

if they remained in the hands of the revolutionists, determined if possible to secure their liberty by stratagem. By bribing one of the officials at St Firmin, and disguising himself as a commissioner of prisons, he gained admission to his friends, and entreated them to effect their escape by following him. All, however, dreading lest their deliverance should render the doom of their fellow-captives the more certain, refused the offer, and one priest only, who was unknown to Geoffroy, left the prison. Already on the night of the 2d of September the massacre of the proscribed had begun, when Geoffroy, yet intent on saving the life of his friends and teachers, repaired to St Firmin. At 4 o'clock on the morning of the 3d Sept., after 8 hours' waiting, he by means of a ladder assisted the escape of twelve ecclesiastics, not of the number of his acquaintance, and then the approach of dawn and the discharge of a gun directed at him warned him, his chief purpose unaccomplished, to return to his lodgings. Leaving Paris he retired to Étampes, where, in consequence of the anxieties of which he had lately been the prey, and the horrors which he had witnessed, he was for some time seriously ill. At the beginning of the winter of 1792 he returned to his studies in Paris, and in March of the following year Daubenton, through the interest of Bernardin de Saint Pierre, procured him the office of sub-keeper and assistant demonstrator of the cabinet of natural history, vacant by the resignation of Lacépède. By a law passed June 10th, 1793, Geoffroy was appointed one of the twelve professors of the newly constituted museum of natural history, being assigned the chair of zoology. In the same year he busied himself with the formation of a menagerie at that institution. On the 6th May 1794 commenced his opening course of lectures, and on December 1st he read to the society of natural history his first paper, on the subject of the Aye-aye. It was in 1794, also, that through the introduction of Tessier he entered into correspondence with Georges Cuvier, to whom, after the perusal of some of his manuscripts, he wrote: "Venez jouer parmi nous le rôle de Linné, d'un autre législateur de l'histoire naturelle." Shortly after the appointment of Cuvier as Mertrud's assistant (see vol. vi. p. 740), Geoffroy received him into his house. The two friends wrote together five memoirs on natural history, one of which, on the classification of mammals, puts forward the idea of the subordination of characters upon which Cuvier based his zoological system. It was in a paper entitled "Histoire des Makis, ou singes de Madagascar," written in 1795, that Geoffroy first gave expression to his views on "the unity of organic composition," the influence of which is perceptible in all his subsequent writings: nature, he observes, presents us with only one plan of construction, the same in principle, but varied in its accessory parts.

In 1798 Geoffroy was chosen a member of the great scientific expedition to Egypt. With Delile and Larrey, on the capitulation of Alexandria in August 1801, he resisted the claim made by the British general Hutchinson to the collections of the expedition, sending him word that, were his demand persisted in, history would have to record of him that he also had burnt a library in Alexandria. Early in January 1802 Geoffroy returned to his accustomed labours in Paris. He was elected a member of the academy of sciences of that city in September 1807. In March of the following year the emperor, who had already recognized his national services by the award of the cross of the legion of honour, selected him to visit the museums of Portugal, for the purpose of procuring from them collections, and these, though in the face of considerable opposition from the British, he eventually was successful in retaining as a permanent possession for his country. In 1809, the year after his return to France, he was made professor of zoology of the faculty of sciences at Paris, and from that period he

devoted himself more exclusively than before to the study of anatomical philosophy. In 1815 he was elected political representative for his native town. Three years later he gave to the world the first part of his celebrated *Philosophie Anatomique*, the second volume of which, published in 1822, and memoirs subsequently written account for the formation of monstrosities on the principle of arrest of development, and of the attraction of similar parts. When, in 1830, Geoffroy proceeded to apply to the invertebrata his views as to the unity of animal composition, he found a vigorous opponent in Georges Cuvier, and the discussion between them, continued up to the time of the death of the latter, soon attracted the attention of the scientific throughout Europe. Geoffroy, a synthesist, contended, in accordance with his theory of unity of plan in organic composition, that all animals are formed of the same elements, in the same number, and with the same connexions: homologous parts, however they differ in form and size, must remain associated in the same invariable order. With Goethe he held that there is in nature a law of compensation or balancing of growth, so that if one organ take on an excess of development, it is at the expense of some other part (cf. Darwin, *Origin of Species*, 5th ed., p. 182); and he maintained that, since nature takes no sudden leaps, even organs which are superfluous in any given species, if they have played an important part in other species of the same family, are retained as rudiments, which testify to the permanence of the general plan of creation. It was his conviction that, owing to the conditions of life, the same forms had not been perpetuated since the origin of all things, although it was not his belief that existing species are becoming modified (see Darwin, *op. cit.*, p. xvi.). Cuvier, who was an analytical observer of facts, admitted only the prevalence of "laws of coexistence" or "harmony" in animal organs, and maintained the absolute invariability of species, which he declared had been created with a regard to the circumstances in which they were placed, each organ contrived with a view to the function it had to fulfil, thus putting, in Geoffroy's consideration, the effect for the cause. In July 1840 Geoffroy became blind, and some months later he had a paralytic attack. From that time his strength gradually failed him. He resigned his chair at the museum in 1841, and on the 19th June 1844, at the age of 72, he died.

