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the two results would be simultaneous ; so the question of relative age will not come in. With regard to tarns in rock basins, these only occur under most favourable circumstances, where ice may have been expected to have had great erosive power. Now, the argument of my earlier papers was, that if glaciers do excavate, they should make tarns at intervals down the valley. Dr. Blandford forgot that mud from glaciers does not prove erosion, but only abrasion, a distinction which I have drawn ; and I quite agree with Mr. Freshfield, a large quantity of mud comes from tributary streams, not from the glacier. Several of the Alpine lakes, in fact, the most important, occur at the ends of the courses of glaciers, where, according to most people, they would be quite impotent to excavate, in fact, where they approach their death-beds. It would seem that glaciers are like some people, who idle away the best part of their life, and try to have a desperate expenditure of good deeds before they leave it. Another point, on which I do not agree with my friend, is that of Alpine valleys. These, as a rule, are not U-shaped, but V-shaped, only being U-shaped in a few very exceptional cases. I have followed up, I should think, half the valleys in the Alps. The upper Haslithal Valley is throughout V-shaped, yet it is ice-worn almost down to the level of the torrent. My argument amounts to this, that if we accept the hypothesis put forward by Professor Ramsay, we are landed in a crowd of practical difficulties.

The PRESIDENT : You will, I think, agree with me in the opinion that Professor Bonney's views have been well smitten and well defended, and will direct me in your name to return your very best thanks alike to him and everyone else who has taken part in the discussion.

PYTHEAS, THE DISCOVERER OF BRITAIN.

By CLEMENTS R. MARKHAM, C.B., F.R.S.

THE discovery of the British Isles in the third century before Christ, by a Greek scientific explorer, was the last link in a chain of events which commenced with the establishment of the Ionian colonies in Asia Minor. We may trace these events as they succeed each other, with ever growing interest, for we shall find that their motive was always a noble thirst for geographical discovery and exploration. The original impulse came from those Ionian colonies in Asia Minor, whose people were gifted with all the Grecian genius for scientific research, for imaginative speculation, and for maritime enterprise. They are said to have established themselves on this coast in about 1060 B.C., to have formed themselves into twelve autonomous cities, to have advanced in civilisation, and to have extended their influence in various directions, during a long period of peace and prosperity, extending over several centuries. Their coast reached for about 80 miles from Phocæa on the north, to Miletus on the south, bordering on Caria ; and the Ionian territory included the islands of Chios and Samos. Deeply indented by bays, it is formed into numerous harbours, and the dozen cities were clustered round their shores. First on the north, between the Cumæan and Hermæan Gulfs, was Phocæa, a colony from Ionian Phocis. Then came

the rocky promontory, on which rose the shaggy forest of Mount Mimas, with the island of Chios by its side, and on the shores of the promontory and island were clustered the cities of Clazomene, Erythræ, Teos, and Chios. From Mount Mimas, a great bay sweeps round to Mount Mycale and the island of Samos, and on or near its shores were the cities of Lebedos and Colophon, and the holy city of Ephesus. Point Trogilium, at the end of Mount Mycale, separates this bay of Ephesus from the southern bay where stood the cities of Priene, Myus, and Miletus, with Samos on its fertile island, off Mycale.

The twelve Ionian cities formed a sort of union, and their delegates periodically met at Panionion, on the slopes of Mount Mycale, to celebrate their games, which were managed by the neighbouring city of Priene. This was a loose bond, and did not prevent all intestine feuds, but it served to maintain a feeling of common origin and of common interest among the citizens of the twelve Ionian colonies. Another such bond was found in the worship of their goddess Artemis at Ephesus. This was an Asiatic divinity whose worship the Ionians found established among the original inhabitants when they arrived. It was a personification of the fructifying powers of nature, to whom the Greeks applied the name of their own goddess Artemis, combining with her worship that of her brother Apollo, the sun-god.

From a very early period these Ionians of Asia Minor were distinguished for the energy and ability with which they conducted their commercial ventures, and not less for their intellectual progress. Of the seven wise men of Greece, two, Thales and Bias, belonged to cities of the Ionian colonists. Thales predicted the solar eclipse which put an end to the battle between the Medes and Lydians, fixed the year at three hundred and sixty-five days, determined the course of the sun, and was the first to form a theory of the universe. He was a native of Miletus, as were his disciples Anaximander and Anaximenes, who were the first to measure time by a sundial. Heracleitus was a citizen of Ephesus, Xenophanes of Colophon, and Anaxagoras, who had an observatory on Mount Mimas, was of Clazomene. In later times, Samos produced more than one astronomer.

