78-79, note (1820).

[42] For example: (a) Wakeley's Mariners compass rectified.

(b) Atkinson's Epitome of navigation.

(c) Crosby's Mariner's Guide.

(d) Colson's Mariner's new calendar.


[44] Lionel Wafer, A new voyage and description of the Isthmus of America, 1699, Hakluyt Soc. ed. p. 123 (1934) (Davis' troubles with the variation will be found on pp. 128-139.)


[48] E. Johnson, Practical illustrations of the necessity for ascertaining the deviation of the compass, 1st ed., p. 28 (1847).


[50] J. Ross, A voyage of discovery, made under the orders of the Admiralty, in His Majesty’s ships Isabella and Alexander, for the purpose of exploring Baffin's Bay, and enquiring into the probability of a North-west passage (1819).


ADMIRALTY COMPASS OBSERVATORY,
Ditton Park, Slough, Buckinghamshire,
England, February, 1947