Geoffroy wrote—*Catalogue des Mammifères du Muséum national d'Histoire naturelle*, 1813, not quite completed; *Philosophie anatomique*,—t. i., *Des organes respiratoires*, 1818, & t. ii., *Des Monstrosités humaines*, 1822; *Système dentaire des Mammifères et des Oiseaux*, 1st pt., 1824; *Sur le Principe de l'Unité de Composition organique*, 1828; *Cours de l'Histoire naturelle des Mammifères*, 1829; *Principes de Philosophie zoologique*, 1830; *Études progressives d'un Naturaliste*, 1835; *Fragments biographiques*, 1852; *Notions synthétiques, historiques, et physiologiques de Philosophie naturelle*, 1838; and other works; also part of the *Description de l'Égypte par la Commission des Sciences*, 1821-30; and, with F. Cuvier, *Histoire naturelle des Mammifères*, 4 vols., 1820-42; besides very numerous papers published in the *Annales du Muséum*, the *Ann. des Sci. nat.*, the *Bulletin philomatique*, *La Décade égyptienne*, *La Décade philosophique*, the *Rev. encyclopédique*, *Mém. de l'Acad. des Sciences*, and elsewhere, among the subjects of which are the anatomy of marsupials, ruminants, and electrical fishes, the vertebrate theory of the skull, the opercula of fishes, teratology, palaeontology, and the influence of surrounding conditions in modifying animal forms.

See *Vie, Travaux, et Doctrine Scientifique d'Etienne Geoffroy Saint-Hilaire*, par son fils M. Isidore Geoffroy Saint-Hilaire, Paris and Strasburg, 1847, to which is appended a list of Geoffroy's works; and July, in *Biog. Universelle*, t. xvi., 1856. (F. H. B.)

**GEOFFROY SAINT-HILAIRE, ISIDORE (1805-61)**, a French zoologist, son of the preceding, was born at the Jardin des Plantes, Paris, December 16, 1805. In his earlier years he showed an aptitude for mathematics, but eventually he devoted himself to the study of natural history and of medicine, and in 1824 he was appointed assistant naturalist to his father. On the occasion of his taking the degree of doctor of medicine. September 8, 1829, he

read a thesis entitled *Propositions sur la monstruosité, considérée chez l'homme et les animaux*; and in 1832-37 was published his great teratological work, *Histoire générale et particulière des anomalies de l'organisation chez l'homme et les animaux*, 3 vols. 8vo, with 20 plates. In 1829 he delivered for his father the second part of a course of lectures on ornithology, and during the three following years he taught zoology at the Athénée, and teratology at the École pratique. He was elected a member of the academy of sciences at Paris on April 15, 1833, was in 1837 appointed to act as deputy for his father at the faculty of sciences in Paris, and in the following year was sent to Bordeaux to organize a similar faculty there. He became successively inspector of the academy of Paris (1840), professor of the museum on the retirement of his

father, inspector general of the university (1844), a member of the royal council for public instruction (1845), and, on the death of Blainville, professor of zoology at the faculty of sciences (1850). In 1854 he founded the Acclimatization Society of Paris, of which he was president. He died at Paris, November 10, 1861.

Besides the above-mentioned works, he wrote—*Essai de Zoologie générale*, 1841; *Vie . . . d'Etienne Geoffroy Saint-Hilaire*, 1847; *Acclimatation et Domestication des Animaux utiles*, 1849, 4th ed., 1861; *Lettres sur les substances alimentaires et particulièrement sur la viande de cheval*, 1856; and *Histoire naturelle générale des règnes organiques*, 3 vols., 1854-62, which was not completed, chap. xx. of tome iii. being unfinished. He was the author also of various papers on zoology, comparative anatomy, and palaeontology, published for the most part in the *Annales du Muséum*, the *Mémoires des Savants étrangers*, the *Comptes rendus*, and the *Dict. des Sciences naturelles*.

## G E O G R A P H Y

### INTRODUCTION.

**GEOGRAPHY** is the science which describes the earth, the term being derived from two Greek words γῆ, the earth, and γράφω, to write. By means of geography the surface of the earth is delineated and described, boundaries are defined, areas are exactly measured, and the relative positions of places are determined. Geography thus embraces a wide range of subjects, and it has been found necessary to divide its study into several distinct sections.

I. Comparative Geography traces the history of discovery, and records the changes which have taken place in land and sea in historic times.

II. Mathematical Geography explains the figure, magnitude, and motion of the earth, teaches how to determine the positions of places on its surface, and shows how the whole or any portion of the earth may, on the principles of projection, be delineated on a map or chart.

III. Physical Geography is the description of the actual state of the earth's surface in its three great divisions—land, sea, and air.

IV. Political Geography describes the earth as divided into countries, occupied by various nations, and improved by human art and industry.