Led and helped by such brilliant intellects, the Ionian sailors soon covered the Ægean with their ships, and began to venture on more distant voyages. Thales taught them to steer by the Little Bear like the Phœnicians, instead of the Great Bear,* while Anaximander gave them some idea of geography, and constructed maps and a celestial sphere. Their ships were enlarged and built on improved principles, and commerce enriched their cities. The invention of money is attributed to the Lydian kings, but the Ionian seaports were among the first to adopt its use. The electrum staters of Phocæa, and her smaller coins,

* Both were wrong. The star nearest the Pole in those days was α Draconis.

impressed, on one side only, with a seal or a seal's head, were circulated throughout the known world. The coin of Erythræ was stamped with a rose, that of Clazomene with a winged boar, Teos with a seated griffin, Chios with a seated sphinx, and Colophon with a lyre. Coins of the sacred city of Ephesus were stamped with a bee, the emblem of Artemis. The coin of Samos showed a lion's face, of Myus a bird, and of Miletus a lion or lion's head. Lebedos and Priene had no early coins, being small cities with little trade.

At different times Miletus, Samos, and Phocæa took the lead. Miletus, with her four harbours, enjoyed great prosperity, and established many colonies, chiefly on the Hellespont and in the Euxine. Abydos, Lampsacus, Cyzicus, Sinope, and Amisus owned her as their mother city. Samos, with her famous temple to Hera, was also a great maritime power under Policrates, and it was a Samian ship that first reached the eastern extremity of the Mediterranean,* B.C. 639. But it was Phocæa that held the supremacy of the sea for the longest time—from about B.C. 602 to 560.

Phocæa stood on a peninsula between the Cumæan and Hermæan gulfs, at a distance of about 20 miles north of Smyrna. The city possessed two excellent harbours, called Naustathmus and Lampter, and in front of them was the island of Baccheion, adorned with temples and other public buildings. Herodotus says that the Phocæans were the first Greeks who undertook distant voyages. Their sailors were acquainted with the Adriatic, the Tyrrhenian, and the Iberian Seas; and they were the first to visit Tartessus, a kingdom in the south of Spain, where the King Arganthonius was warmly attached to them, B.C. 639. This proves that the Phocæans undertook their expeditions without any predatory motives, and with the great objects of discovery and the extension of trade. Hence their relations with the people they visited were friendly and peaceful. They established a settlement at Alalia on the east coast of Corsica, in B.C. 566; but their great work was the foundation of the rich and powerful colony of Massalia (Marseilles) in B.C. 600.

When the Phocæans arrived on the south coast of Gaul, the country was ruled by a chief named Nannus. It was in about the year 600 B.C. when Euxenus, the Phocæan, opened friendly intercourse with him. The Grecian stranger was present at a banquet given by the Gaulish chief, when it was arranged that his daughter Petta was to give a cup of wine to the suitor she preferred. She presented it to Euxenus. They were married, and the lady received the Grecian name of Aristoxena, bringing the site of Massalia as her dower. Their son was named Protis, and the family of Protiadæ flourished at least down to the time of Aristotle. Brought to the Grecian colonists by one fair

* 'Herodotus,' Melpom., iv. 5.

Gaulish lady, Massalia was saved by another. Comanus, the son of Nannus, formed the design of seizing the place during a festival. His men entered the town in disguise, while he and a chosen band waited for a signal outside, the gates being all wide open. But a kinswoman of Comanus had a Grecian lover. She betrayed the plot to him, and Comanus was attacked and killed. Ever afterwards the gates of Massalia were closed when a festival was celebrated within the walls.

Warned by an oracle, the Phocæans had received a statue of the earth goddess from Ephesus, and with it they brought the first branch of olive to Massalia. Twin temples were raised to the Ephesian Artemis and the Delphian Apollo on the acropolis of the new city. The colonists formed settlements along the Gaulish and Iberian coasts, and while extending their commerce in all directions, they taught the Gauls in their neighbourhood to live under laws, to plant the olive, and to prune the vine. Cordial relations continued to exist between Phocæa, the mother city, and Massalia.

In the middle of the sixth century, a great calamity befell the Ionian cities. The Persian Empire, under Cyrus, was extended to the shores of the Ægæan, and most of the autonomous colonies had to submit, sooner or later, to the barbarian yoke. But freedom was the breath of life to the sailor princes of Phocæa. In B.C. 546 their city was closely besieged by Harpagus the Mede. Preparations were made for a desperate defence; and Arganthionius, King of Tartessus, the tried friend of Phocæa, gave large sums for strengthening the walls. At length, when longer resistance became hopeless, the Phocæans applied for a truce of twenty-four hours before surrendering, which was granted. They had collected a large fleet in the harbour. A noble resolution had been taken. The Phocæans actually carried out such a patriotic scheme as the Dutch meditated long afterwards, when their liberties were threatened by Louis XIV. Harpagus only demanded the demolition of one bulwark, and the dedication of one house in token of submission. But the Phocæans preferred exile to a home without freedom. They embarked with their wives and children, and their movable property. The descendants of such men were worthy to be the discoverers of the British Isles.

Teos alone followed the example of Phocæa. The other Ionian cities submitted after a brave struggle, and gradually sank into dependencies of Persia.

The fugitives, after resting at Chios, sailed away to their settlement at Alalia in Corsica. But they could only maintain their position there by exhausting sea fights with Etruscans and Carthaginians. Eventually a portion settled at Velia in Italy, while the bulk of the Phocæans were welcomed in their own colony at Massalia. Thus the distant city on the coast of Gaul became a second Phocæa, a second emporium of commerce, a second centre of maritime enterprise and discovery.

