on a hinge—to all intents and purposes a huge pair of compasses. The direction of the sight was fixed by the use of a slit and a pointer, much as in the ordinary rifle. This instrument was vastly improved by the use of a telescope, which not only allowed fainter objects to be seen, but especially enabled the sight to be accurately directed to the object observed.

The instruments of the pre-telescopic age reached their glory in the hands of Tycho Brahe. He used magnificent instruments of the simple "pair of compasses" kind—circles, quadrants, and sextants. These were for the most part ponderous fixed instruments, and of little or no use for the purposes of navigation. But Tycho Brahe's sextant proved the forerunner of the modern instrument. The general structure is the same; but the vast improvement of the modern sextant is due, firstly, to the use of the reflecting mirror, and secondly, to the use of the telescope for accurate sighting. These improvements were due to many scientific men—to William Gascoigne, who first used the telescope, about 1640; to Robert Hooke, who, in 1660, proposed to apply it to the quadrant;* and to John Hadley, who introduced it. The modern sextant is merely a modification of Newton's or Hadley's quadrant, and its present construction seems to be perfect.

It therefore became possible accurately to determine the position of a ship at sea as regarded its latitude. But it was quite different as regarded the longitude—that is, the distance of any place from a given meridian, eastward or westward. In the case of longtitude there is no fixed spot to which reference can be made. The rotation of the earth makes the existence of such a spot impossible. The question of longitude is purely a question of TIME. The circuit of the globe, east and west, is simply represented by twenty-four hours. Each place has its own time. It is very easy to determine the local time at any spot by observations made at that spot. But, as time is always changing, the knowledge of the local time give no idea of the position of a moving object—say, of a ship at sea. But if, in any locality, we know the local time, and also the local time of some other locality, at that moment—say, of the Observatory at Greenwich—we can by comparing the two local times, determine the difference of local times, or, what is the same thing, the difference of longitude between the two places. It was necessary therefore to be in possession of a first-rate watch or chronometer to enable him to determine accurately the position of his ship at sea, as respected the longitude.

Before the middle of the eighteenth century good watches were comparatively unknown. The navigator mainly relied upon his Dead Reckoning, without any observation of the heavenly bodies. He depended upon the accuracy of the course which he had steered by the compass, and the measurement of the ship's velocity by an instrument called the log, as well as by combining and rectifying all the allowances for drift, lee-way, and so on, according to the trim of the ship; but all of these were liable to much uncertainty, especially when the sea was in a boisterous condition. There was another and independent course which might have been adopted—that is, by observation of the moon, which is constantly moving amongst the stars from west to east. But until the middle of the eighteenth century good lunar tables were as much unknown as good watches.

Hence a method of ascertaining the longitude with the same degree of accuracy which is attainable in respect of latitude, had for ages been the grand desideratum for men "who go down to the sea in ships." Mr. Macpherson, in his important work entitled "The Annals of Commerce," observes, "Since the year 1714, when Parliament offered a reward of £20,000 for the best method of ascertaining the longitude at sea, many schemes have been devised, but all to little or no purpose, as going generally upon wrong principles; till that Heaven-taught artist, Mr. John Harrison arose;" and by him, as Mr. Macpherson goes on to say, the difficulty was conquered, having devoted to it "the assiduous studies of a long life."

The preamble of the Act of Parliament in question runs as follows: "Whereas it is well known by all who are acquainted with the art of navigation that nothing is so much wanted and desired at sea as the discovery of longitude, for the safety and quickness of voyages, the preservation of ships and the lives of men," and so on. The Act proceeds to constitute certain persons commissioners for the discovery of the longtitude, with power to receive and experiment upon proposals for that purpose, and to grant sums of money not exceeding £2,000 to aid in such experiments. The clause of the Act, by which rewards are offered to such inventors or discoverers as shall succeed in enabling the longtitude to be ascertained within certain limits, is as follows:—

"And for a due and sufficient encouragement to any such person or persons as shall discover a proper method for finding the said longitude, be it enacted by the authority aforesaid that the first author or authors, discoverer or discoverers, of any such method, his or their executors, administrators, or assigns, shall be entitled to, and shall have such reward as is hereinafter mentioned; that is to say, to a reward or sum of £10,000 if it determines the said longitude to one degree of a great circle, or sixty geographical miles; to £15,000 if it determines the same to two-thirds of that distance; and to £20,000 if it determines the same to one-half of the same distance; and that one moiety or half part of such reward or sum shall be due and paid when the said commissioners, or the major part of them, do agree that any such method extends to the security of ships within eighty geographical miles of the shores which are the places of the greatest danger, and the other moiety or half part when a ship, by the appointment of the said commissions, or the major part of them, shall thereby actually sail over the ocean from Great Britain to any such port in the West Indies as these commissioners, or the major part of them, shall choose or nominate for the experiment, without losing their longitude beyond the limits before mentioned."

It will, in these days, be scarcely believed that little more than a hundred and fifty years ago a prize of not less than ten thousand pounds should have been offered for a method of determining the longitude within *sixty miles*, and that double the amount should have been offered for a method of determining it within *thirty miles!* The amount of these rewards is sufficient proof of the fearful necessity for improvement which then existed in the methods of navigation. And yet, from the date of the

* Sir Isaac Newton gave his design to Edmund Halley, then Astronomer Royal. Halley laid it on one side, and it was found among his papers after his death in 1742, and twenty-five years after the death of Newton.