The following article is limited to a view of the progress of geographical discovery, an explanation of the principles of mathematical geography, and a synopsis of physical geography. For details relating to political geography the reader must consult the descriptive articles under their particular headings.

### I. VIEW OF THE PROGRESS OF GEOGRAPHICAL DISCOVERY.

Four main causes have led to geographical discovery and exploration, namely, commercial intercourse between different countries, the operations of war, pilgrimages and missionary zeal, and in later times the pursuit of knowledge for its own sake, which is the highest of all motives.

The Phœnicians are the earliest commercial people of whose discoveries we have any correct accounts. They first explored the shores of the Mediterranean, and eventually extended their voyages through the Straits of Gibraltar, and visited the western shores of Spain and Africa, planting colonies and opening wider fields for their commerce by instructing the natives in their arts and improvements. They also monopolized the trade with India; and their chief emporium, the rich city of Tyre, was the centre whence the products of the East and West were distributed. The trade of the West was brought from the port called Tarshish in Scripture, which is probably identical with Carthage, where the ships arrived from Spain, Africa, and distant Britain. Concerning the far eastern land reached by the Phœnicians,

called Ophir in Scripture, there has been much dispute. The voyage to Ophir, we are told, occupied three years thither and homeward, and the cargo consisted of gold, ivory, apes, peacocks, and "algum" wood (1 Kings ix. 26, and x. 11). The following reasons lead to the conclusion that Ophir was the Malabar coast of India. In the Hebrew word for apes is *koph* (without any etymology in Semitic tongues), in Sanskrit *kāfi*. Ivory in Hebrew is *shen-habbim*; in Sanskrit *ibha* is an elephant. Peacocks is in Hebrew *tokki-im* from *toget*, the name still used on the Malabar coast, derived from the Sanskrit. Algum wood, or almug, is corrupted from *valgu* (ka), sandal wood from Malabar. Thus the Phœnicians were the first great carriers of the ancient world, extending their commercial operations from their central mart of Tyre on the Syrian coast to the tin-yielding isles of the Cassiterides in the far west, and to the ports of India in the east.

The great Phœnician colony of Carthage retained in full vigour the commercial spirit of the parent state. The Carthaginians traded on the coasts of Spain and Gaul, and extended their discoveries southwards along the coast of Africa, and to the Fortunate Islands, now known as the Canaries. Herodotus relates how the Phœnicians, setting sail from the Red Sea, made their way to the south, and when autumn approached they drew their vessels to land, sowed a crop, and waited till it was grown, when they reaped it and again put to sea. Having spent two years in this manner, in the third year they reached the pillars of Hercules and returned to Egypt. But the most celebrated voyage of antiquity, undertaken for the purpose of discovery, was the expedition under Hanno, fitted out by the senate of Carthage with the view of attempting the complete survey of the western coast of Africa. Hanno is said, in the *Periplus Hannonis*, to have set sail with a fleet of 60 vessels, and the extent of his voyage has been variously estimated as reaching to the river Nun, to a little beyond Sierra Leone, and even as far as the Gulf of Benin. Another famous navigator, who sailed from the Carthaginian colony of Massilia (Marseilles) in about 320 B.C., was Pytheas. He steered northwards along the coasts of Spain and Gaul, sailed round the island of Albion, and stretching still further to the north, he discovered an island known to the ancients as *Ultima Thule*, which may possibly have been the Shetland Isles.

The conquests of Alexander the Great, by making known the vast empire of Persia, materially enlarged the bounds of geographical knowledge. Although the course of his expedition was mainly by land, the mind of the conqueror was also intent on commerce and maritime discovery. In 327 B.C. Alexander led an army of Greeks down the valley of the Cabul river into the Punjab, and his expedition



resulted in a voyage of discovery from the mouth of the Indus to that of the Tigris, and in opening direct intercourse between Grecian and Hindu civilization. The Greeks who accompanied Alexander were accurate observers, and described the towns and villages, the products and the aspect of the country, with care. The conqueror resolved to return through Gedrosia (the modern Baluchistan), but he also intended to open the trade by sea between Europe and India, and his general Nearchus, a native of Crete, volunteered to lead this famous voyage of discovery. His fleet consisted of 30 galleys containing 2000 men. On October 2, 326 B.C., the fleet of Nearchus left the Indus, and the anchorages each night are carefully recorded. On the 17th of December Cape Jask was doubled and the fleet entered the Persian Gulf, and on the 9th of February it was at the mouth of the Karun. Nearchus rejoined Alexander at Susa; and the conqueror himself embarked in the fleet and ascended the Tigris to Opis, above Baghdad. He then ordered his successful admiral to prepare another expedition for the circumnavigation of Arabia; but unfortunately the great conqueror died at Babylon in 324 B.C., and the fleet was dispersed.

