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the winds were driving it in that direction ; the other is the error of longitude, and I do not see how Prof. Brown is going to get over that.

The CHAIRMAN: We are very much indebted to Lieut. Wordie for taking part in the discussion, and for giving us quite a lively afternoon ; perhaps in the future we will have a little more amusement out of Morrell.

HALLEY'S MAGNETIC VARIATION CHARTS

E. A. Reeves

NOTE by the Editor, G.J.—At the first meeting for the discussion of Geophysical questions arranged by a committee of the British Association, and held at the Rooms of the Royal Astronomical Society on Wednesday, November 7, Dr. S. Chapman of the Royal Observatory, Greenwich, gave an account of the history of terrestrial magnetism, and showed on the screen a photograph of Halley's Atlantic Chart, which he described as forgotten until Dr. Bauer (*Nature*, 23 May 1895, p. 79) called attention to a copy in the British Museum. In the following January Dr. Bauer reproduced on a small scale in *Terrestrial Magnetism* a second copy of the chart in the possession of Mr. Thomas Ward of Norwich.

After the meeting I was talking to Mr. W. H. Wesley, assistant secretary of the Royal Astronomical Society, in his room, when I noticed on the wall a copy of the Atlantic Chart, which had hung there certainly since 1872. On the following morning I asked our Map Curator if we possessed a copy. We did not, but within a day or two he succeeded in buying one which proves on examination and comparison with other copies to be of interest, as probably the earliest. At my request, therefore, Mr. Reeves has written the following note. A. R. H.

I have compared the copy of Halley's "New and Correct Chart showing the Variations of the Compass in the Western and Southern Oceans," now known as his Atlantic Chart, which has just been purchased for the Society, with early copies in the Map Room of the British Museum and at the Royal Astronomical Society, and find that they are evidently all from the same plate, with the engraver's name "I. Harris" at the bottom : but there is one important difference. Our copy lacks the dedication to King William III., the space for it within the frame being blank. On close examination it is clear that the dedicatory inscription cannot have been erased from the plate before our copy was printed, as the engraver's "spacing out" lines are all plainly visible across the blank space, as well as in other parts of the plate. It would seem, therefore, that the Society's copy is an earlier impression than either of the others. It does not bear the names of Mount and Page under the engraved title as the Astronomical

Society's copy does, nor does it seem ever to have had the columns of explanatory text pasted on it which some other copies have. So far as I have been able to ascertain no other copy exists with the space for the dedication blank, so it may be that the Society possesses the earliest known copy of this interesting chart. It is probably a proof pulled from the plate before publication, and before the dedication was written. It is in excellent condition, and the lines and lettering remarkably clear.

The dedication to William III. fixes the date of this Atlantic Chart very closely. Its full title is "A New and Correct Chart showing the variations of the Compass in the Western and Southern Oceans as Observed in y^e year 1700 by his Ma^{ties} Command by Edm. Halley." The voyage of the '*Paramour* pink' ended on 7 September 1700, and it is not likely that Halley had time to prepare his magnetic observations, to draw the chart, and to get it engraved before the end of that year. But William III., under whose orders the voyage was undertaken, and to whom the chart is dedicated, died 8 March 1702, so the chart in all probability was engraved and published in 1701.

It is certainly remarkable that Halley never referred to this chart in any of his writings; but this may be due to the fact that he considered it as only preliminary to his world chart, which includes the variation lines for the Indian Ocean as well.

Although the world chart is well known, the Atlantic chart seems to have been entirely overlooked until Dr. Bauer called attention to the copy he had seen in the British Museum. This is more remarkable since other early copies of the chart have since come to light. The chart was re-published (the later copies with the chart re-engraved) several times during the eighteenth century, and appears, with corrections to bring it up to date, in a number of editions of '*The English Pilot*' (fourth book), which was first published by W. Fisher and J. Thornton in 1689 (too early for the chart) and later by Mount and Page. Dr. Bauer wrote further notes on the chart in *Terrestrial Magnetism* (vol. 1, p. 28 and vol. 18, p. 115). His photographic reproduction of an early copy lent by Mr. T. Ward of Northwich is similar to the British Museum, R.G.S., and R.A.S. copies, except that the R.G.S. copy has no dedication. The R.G.S. possesses one of these later editions (corrected to 1744) with Halley's text and additions pasted on in strips at the side, sold by W. J. Mount and T. Page & Sons on Tower Hill, and I have inspected three or four editions of the '*English Pilot*' containing the chart at the shop of Messrs. Stevens & Styles, the well-known second-hand booksellers of Museum Street, Bloomsbury. The earliest edition of the atlas with the chart they now have there is dated 1749, but they have had much earlier, and the British Museum has a copy of the atlas of 1737 with the chart, from the original Harris plate. Among those who copied this Atlantic chart, re-engraved it, and published it in their edition of the '*English Pilot*,' was George Grierson of Dublin, in 1730-1749. The chart is missing from

many copies of the 'English Pilot,' and has probably been taken out by mariners for use at sea.

