THE HISTORY

OF

MARITIME AND INLAND DISCOVERY.

BOOK V.

CHAP. I.

PROGRESS OF GEOGRAPHICAL SCIENCE.

GEOGRAPHICAL SCIENCE IN THE MIDDLE AGES. — ERRORS OF ANTIQUITY ADOPTED BY THE LEARNED. — SUPPOSED LONGITUDES OF NUREMBERG AND ROME; OF FERRARA AND CADIZ. — IMPROVEMENTS IN MAPS. — DOUBTFULNESS RESPECTING THE DISTANCE AND SEPARATION OF ASIA AND AMERICA. — GALILEO. — ECLIPSES OF JUPITER'S SATELLITES EMPLOYED TO FIND THE LONGITUDE. — OBSERVATIONS OF PICARD. — THE MAP OF FRANCE REFORMED. — LABOURS OF CASSINI. — CHAZELLES RECTIFIES THE MAP OF THE MEDITERRANEAN. — GEOGRAPHY REFORMED BY DELISLE. — PETER THE GREAT VISITS HIM. — D'ANVILLE. — INFLUENCE OF NEWTON. — HALLEY. — HIS VOYAGE TO ST. HELENA. — HE INVITES THE ATTENTION OF THE LEARNED TO THE TRANSIT OF VENUS. — STUDIES PHYSICAL GEOGRAPHY. — IMPROVES THE THEORY OF LUNAR MOTIONS. — BELIEF IN THE EXISTENCE OF A SOUTHERN CONTINENT. — DALRYMPLE. — HIS PLANS OF COLONISATION, AND CODE OF LAWS.

THE various branches of human knowledge are so intimately interwoven, that it is hard to conceive an improvement in one which does not conduce to the advantage of the others. The modes of connection which exist between the numerous objects of mental research, are, like the membranes that embrace the humours of the eye, so minute and transparent, that while they give

union and solidity to the whole, they themselves remain unperceived, or wholly invisible. The general advancement in knowledge which followed the discovery of the art of printing, and the increased activity and spirit of mercantile enterprise resulting from the discoveries of Columbus and Vasco de Gama, all seemed to conspire to the improvement of geography; and one might have supposed that this study would have been the first to arrive at perfection: but notwithstanding the zeal with which geographical enquiries were prosecuted during the sixteenth century, this science grew up with so many original imperfections, that its rudeness and deformity, compared with its sister sciences, became continually more conspicuous.

No errors are so difficult to correct as those which are adopted by the people. Opinions received implicitly are seldom overturned by the arguments of reason; thus geography laboured under a disadvantage from the very popularity of its nature. A system was in vogue, and, though manifestly incorrect, still maintained its ground until the scientific principles against which it offended became as generally known and recognised. The most eminent geographers of the 16th and 17th centuries were men of learning, who, in the spirit of that age, adopted with zeal and obstinacy all the mistakes committed by the writers of antiquity. The authority of their names, added to that of the ancient writers on whom they rested, offered an inert resistance which scientific geographers were long unable to overcome.

The first requisite in a correct system of geography is, to determine accurately the relative position of places; but in this the ancients were guilty of gross errors. The method which they employed to determine the latitude of places admitted of but little precision, and their determination of longitude was still more erroneous.

The countries with which the Greek and Roman writers were best acquainted were those situated on the shores of the Mediterranean Sea; and here, of course, we should expect to find their geographical accuracy exhi-

bited to advantage: yet Constantinople or Byzantium, the capital of the eastern empire, is placed by Ptolemy two degrees to the north of its true position. The Arab writers, who seem to have learned that there was an error of two degrees, without knowing in which direction, instead of lessening the latitude of Constantinople from 43 to 41, which would have been near the truth, increased it to 45, thus placing that city in their maps 276 English miles to the north of its true place. When Amurath III., about 1580, caused observations to be made, which reduced the latitude of that city to 41° 30′, the learned were indignant that barbarians should think of correcting Hipparchus.