The dynasties founded by Alexander's generals, Seleucus, Antiochus, and Ptolemy, encouraged the same spirit of enterprise which their master had so carefully fostered, and extended geographical knowledge in several directions. Seleucus Nicator established the Greco-Bactrian empire, and continued the intercourse with India. The most authentic information respecting the Gangetic valley was supplied by Megasthenes, an ambassador sent by Seleucus, who reached the remote city of Patali-putra, the modern Patna, on the Ganges.

The Ptolemies of Egypt showed equal anxiety to extend the bounds of geographical knowledge. Ptolemy Euergetes sent an expedition which discovered Abyssinia, and fitted out a fleet under Eudoxus to explore the Arabian Sea. After two successful voyages, Eudoxus left the Egyptian service, and proceeded to Cadiz with the object of fitting out an expedition for the purpose of African discovery; and we learn from Strabo that the veteran explorer made at least two voyages southward along the coast of Africa. The Ptolemies sent fleets annually from their Red Sea ports of Berenice and Myos Hormus to Arabia, as well as to ports on the coasts of Africa and India.

**ROMANS.** The Romans did not encourage navigation and commerce with the same ardour as their predecessors; still the luxury of Rome, which gave rise to demands for the varied products of all the countries of the known world, led to an active trade both by ships and caravans. But it was the military genius of Rome, and the ambition for universal empire, which led not only to the discovery but also to the survey of nearly all Europe, and of large tracts in Asia and Africa. Every new war produced a new survey and itinerary of the countries which were conquered. In the height of their power the Romans had surveyed and explored all the coasts of the Mediterranean, Italy, Greece, the Balkan peninsula, Spain, Gaul, western Germany, and Britain; but the eastern parts of Germany, Denmark, Sweden, and Russia were still unknown regions. In Africa their empire included Egypt, Carthage, Numidia, and Mauritania. In Asia they held Asia Minor and Syria, had sent expeditions into Arabia, and were acquainted with the more distant countries formerly overrun by Alexander, namely, Persia, Scythia, Bactria, and India. Roman intercourse with India especially led to the extension of geographical knowledge.

The first Roman who undertook a journey to India was solely influenced by the desire to acquire a knowledge of the people and their doctrines. This was Apollonius, a resident at Antioch, who set out towards the close of the

first half century of our era. He and his attendants, Damis and Philostratus, reached the Indus, and journeying across the Punjab, came to a bronze pillar with the inscription "Here Alexander halted"; but it is doubtful whether the party advanced as far the Ganges. It was, however, in the reigns of Severus and his immediate successors that Roman intercourse with India was at its height.

In all time, while warriors and explorers extended the area of geographical knowledge, there have been students who have striven to systematize and put into due form the accumulated information. From the first it was perceived that a knowledge of localities could not be attained without some notion of their relative positions, and their distances from each other. Consequently the attempts to establish fixed principles on which the surface of the earth, or any portion of it, could be delineated, were almost coeval with the earliest voyages of discovery.

The first attempt made to determine the position of places appears to have depended on the division of the earth into "climates," distinguished by the species of animals and plants produced in each. This method, however, was soon abandoned for another, which consisted in observing at places the length of the longest and shortest days by means of a "gnomon." An upright pillar of a known height being erected on a level pavement, by observing the lengths of the meridian shadows the progress of the sun from tropic to tropic was traced. The most ancient observation with the gnomon is that of Pytheas, in the days of Alexander the Great, who observed at the summer solstice at Massilia that the length of the meridian shadow was to the height of the gnomon as 213 to 600, an observation which makes the meridian altitude of the sun at Marseilles on that day 70° 27'. The merit of the invention of the gnomon in Greece is ascribed to the astronomical school of Miletus; but there is reason to believe that this method of observation was invented in Egypt, and that Thales carried the knowledge of it into Greece. This was the first step towards connecting geography with astronomy; and little further advance was made until the establishment of the famous astronomical school of Alexandria.

Eratosthenes (276-196 B.C.) was the first who reduced geography to a regular system, and laid its foundations on clear and solid principles. Under the patronage of the Ptolemies he had access to all the materials collected by Alexander and his generals. The doctrine of the sphericity of the earth had by this time been adopted, and the aim of his labours was to delineate, in conformity with this principle, the known parts of the earth's surface. Founding his system on the use of the gnomon, he supposed a line to be traced through certain places, in all of which the longest day was known to be exactly of the same length. Such a line would evidently be a parallel to the equator. This first parallel passed through Rhodes, and was ever afterwards adopted as the basis of ancient maps. Eratosthenes continued his work by tracing other parallels at certain intervals from the first, one through Alexandria, another through Syene, a third through Meroe. He also traced, at right angles to these, a meridian passing through Rhodes and Alexandria, southwards to Syene and Meroe. As the progress which he thus made towards the completion of what he had so skilfully conceived naturally tended to enlarge his ideas concerning geographical science, he attempted next to determine the circumference of the globe by the actual measurement of a segment of one of its great circles. Posidonius made another measurement of an arc of the meridian between Rhodes and Alexandria about 170 years afterwards; but the amount of error in the calculations of Eratosthenes and Posidonius is uncertain, for want of a knowledge of the true length of the stadium in which their results are expressed. The ancients made their first meri-





dian at the sacred promontory of Iberia, and their longitudinal error increased rapidly as they advanced eastwards. This is no doubt due to their longitudes being based entirely on distances calculated in the itineraries of travellers. Such data of course produced very great distortions in the representations given of the countries on the surface of the globe.