Thus, although the original impressions of the Halley's Atlantic Magnetic Variation are rare, corrected copies published later during the next fifty or sixty years are fairly common.

The relative dates of Halley's Atlantic and World Magnetic Charts is an interesting question. Dr. Bauer discusses it in his notes referred to, and comes to the conclusion (*Terrestrial Magnetism*, vol. 1, p. 30) that the World Chart could not have been published in 1701, as has been supposed, but somewhat later, probably in 1702. The Royal Geographical Society has no copy of the original edition, which is rare, but has recently bought a copy of Halley's World Chart, with corrections to 1756, by W. Mountaine.

I have lately compared the Society's copy of the Atlantic Chart with those in the British Museum, and with their original copies of the World Chart (they have two at least, besides others of later date), to see what evidence could be found of their respective dates; and on the whole I agree with Dr. Bauer's conclusions. As he points out, the World Chart must be later than the Atlantic Chart, since it is dedicated "To His Highness Prince George of Denmark, Lord High Admiral of England, Generalissimo of all Her Majesty's Forces." Prince George, who was the consort of Queen Anne, did not bear this title until 17 April 1702. He died on 28 October 1708.

The difficulty as to the date is due chiefly to the statement made by Halley (*Phil. Trans.*, vol. 19, unabridged, 1714, p. 165), in which he says that he has "to examine the chart I published in 1701 for showing at one view the Variations of the Magnetical Compass in all those Seas with which English Navigators are acquainted." The last words of this statement would seem to refer to the World Chart, and not to that of the Atlantic; and yet he says that the chart was published in 1701, which is inconsistent with the dedication to Prince George of Denmark. Dr. Bauer thinks that either Halley made a slip in the date when he wrote 1701, or that there may be an earlier edition of the World Chart not yet come to light, published in 1701, from which those at present known were copied, with a new dedication.

In talking this matter over with Mr. de Villiers of the British Museum, we came to the conclusion that, as he suggested, the solution may lie in the fact that at that time, owing to the New Style not having yet come into legal use, and the year not beginning until March 25, the first two and the greater part of the third month of 1702 would be reckoned as belonging to 1701. It is thus possible that Halley may have prepared the World Chart for publication quite early in 1702, which would then be reckoned 1701, and have added the dedication a month or so later, after Queen Anne's accession and Prince George's assumption of the offices described.

An interesting point that seems to have escaped Dr. Bauer's notice is

that the variation lines on the Atlantic and the World Charts are not exactly the same in some places. Although the difference is very slight, and might at first be taken for inaccuracy in drawing, I am inclined to think that they are intentional, and meant to be corrections to the lines for the interval of time between the drawing of the two charts. Halley in his notes states that in one part the change in the variation amounts to a degree in seven years, and in another to a degree in eleven or twelve years, so that, since the degrees of variation on the chart are separated by a fairly large space, often over half an inch, the amount of annual change would be quite appreciable. I have found in the few cases that I have compared that the difference is roughly consistent with the change, supposing the Atlantic Chart to have been drawn early in 1701, and the World Chart nine months or a year later. As Dr. Bauer points out, the two charts are not from the same plate, as will be seen at once from the considerable discrepancies in the outlines of the coasts, and the lettering of names.

THE WORK OF COMMANDANT TILHO IN TIBESTI AND WADAI

THROUGH the courtesy of M. Charles Rabot, editor of *La Géographie*, we are able to publish a brief account of the remarkable work carried out by Commandant Tilho between Tibesti and Darfur during the last five years. By a fortunate combination of circumstances Commandant Tilho has been placed in a position to combine the establishment of French authority in these little-known regions with geographical reconnaissance of the first importance, and to extend his well-known work in the neighbourhood of Lake Chad right through the almost unknown country north-east and east to connect with the Anglo-Egyptian Surveys at El Fasher. It is the most considerable contribution to the geography of Africa which has been made for some time, and has particular importance in view of certain floating ideas as to a possible connection in the past between the Nile system and the system of Lake Chad.

In June 1912 Commandant Tilho, being appointed to the command of Kanem, was entrusted by the *Académie des Inscriptions et Belles Lettres* with the task of extending his surveys and geographical inquiries whenever military duties allowed. Soon after his arrival he distinguished himself in the capture of Ain' Galakka, the principal stronghold of the Senussi in this country. By the middle of January 1914 the military operations were finished, and Commandant Tilho was ordered to Faya to organize the newly occupied territories of the district Borku-Ennedi. As it turned out, these operations against the Senussi in the west had very important consequences in destroying their advanced western base and making it impossible for them to operate with the neighbouring Germans in the