As the northern shore of the Mediterranean was placed by Ptolemy in general too far to the north, so the southern shore was removed too far to the south; the breadth of that sea being thus increased far beyond the truth. The latitude assigned to Carthage was 32° 20′, which is 4° 32′ or 313 English miles to the south of its true place. This gross error was not taken notice of till 1625.

But these errors of the ancients in calculating latitudes were far exceeded by those which they committed in measuring the longitude, even at the places with which they were best acquainted. The length of the Mediterranean from Calpe or Gibraltar to the bottom of the bay of Issus, where Scanderoon stands at present, which is really a distance of 41° 28′, is increased in the map of Ptolemy to 62 degrees. Thus the error in the length of the Mediterranean alone amounts to 20° 32′, or nearly 1400 English miles; and this enormous error continued in the maps of Europe with little change till the beginning of the last century.

The difficulties of ascertaining the longitudes of places while astronomical observations were still deficient in precision, and the extent to which those errors were carried during the middle ages in fixing the relative positions of even the best known places of Europe, may be estimated from the following list, formed by Kepler, who, feeling that his own observations would overturn

those of antiquity, pleaded by way of excuse the inevitable uncertainty of these calculations: —

The difference in longitude between Rome and Nuremberg in the time of

Regiomontanus was reckoned at -	9°	
Werner - - - -	8	
From an eclipse in 1497 - -	7	
Apianus - - - -	8	30′
Mestlin - - - -	8	15
Stoffler - - - -	4	30
Apianus again - - -	4	45
Magini - - - -	6	30
Schoner - - - -	3	
Stade - - - -	3	15
Jansen - - - -	2	30
Kepler - - - -	1	

Thus the difference in longitude between two of the best known towns in Europe varied above 500 miles from the fifteenth to the seventeenth centuries. But this uncertainty will appear more remarkable when found to exist in the longitudes of places which are nearly in the same latitude. For this purpose Ferrara and Cadiz may be conveniently compared. The difference of the longitude between these two places as stated by

Ptolemy in the edition of 1475 was	27°	20′
Alphonsine tables - 1492 -	27	30
Mauro the Florentine - 1537 -	28	13
Apianus - - 1540 -	27	5
Gemma Frisius - - 1578 -	27	55
Ridolfine tables - 1627 -	17	
Argoli - - 1638 -	24	35
Riccioli - - 1672 -	19	27
Schott - - 1677 -	26	50
De Lalande - - 1789 -	17	52

Hence it appears, that in the maps of the sixteenth century Cadiz and Ferrara were placed 600 miles too far asunder, and that this egregious error still maintained its ground till the close of the seventeenth century. *

* See a dissertation on the fluctuation of longitudes in the middle ages, by Canovai, in the *Memorie dell' Academia di Cortona*, vol. ix.

Errors of a wilder kind, originating rather in credulity than in positive inaccurate observation, found a place in the maps of the middle ages, and were tardily banished from them, at a comparatively recent date, by the improvements of astronomy and navigation. We will here glean a few of those errors from the best of the early maps.

From a map of the world published in Venice in 1546, by Giacomo, we find Asia and America united in lat. 38°. Thibet is placed at the junction of the two continents, and Zangar is the name given to the remote region on their frontiers. California, it is remarkable, is here described as a peninsula. China, conformably to the map of Ptolemy, stretches to the 180th degree. In the South Sea the *Isla de los Tuburones,* discovered by the Spaniards, is marked in 10° S. lat.

In another Venetian map by Tramezini, dated 1554, the distance from Quinsai in China to the gulf of California in America is only 31°. These two continents being unduly stretched some thousand miles respectively to the east and west. In this map is marked the *Island of Papuas,* or New Guinea, and the Ladrones; but it is remarkable that Asia and America are here separated by a wide strait, the author observing in a note, "In this place we have followed the latest authorities in separating this coast of Tartary from the continent of America." He thus insinuates that his delineation of the shores round the Pacific was founded on something better than mere caprice. Yet in the Venetian maps which immediately followed, the two continents are again united. In all these maps we find the *Terra Australis adhuc inexplorata,* or southern land as yet unexplored; and the first printed map in which more positive indications occur in this quarter appears to be that executed by Fernando Bartoli in 1571. In this we find the *Terra incognita discuoperta di Nuovo,* or lately discovered, situated to the south of New Guinea and the Spice Islands, or corresponding with the general situation of New Holland.