The improvements introduced by Eratosthenes were perfected in principle by Hipparchus, who flourished from 160 to 135 B.C. He was the first astronomer who undertook the arduous task of making a catalogue of the stars and fixing their relative positions. His object was to transmit to posterity a knowledge of the state of the heavens at the period of his observations. The extremities of the imaginary axis round which the heavens perform their diurnal revolutions suggest two fixed points by which the position of the great circle of the celestial sphere, called the celestial equator, is determined. If a great circle be supposed to pass through these points and any star, the position of the star will be ascertained if we measure in degrees and parts of a degree the arc of the meridian circle intercepted between the star and the equator, and also the arc of the equator intercepted between a given point in it and the meridian circle passing through the star. Upon this principle Hipparchus arranged the stars according to their places in the heavens; and the great improvement which he introduced into geography consisted in this, that he applied to the determining of the position of any point on the surface of the earth the same rule which he had introduced in the arrangement of the constellations. Thus he furnished the means of ascertaining the relative positions of places with far greater accuracy than could be obtained from itinerary measurements. He made a considerable number of observations for latitude, and pointed out how longitudes might be determined by observing the eclipses of the sun and moon.

The most ancient maps that have reached modern times are those which illustrate Ptolemy's geography, but an earlier map made for Aristagoras, king of Miletus (500 B.C.), is minutely described by Herodotus. Ptolemy composed his system of geography in the reign of Antoninus Pius, about 150 A.D. His materials consisted of all the itineraries prepared by the Romans, proportions of the height of the gnomon and its shadow at the time of the equinoxes and solstices taken by different astronomers, calculations founded on the length of the longest days, and various reports of travellers and navigators. Ptolemy undertook the task of comparing and reducing this mass of crude material into one system, following the principles laid down by Hipparchus, but which had been neglected during the two centuries and a half since his time, even by such men as Strabo and Pliny. In Ptolemy's work we find for the first time the mathematical principle of the construction of maps, as well as of several projections of the sphere.

The errors of Ptolemy arose from defective information, and the want, in many instances, and especially as regards the remote parts of the then known world, of astronomical observations. He adopted the measure of a degree at 500 stadia; and the latitudes along the chief parallel of Rhodes, as first laid down by Eratosthenes, are tolerably correct. But the elements for determining the longitudes were still derived from itineraries, and errors in latitude accumulated to the north and south of the central parallel.

Strabo. Although Ptolemy was the first scientific geographer whose work has come down to us in a complete form, the earlier labours of Strabo, who lived in the reigns of Augustus and Tiberius, are of equal value, and we fortunately possess the whole of his 17 books. Pliny also devoted two books of his extensive work to geography; and the scattered geographical notices of other ancient writers were collected

into one work of four volumes by Hudson, and published between 1698 and 1712, with notes by Dodwell. From the days of Ptolemy to the revival of letters in Europe, little was done towards the scientific improvement of geographical science, though military and commercial enterprise led to a great extension of knowledge of the earth's surface.

After the dissolution of the Roman empire, Constantinople became the last refuge of arts, taste, and elegance; while Alexandria continued to be the emporium whence were imported the commodities of the East. The emperor Justinian sent two Nestorian monks to China, who returned with eggs of the silkworm concealed in a hollow cane, and thus silk manufactures were established in the Peloponnesus and the Greek Islands. It was also in the reign of Justinian that Cosmas Indicopleustes, an Egyptian merchant, made several voyages, and afterwards composed his *Topographia Christiana*, containing a particular description of India. The great outburst of Mahometan conquest was followed by an Arabian civilization, having its centres at Cordova and Baghdad, in connexion with which geography again received a share of attention.

From the 9th to the 13th century intelligent Mahometan travellers wrote accounts of what they had seen and heard in distant lands, which have been handed down to us; while the caliphs of Baghdad encouraged the study of geographical science.

The caliph Al-Mamun, the worthy son and successor of Harun er-Rashid, caused an Arabic version of Ptolemy's great astronomical work (*Σύνταξις μαθηματικῆ*) to be made, which is known as the *Almagest*, the word being nothing more than the Greek *μαθηματικῆ* with the Arabic article *al* prefixed. The geography of Ptolemy is also constantly referred to by Arab writers. The learned men under Al-Mamun began to apply themselves to astronomy in 813 A.D., following the system of Ptolemy; and the first observations that are properly their own were made by El-Bathany in Mesopotamia, of the vernal and autumnal equinoxes, in 882 A.D. The Arab astronomers also measured a degree on the plains of Mesopotamia, and Ibn Yunus observed three eclipses at Cairo. The caliph's librarian, Abu Jafer Muhammad Ben Musa, wrote a geographical work, now unfortunately lost, entitled *Rasm el Arsi* ("A Description of the World"), which is often referred to by subsequent writers as having been composed on the model of that of Ptolemy.

