proof of the estimation in which he was held, not only by his friends but by those in his employ, was given by the great number who crowded to pay the last tribute of respect at his grave.

The Rev. GEORGE FISHER was born at Sunbury, on the 31st of July, 1794. One of a numerous family, and left from childhood to the guardianship of a widowed mother, he received but little early education, and, at the age of fourteen, when most boys of his position in life are enjoying advantages he would have appreciated to the utmost, employment was found him as a clerk in the Westminster Insurance Office. His strong mathematical and scientific tastes had already declared themselves, and such occupation as his must necessarily have been distasteful to him; yet when after some years he left it for work more in accordance with his inclinations, his employers gave substantial testimony to the respect which his diligence and devotion to duty had earned from them.

The ardent desire for knowledge, which never in extreme old age deserted him, now brought him into contact with men of distinguished rank in the scientific world to whom he would otherwise have remained unknown, and the names of Sir Joseph Banks, Sir Humphry Davy, Sir Everard Home, with many others, were always gratefully mentioned by him as having noticed with kindly sympathy and generously fostered his early love of science.

In 1817 he entered St. Catharine's College, Cambridge, with no greater store of information than he had contrived to gain during the hardly-won intervals of leisure which his London life afforded him. It is much to be regretted that Mr. Fisher's University career was interrupted, not only by the Polar voyage which he undertook in 1818, but by a serious illness, which, attacking him at the very time of examination, prevented his attaining all the success which his talent and industry deserved.

In the year 1818, by the recommendation of the President and Council of the Royal Society, Mr. Fisher was appointed Astronomer to an expedition then setting out in His Majesty's ships *Dorothea* and *Trent* (about to proceed to the Arctic regions), to make observations concerning the length of a pendulum vibrating seconds, for the determination of the figure of the earth, and to make other scientific observations, for which instruments were provided. Unfortunately, the vessels encountered a violent gale of wind and were disabled, returning to England in the latter part of the same year. However, the time was not entirely thrown away: experiments were made on the length of the pendulum at Spitzbergen, from which Mr. Fisher deduced the ellipticity of the meridian to be $\frac{1}{313}$, in latitude 79° 40′ N., which agreed sensibly with Sabine's previous determinations in latitudes 60° 10′ N. and 70° 10′ N. He was afterwards, on the same recommendation,

appointed Astronomer of the expedition commanded by Captain Parry, in the years 1821–2–3, to discover a North-west Passage; and being then in Holy Orders, he was, on the recommendation of the Bishop of London, directed by the Lords of the Admiralty to act as chaplain also, and formally entered the naval service. A large number of astronomical instruments and a portable observatory were embarked on board the *Fury*, and afterwards set up at Igloolik and Winter Island; and were used to such good purpose, that Captain Parry concludes the introduction to the second voyage in these words: "I have the most sincere pleasure in offering my testimony to the unabated zeal and perseverance with which, under circumstances of no ordinary difficulty from climate, and in spite of frequent ill-health, he (Mr. Fisher) continued to pursue every object which could tend to the improvement of astronomy and navigation, and to the interests of science in general."

The results of this expedition were arranged by Mr. Fisher, and published in 1825, and consist of an account of the chronometers, their rating by lunar observations while at sea, and by meridional transits of the Sun and other observations when on shore, and a great number of observations, taken principally by the officers accompanying the expedition, for the determination of geographical position, the dip and variation of the magnetic needle, and the changes in the tides. An important paper by Mr. Fisher, on Atmospheric Refraction, appears in the same volume, the results being deduced from nearly four thousand observations, most of them taken at temperatures as low as $-30°$ to $-50°$ Fahrenheit. The principal instrument used was a Repeating Circle, by Troughton, fixed on a cask filled with pebbles and sand, cemented firmly together and to the ground by pouring water upon it, which immediately froze, rendering the whole one solid mass, which could not be affected by any force that could be applied. The principal difficulties to be encountered in the use of this instrument, as found by previous Arctic explorers, were, first, that of moving the circle in azimuth, arising from the unequal contraction of the centre work; and secondly, that of the great contraction of the spirit within the principal level, this contraction causing the bubble to vary in length from 36 divisions at a temperature of $+30°$ to 105 divisions at a temperature of $-30°$ Fahrenheit. The second difficulty was partially obviated by the introduction of more spirit, and the stiffness of the circle was found afterwards to be caused principally by the frozen vapour in the joints, and was easily expelled by taking the instrument into the computing-room of the observatory, which was always kept temperate by a stove. The method employed to determine the refraction was by observing the difference between the Polar distances of high and low stars as they crossed the meridian, keeping the horizontal wire of the back telescope in line with an illuminated horizontal row of holes in the meridian-mark, in order to ensure perfect stability of the telescope. This method failed,

first, from the uncertainty of a distant terrestrial object being refracted alike during the interval of the meridional passage of the two stars; and secondly, the principle of repetition was lost. The method subsequently employed was simply comparing the observed meridional zenith distances of the Sun and low stars with the zenith distances computed from the Polar distance and the latitude of the place, Igloolik, on the N.E. coast of America, in latitude 69° 21′ 0″·62 N. Captain Parry and his officers also adopted the same plan at the ships (about half a mile distant) with their sextants; many trials, however, showed that the refraction for altitudes that could conveniently be taken with an artificial horizon so nearly agreed with the tabular refraction, that the difference was within the limits of accuracy attainable by the sextant at low temperature.