In this, as in other early maps, the *Terra Australis* is represented as one great continent, filling the antarctic regions; but Bartoli has named some portions of it as if he had received information of land in those directions. Thus, to the south of the Cape of Good Hope is a promontory named *Terra de Vista*.

Notwithstanding the great increase of geographical information, even the best maps were long deficient in correct distances, particularly in longitude. South America is represented by Fischer as 62 degrees, or near 4500 miles across; while North America, in the same map, extends from the mouth of the St. Laurence on the east, to New Albion on the west, through a space of 150 degrees, or above 9000 miles. Here also we find California again represented as an island, an error which is repeated in many maps executed at the commencement of the eighteenth century; and in some of them the north-west coast of America is represented as running westward in the parallel of 42°, till it nearly meets Yedzo; it is then marked as doubtful. It is remarkable that in some of these maps we find the south coast of New Guinea delineated, though at a later period that island was supposed to be connected with New Holland. The Terra Australis, or antarctic continent, which De Witt banished from his maps, was restored by Sanson in the beginning of the last century; so slow and fluctuating was the progress of accurate geography. Hondius, in 1630, ventured to abridge Asia of the undue dimensions given to it by Ptolemy, and to reduce its extension towards the east to 165°. But his example was not followed, and many instances might be adduced in which the authority of Ptolemy, who was but slightly acquainted with one half of the globe, was blindly submitted to in an age when Europeans wandered over its entire surface.

As scientific knowledge advanced, hopes were entertained that the longitudes of places might be fixed by observing the eclipses of the sun and moon; but this method proved, on experience, to be so pregnant with

error that astronomers were again reduced to despair. A grand step, however, was made towards the attainment of their wishes, when in 1610 Galileo discovered the eclipses of Jupiter's satellites. In 1631 that great man proposed to the king of Spain to apply his discoveries for the purposes of navigation and geography. The supineness of the Spanish court was not calculated to foster his zeal; but the Dutch embraced his offer, and sent Hortensius and Blaew to study under him at Florence. Yet the defects of telescopes, and the mistakes of his followers, long stood in the way of that improvement which must otherwise have been the immediate consequences of Galileo's discoveries. At a time when some astronomers imagined that they saw no fewer than twelve satellites round Jupiter, no satisfactory conclusions could be drawn from the observation of that planet. Until Cassini published his tables in 1668 nothing accurate was known respecting the eclipses and revolutions of Jupiter's satellites. Shortly afterwards, however, (in 1671,) Picard went to Uraniburg in Denmark, to the observatory of Tycho Brahe, to observe according to the advice of Cassini. He was thus able to calculate, with an accuracy hitherto unknown, the difference between the longitudes of the observatories at Uraniburg and Paris.

In consequence of this successful experiment, MM. Picard and Delahire, both academicians, were immediately employed to examine and to correct the map of France by astronomical observations. In executing this task, they were obliged to contract France within much narrower boundaries than it was supposed, according to the maps of that time, to occupy. They reduced it above 1° of longitude along the western coast from Britany to the Bay of Biscay, and in the same manner they cut away about half a degree from the shores of Languedoc and Provence. These changes gave rise to a jest of Louis XIV., who, when complimenting the academicians on their return, told them "he was sorry to observe that their journey had cost him a large portion of his kingdom."

Cassini, in the mean time, laboured indefatigably in endeavouring to improve geography, by allying it strictly with astronomy. He drew, in 1696, a planisphere on the floor of the observatory at Paris, on which he marked thirty-nine positions determined by recent observations. He vehemently reproached the learned world with the defects of geography, which in the march of science still lingered considerably in the rear. Map-makers paid no attention to the astronomical observations which were multiplied round them every day, and which, though far from exact, never deviated into such errors as those which were handed down traditionally from the antients. By his desire Chazelles was sent to the Levant, to correct the map of the Mediterranean: his observations ascertained the difference in longitude between the shores of Palestine and the meridian of Paris. The map of the portion of the Mediterranean which lies to the west of this meridian was not corrrected till 1720. It is remarkable that Peiresc, in 1635, had reduced the distance from Aleppo to Marseilles from 45° to 30°. But the learned did not universally accede to those improvements proposed by individuals of eminent abilities. While Newton taught the laws which regulate the movements of the earth among heavenly bodies, little care was taken to delineate its surface. Geography continually relapsed to the errors of antiquity, and needed, as Cassini loudly complained, a total reform.