The earliest Arabian traveller whose observations have come down to us is the merchant Sulaiman, who embarked in the Persian Gulf and made several voyages to India and China, in the middle of the 9th century. Sulaiman's information was supplemented by that collected by another writer named Abu Zaid; and, so far as India is concerned, this work is the most important that we possess before the grand epoch of the discoveries of Marco Polo. Next to Sulaiman followed the voyages of Sindbad the Sailor, whose narrative, though inserted in the *Arabian Nights*, also forms a distinct and separate work, which was translated into French by M. Langlès in 1814. Baron Walckenaer ascribes to the voyages of Sindbad a date about coincident with those of Sulaiman. Ibn Khurdadra, a fire-worshipper converted to Islam, who died in 912 A.D., also wrote an account of India. Al Masudi, a great traveller who knew all the countries between Spain and China, described the plains, mountains, and seas, the dynasties and peoples, in his *Muraju-l Zahab* ("Meadows of Gold"). He died in 956. His contemporaries were Al Istakhri, who travelled through all the Mahometan countries, and wrote his *Book of Climates* in 950, and Ibn Haukal, whose *Book of Roads and Kingdoms* was written in 976. Al Idrisi was born at Ceuta, and after travelling far and wide, settled in Sicily, where he was induced by Roger II, the Norman king, to write his book



on geography, the full title of which is *The Delight of those who seek to wander through the Regions of the World*. Finally Al Kazwini, who was a compiler for the works of Istakhri and Ibn Haukal in about 1263, brings us down to the times when the Italian explorers began to make known the vast realms of Asia to the people of Europe.

The Mongol and Turkish dynasties, which succeeded each other after the fall of the Arabian caliphs, also produced rulers who encouraged geographical science. Philosophers assembled at the court of Hulaku Khan (1253-1264) at Maraghah in the north of Persia; and his friend Nasiru'd-Din was the most famous astronomer of the age. He constructed the tables known as the Tables of the Ilkhany, which corrected some important errors in the former mode of adjusting the commencement of the new year. Nearly two centuries later, in 1446, Ulugh Begh, of the house of Timur, succeeded to the throne of Samarkand, and under his auspices the famous tables called "Zij Ulugh Begh" were composed. They continued to be authorities for long afterwards, and even Kinneir, in determining the latitudes of places in Persia, often quotes the tables of Ulugh Begh.

North-  
man.

The Northmen of Denmark and Norway, who were the terror of all the coasts of Europe, and who established themselves in England and Ireland, in France and Sicily, were also great promoters of geographical discovery during the darkest period of the Middle Ages. The Northmen were far from being always vikings, bent only on rapine and plunder. They were very often peaceful merchants. King Alfred sent Ulfsten and the Norwegian Ottar on voyages of discovery towards the White Sea; and the Scandinavian merchants brought the products of India to England and Ireland. From the 8th to the 11th century a commercial route from India passed through Kharism and Novgorod to the Baltic, and immense quantities of Arabian coins have been found in Sweden, and particularly in the island of Gothland, which are preserved at Stockholm. Five-sixths of them were from the mints of the Samanian dynasty, which reigned in Khorasan and Transoxiana from about 900 to 1000 A.D. It was the trade with the East that originally give importance to the city of Visby in Gothland.

In the end of the 9th century Iceland was colonized from Norway; and in 985 the intrepid viking Erik, surnamed the Red, discovered Greenland, and induced some of his Icelandic countrymen to settle on its inhospitable shores. In 986 young Bjorni, son of one of Erik's comrades, sailed from Iceland to join his father in Greenland, but shaped his course too far to the south, and was the discoverer of America. He sailed along the coasts of Connecticut, Massachusetts, and Nova Scotia, before he eventually found the fjord on the Greenland coast where his father dwelt. Then Leif, the son of Erik, bought the ship from young Bjorni and made another voyage of discovery, and once more the coast of America was visited. Other expeditions were undertaken by his two brothers, intercourse was kept up between Greenland and Norway, and the saga of Thorfinn tells us of other voyages to America. The last that was heard of the Norwegian colonies in Greenland was in a brief of Pope Nicolas V. in 1448, where it is stated that, 30 years before, the settlements had been destroyed by the attacks of savages. Two noble Venetians, Nicolo and Antonio Zeno, who were in the service of the prince of the Faroe Islands in the end of the 13th century, recorded their observations respecting the Norse colonies. Antonio actually went to Greenland, and heard of the visits of fishermen to two parts of North America called Estotiland and Drogeo.