The method adopted the second winter at Winter Island was by measuring the distance between two stars nearly in the same vertical circle, one of them being a low star, and the other as near the zenith as possible. The true distance being computed, it is clear that the discordance is due to the difference of refraction of the two stars, that of the higher star being assumed to be correct. The greatest care being taken in these observations, the results show that, at a temperature of − 20° F., at an altitude of $4\frac{1}{2}°$, the tables of Dr. Young were not more than ten or eleven seconds in defect; but when the temperature is as low as −41° the errors of the tables rapidly increase. Amongst the other observations made by Mr. Fisher we find a determination of the velocity of sound, giving mean results of 985·9 feet per second at −41° Fahrenheit, varying to 1069·9 feet per second at +33°.

A vessel of air having been brought from Igloolik and submitted to Faraday for analysis, was found to contain only 20·58 per cent. of oxygen, a quantity which, according to Dr. Angus Smith's experiments in the Cornish mines, would be at least impure, an atmosphere which contains less than 20·6 per cent. of oxygen being marked *exceedingly bad*. At the suggestion of Mr. Fisher vessels containing various gases were sent out, some condensed by pressure. In many of the vessels the gases were reduced to fluids at low temperatures, and small crystals were found in the upper parts of the vessels, while in some only a few white deposits on the sides of the glass were seen, and others were not affected by the greatest artificial cold in which they were placed. This discovery of the liquefaction of gases, especially chlorine, took place in 1822, one year before the discovery was made by Faraday. Observations were also made on the variation, dip, &c., from which the magnetic force was observed to be "greater during the summer than the winter," a discovery attributed by Sir E. Sabine, in 1845, to the result of the Toronto observations.

After the return of the *Fury* and *Hecla* to England in November 1823, Mr. Fisher was employed for about a year in preparing and passing through the press his valuable observations and

papers. He was elected a Fellow of the Royal Society in 1825, and in 1827 a Fellow of this Society; and was a Member of the Council from 1835 to 1863, several times filling the office of Vice-President. From the year 1828 to 1832 he was employed as Chaplain to H.M.S. *Spartiate* and *Asia*, continuing his magnetic observations at London, Ryde, Malta, and various ports on the coast of the Mediterranean, and on his return retired from the Navy on half-pay. The following year he presented his observations in a paper to the Royal Society on the "Relative forces soliciting a magnetic needle"; on the "Variation in the intensity of those forces"; and on the "Diurnal oscillations in the direction of a magnetic needle," the needle being suspended horizontally.

In the year 1834 Mr. Fisher was offered by Lord Auckland (then First Lord of the Admiralty), the choice of the Greenwich Hospital living of Falstone, in Northumberland, or the Chaplaincy and Head-Mastership of the Greenwich Hospital School, with an intimation that "he would be better pleased by the acceptance of the latter, as it was more in accordance with his former pursuits." The latter office was accepted, and Mr. Fisher entered on his duties at a time when the school was rising from a very low state, morally, physically, and intellectually, and by his indomitable perseverance in carrying out schemes for the good of the establishment, his calm demeanour, his tact, and even-handed justice dealt to all with whom he came in contact, combined with the respect and affection he succeeded in gaining from his colleagues, the School became, as described by the late Professor Moseley, "second to no other similar school in Europe." During his time of office the Royal Naval School at Greenwich assumed a highly practical character as a "hot-bed of navigation," supplying to all the Navigation Schools on the coast masters who instructed officers of the Mercantile Marine in navigation, &c., in that "peculiarly efficient mode which characterises this school," as well as several Naval Instructors and Navigating Officers of Her Majesty's Fleet. To carry out the instruction of the Admiralty of making the school a "nursery of skilful navigators," an observatory was planned by, and erected under, the superintendence of Mr. Fisher, and this continued under his supervision for thirteen years, to the great advantage of those who received his practical instruction.

In the year 1845 an application was made to him by the late Lord Herbert to undertake the writing of elementary text-books for the use of the school. Two elementary works were written by Mr. Fisher in consequence, the first on Algebra, and the second on Geometry, in which the Elements of Euclid were departed from, and an attempt made to introduce modern methods. He was appointed Principal of the School in 1860, and finally retired in 1863.

During these later years he wrote principally on the nature and origin of the Aurora Borealis in Arctic regions, advancing