William Delisle, the friend of Cassini, was the first who seriously set about the task of reconstructing the geographical edifice. He conceived his grand design when young, and applied himself to it with such uncommon ardour that he had finished the task at the age of twenty-five. In the year 1700 he published his map of the world, as well as separate maps of Europe, Asia, and Africa. In these he boldly departed from the examples of his predecessors, and made free use of the materials which the improvements in astronomy had placed within his reach. The defects of geography in his age belonged to the original vice of its system, and

not to any deficiency of materials: it had been already enriched, and in every way improved, by the industry of Sanson, the learning of Ortelius, and the cleverness of Mercator. But Sanson, though the first geographer of the seventeenth century, still remained far behind the astronomical discoveries of the time. He followed blindly the longitudes of Ptolemy, and his sons and grandsons after his death continued to reproduce his maps, without paying any attention to the observations that were daily increasing. The maps of Coronelli and others, notwithstanding their reputation, were inferior to those of Sanson. In order to improve geography it was necessary to combine the narratives of travellers with the results of astronomical observations. This had been partially and ineffectually attempted before by Riccioli, Hondius, and others. But these previous revolts of reason against authority do not diminish the glory redounding to Delisle, from the revolution which he effected in geography: for he proved himself to accord with both ancient and modern measures; he combined a greater mass of materials, and instead of confining his corrections to one quarter of the globe, he proceeded through the whole; hence he has a good right to be considered the creator of modern geography. Peter the Great, when in Paris, condescended to visit him, and to give him what information he possessed respecting the geography of Muscovy.

Delisle died in 1726, but he lived to see his disciple J. B. d'Anville attain such eminence in his favourite study, as promised to bring geography to a speedy perfection. The talents of D'Anville procured him, at the early age of twenty-two, the honour of being appointed the king's geographer. He was remarkable for a singular correctness of judgment, and fineness of penetration, which appeared almost instinctive. He proceeded much on conjecture, and yet he rarely erred. The researches of the learned, and the increased acquaintance made with the globe within the last century, both bear witness to the sagacity of his spirit. Italy, before his time, was en-

larged in the maps far beyond its true dimensions, and extended from west to east, according to the ideas of the ancients. But he ventured to reduce it, having previously discovered the true measures of the ancients; and the geodesical operations of Benedict XIV. showed him to be correct. His boldness completed what the resolution of Delisle had begun.

If the glory of reforming the inveterate errors of geography belongs in a peculiar manner to the French nation, the English at least had the merit of affording the most important elements to the laborious task. The discoveries of Newton did not terminate merely in the improvement of astronomy; they communicated, of course, an impulse to every branch of knowledge at all connected with that science. But his disciple Halley exerted a more immediate influence on geography. This extraordinary man, like D'Anville, distinguished himself at a very early age by his remarkable proficiency in his favourite study. At the age of nineteen, he published a direct method of finding the aphelia and eccentricity of the planets. He was aware that astronomy depended on an extensive knowledge of the position of the stars, and expressed his zealous desire to observe the stars in the southern hemisphere. Charles II. favoured his zeal; and in 1676, when Halley was only twenty years of age, he embarked for St. Helena, on this important mission. He remained there a year; and, during that time, from the fault of the climate, he had fixed the places of only 350 stars. Had he chosen the Cape of Good Hope he would have found a clearer sky, as well as a more southern position.

While Halley was at St. Helena he observed a transit of Mercury across the sun's disc. This kind of phenomenon had already attracted the notice of Gassendi, Horrox, and other great astronomers; but Halley was the first to see all the important consequences that might be derived from it. He perceived that it might serve to determine the parallax of the sun, whence again might be calculated the dimensions of the solar system.