At length the long period of barbarism which accompanied and followed the fall of the Roman empire drew to a close in Europe. The crusades had a very favourable influence

on the intellectual state of the Western nations. Interesting regions, known only by the scant reports of pilgrims, were made the objects of attention and research; while religious zeal, and the hope of gain, combined with motives of mere curiosity, induced several persons to travel by land into remote regions of the East, far beyond the countries to which the operations of the crusaders extended. Among these was Benjamin of Tudela, who set out from Spain in 1160, travelled by land to Constantinople, and having visited India and some of the eastern islands, returned to Europe by way of Egypt after an absence of 13 years.

Christian missionary zeal was another motive for exploration. John of Plano Carpini in Perugia, a Franciscan monk, was the head of one of the missions despatched by Pope Innocent to call the chief and people of the Tatars to a better mind. He reached the headquarters of Batu, on the Volga, in February 1246; and, after some stay, went on to the camp of the great khan near Karakorum, and returned safely in the autumn of 1247. A few years afterwards, a Fleming named Rubruquis was sent by St Louis on a mission to the Tatar chiefs, and wrote a very interesting narrative. He entered the Black Sea in May 1253, visited Batu and the court of the great khan Mangu near Karakorum, and got back to Antioch about the end of June 1255. Rubruquis had the merit of being the first modern traveller who gave a correct account of the Caspian Sea. He ascertained that it had no outlet. At nearly the same time Hayton, king of Armenia, made a journey to Karakorum in 1254, by a route far to the north of that followed by Carpini and Rubruquis. He was treated with honour and hospitality, and returned by way of Otrar, Samarkand, and Tabriz, to his own territory. The curious narrative of King Hayton was translated by Klaproth.

While the republics of Italy, and above all the state of Venice, were engaged in distributing the jewels, the spices, and the fine cloths of India over the Western world, it was impossible that motives of curiosity, as well as a desire of commercial advantage, should not be awakened to such a degree as to impel some to brave all the obstacles and dangers to be encountered in visiting those remote countries. Among these were Nicolo and Maffeo Polo, two brothers who traded with the East and visited Tatar. The recital of their travels fired the youthful imagination of young Marco Polo, the son of Nicolo, and he set out for the court of Kublai Khan, with his father and uncle, in 1265. After a journey of three years and a half they reached Yeu-king, near the spot where Peking now stands, and young Marco was enrolled among the attendants of honour of the Grand Khan. During the seventeen years that he remained in this service, Marco Polo was employed on important missions; and besides what he learnt from his own observation, he collected from others much information concerning countries which he did not visit. He returned to Europe possessed of a vast store of knowledge respecting the eastern parts of the world, and, being afterwards made a prisoner by the Genoese, he dictated the narrative of his travels during his captivity. The work of Marco Polo is the most valuable narrative of travels that appeared during the Middle Ages, and its latest and ablest editor truly says, "All other travellers of that time are but stars of a low magnitude beside the full orb of Marco Polo."

Still these minor orbs continued to do useful geographical work, while striving to spread the truths of the Gospel. Among them were John of Monte Corvino, a Franciscan monk, Andrew of Perugia, John Marignoli, and Friar Jordanus, who visited the west coast of India, and above all Friar Odoric of Pordenone. Odoric set out on his travels in about 1318, and was in western India and northern China between 1321 and 1328, dying in 1331. He went by Constantinople to Trebizond, thence through

Persia to Ormuz, where he embarked for Tana in Salsette. He then went to Malabar, Sumatra, and Java, and by the ports of China to Cambaluc or Peking, where he remained for three years. Turning westward he journeyed by Shensi into Tibet, and was the first European to visit Lassa. His homeward journey led him by Cabul and Khorasan to Tabriz, and thence to Venice. His companion was an Irishman named Friar James.<sup>1</sup>

Ibn Batuta, the great Arab traveller, is separated by a wide space of time from his countrymen already mentioned, and he finds his proper place in a chronological notice after the days of Marco Polo—for he was not born at Tangier until 1304. He began his wanderings in 1325, his career thus coinciding in time with that of Sir John Mandeville (1322-1356), but the Moor was more trustworthy than the Englishman. Ibn Batuta went by land from Tangier to Cairo, then visiting Syria, and performing the pilgrimages to Medina and Mecca. After exploring Persia, and again residing for some time at Mecca, he made a voyage down the Red Sea to Yemen, and travelled through that country to Aden, which remarkable place he correctly describes. Thence he visited the African coast, touching at Mombas and Quiloa, and then sailed across to Ormuz and the Persian Gulf. He crossed Arabia from Bahreyn to Jiddah, traversed the Red Sea and the desert to Syene, and descended the Nile to Cairo. After this he revisited Syria and Asia Minor, crossed the Black Sea to Caffa, and proceeded to the camp of the khan of Kipchak at the foot of the Caucasus. Ibn Batuta crossed the desert from Astrakhan to Bokhara, and went over the Hindu Kush to Cabul, reaching the Indus somewhere below Larkhana, in 1333. He gives an interesting account of Muhammad Tughluk, then ruler of Delhi, in whose service the great traveller remained for about eight years. He was sent on an embassy to China in 1342, travelling by land from Delhi to the seaport; whence the ambassadors sailed down the west coast of India to Calicut, and then visited the Maldiv Islands and Ceylon. He made a voyage through the Islands to China, and on his return he proceeded from Malabar to Baghdad and Damascus, where he got his first news from home and heard of his father's death. Finally he reached Fez, the capital of his native country, in November 1349, after an absence of twenty-four years, and came to the conclusion that there was no place like home. After a journey into Spain, he set out for Central Africa in 1352, and reached Timbuctoo and the Niger, returning to Fez in 1353. He had travelled over a length of at least 75,000 English miles. His narrative was committed to writing from his dictation, by order of the sultan of Fez, and the work was completed in December 1355. Ibn Batuta died at the age of seventy-three, in the year 1377. His whole work was carefully edited in the original, with a translation into French under the auspices of the Asiatic Society of Paris, and published in 1858. Colonel Yule has given us an English version of the portion relating to China.

Ibn Batuta was certainly the greatest of Arab travellers, and soon after his death in the kingdom of Fez, the opposite realm of Spain began to send forth explorers to distant lands. The peaceful reign of Henry III. of Castile is famous for the attempts of that prince to extend the diplomatic relations of Spain to the remotest parts of the earth. Mariana tells us that he sent embassies to the princes of Christendom and to the Moors. In 1403 the Spanish king sent a knight of Madrid, named Ruy Gonzalez de Clavijo, to the court of the mighty Timur, at Samarkand. He re-

turned in 1406, and died soon after, but not before he had written a most valuable and interesting narrative of his travels from Constantinople through Persia and Khorasan to the Oxus, and thence by the Iron Gates to Samarkand.

Several Italians continued to make important journeys in the East during the 15th century. Among them was Nicolo Conti, who passed through Persia, sailed along the coast of Malabar, visited Sumatra, Java, and the south of China, returned by the Red Sea, and got home to Venice in 1444, after an absence of twenty-five years. He related his adventures to Poggio Bracciolini, secretary to Pope Eugenius IV.; and the narrative contains much interesting information. Towards the end of the same century, the Venetians sent several embassies to Uzun Hassan, the ruler of Persia, and to Shah Ismail, his successor; and the narratives of the envoys furnish some new geographical information. The first of these was Caterino Zeno, who induced Uzun Hassan to make war on the Turks in 1472; and he was followed by Josafat Barbaro and Ambrogio Contarini. Another Venetian traveller of this period, whose narrative has been preserved, was Giovan Maria Angiolello. He was in the service of the Turks, and was present in their campaign against the Persians. One of the most remarkable of the Italian travellers was Ludovico di Varthema, whose insatiable desire to see foreign countries induced him to leave his native land in the year 1502. He went to Egypt and Syria, and for the sake of visiting the holy cities became a Mahometan. After many extraordinary adventures he got on board a ship at Aden. Varthema is the first European who gave an account of the interior of Yemen. He afterwards visited and described many places in Persia, India, and the Eastern Archipelago, returning to Europe in a Portuguese ship after an absence of five years.

In mentioning Varthema we have anticipated events; but in the 15th century the time was approaching when the discovery of the Cape of Good Hope was almost indefinitely to widen the scope of geographical enterprise. The great event was preceded by the discovery of the polarity of the magnetic needle, and the consequent construction of the mariner's compass. This most important discovery appears to have been made in China, and it is uncertain when the compass was first used by Western nations. Its introduction has been attributed to Flavio Gioia, a citizen of Amalfi, in the kingdom of Naples, about the year 1307. Encouraged by the possession of this sure guide, by which at all times and in all places he could with certainty steer his course, the navigator gradually abandoned the method of sailing along the shore, and boldly committed his bark to the open sea. Navigation was then destined to make rapid progress. The growing spirit of enterprise, combined with the increasing light of science, prepared the states of Europe for entering upon that great career of discovery, of which the details constitute the materials for the history of modern geography. Portugal took the lead in this new and brilliant path, and foremost in the front rank of the worthies of this little hero-nation stands the figure of Prince Henry the Navigator.

The work of Prince Henry is well defined by his biographer, Mr Major. Until his day the pathways of the human race had been the mountain, the river, and the plain, the strait, the lake, and the inland sea. It was he who first conceived the thought of opening a road through the unexplored ocean,—a road replete with danger but abundant in promise. Born on March 4, 1394, Prince Henry was a younger son of King João of Portugal and of Philippa of Lancaster, the grandchild of Edward III.; so that he was half an Englishman. Prince Henry relinquished the pleasures of the court, and took up his abode on the inhospitable promontory of Sagres, at the extreme south-western

<sup>1</sup> Sir John Mandeville copied largely from Odoric, and the substance of his travels to the Indies and Cathay is entirely stolen from the Italian traveller, though amplified with fables from Pliny and other ancients, as well as from his own imagination. See Colonel Yule in his account of Odoric (*Cathay, and the Way Thither*, i. p. 27).