Massalia, the new Phocæa, was situated most advantageously for the prosecution of commercial enterprises by an intelligent and energetic people. It had an excellent harbour, a strong citadel, and the coasts of Spain and Italy stretched away on either hand, while its proximity to the mouths of the Rhone placed the internal trade of Gaul in the hands of the Massalians. It was not long before they had established trading-stations or settlements along the shores of the Mediterranean both to the east and to the west. To the east were Tauroentum, Olbia, Athenopolis, Antipolis the modern Antibes, and Nicæa, while far down in the south of Italy was the Phocæan colony of Velia. To the west were Rhodanusia at the mouth of the Rhone; Agatha near the modern Narbonne; and Rhoda, originally a colony of Rhodes, at the foot of the Pyrenees, the modern Rosas. Near Rhoda was the port of Emporium. On the modern Cape St. Martin in Spain, the Massalians had a temple of Artemis and a look-out station called Hemeroscopium, their town of Artemisia, the modern Denia, being at its base. The most western Phocæan trading-station, which was already a ruin in Strabo's time, was Mænaca, the modern Malaga.

Massalia soon became a rich and flourishing city, devoted to the worship of Artemis and Apollo, whose temples crowned the acropolis. The Phocæan emigrants traded peacefully to all parts of the Mediterranean, and continued their friendly relations with the people of Tartessus, even beyond the Pillars of Hercules. Their earliest coins were uninscribed divisions of the Phocæan drachma, and on their small obols of B.C. 350 they engraved a crab, symbol of Artemis, as protectress of harbours. One would have wished that the seal, the old coin of Phocæa, had been retained. It would have been specially appropriate for the Phocæan colony, one of whose sons was destined to bring to the knowledge of the world the first tidings of the Arctic Regions. But the seal disappeared. In its place was substituted a coin with the head of Artemis, and hair adorned with sprigs of olive on one side, and a lion with the letters Μ Α Σ Σ Α (LIA) on the other. This coin became the chief currency in Gaul as far as Lyons and in the valley of the Po, and was copied by more distant Celtic tribes.

For the commercial relations of the Massalians extended their ramifications to far distant regions some of them unknown to the civilised world. Through their enterprise the countries of civilisation were supplied with rare products, the origin and sources of which, in some cases, were unknown. Especially was this the case with tin, the *Κασσίτερος* of the Greeks. Unmentioned in the 'Odyssey,' the name occurs as a white and shining metal in the 'Iliad,' used as ornaments for arms and chariots. Herodotus had heard of the regions whence tin was brought, as the *Cassiterides*, but he knew nothing about them. The Massalians knew this much more than Herodotus, that tin and amber were brought from a distant country far to the

north, to their station at the mouth of the Rhone, by Gaulish merchants. Naturally the enterprising Phocæans desired to know more. They were explorers and the descendants of explorers. It would be an easy transition from the wish for knowledge, to the resolution to attain it. We thus come to a consideration of their expeditions beyond the Pillars of Hercules, and to the achievements of their great explorer Pytheas.

The Carthaginians, in about 500 B.C., had sent two expeditions beyond the Pillars of Hercules, one under Hanno to go south along the coast of Africa, the other under Himilco northwards in search of the tin country. Of course the despatch of Himilco implies that voyages had previously been made through which the country of tin mines had become known, but such voyages were made by the sailors of Tartessus in the south of Spain. Himilco described Abyla and Calpe, and then a lofty promontory called Æstrymnis, opening on the Æstrymnic Gulf. Here his voyage appears to have ended, Æstrymnis being Cape Finisterre in Spain,* and the gulf answering to the Bay of Biscay. He heard of islands called the Æstrymnides scattered widely about, rich in tin and lead, and inhabited by active traders navigating in vessels of skins. Thence it is two days' sail to the Sacred Island near the Island of Albion. The names given by Himilco occur nowhere else. He was told that the people of Gades (Tartessus) traded with the Æstrymnides,† but the voyage was made with difficulty in four months, the wind often failed, monsters of the deep swam to and fro, and sea-weed hampered the progress of the ships. This hearsay information was of little or no value. But, whether useful or worthless, it is certain that the Carthaginians kept it secret, and that the Greeks of Massalia had never heard of the voyage of Himilco.

Any discovery beyond the Pillars of Hercules by the Phocæans of Massalia must have been achieved by their own unaided efforts, without guidance from the experience of Himilco or any other foreign navigator. Fortunately, the colony possessed a man eminently fitted to conduct an exploring expedition, in the person of Pytheas, the mathematician and astronomer. It is alleged by Polybius that Pytheas was in poor circumstances, and we may, therefore, conclude that the enterprise was a government expedition of which Pytheas was placed in command. The nearest approximation we can get to its date is the time of

* Mr. Elton holds that Æstrymnis is Cape St. Vincent, and that the Æstrymnides represent Madeira and Teneriffe: pp. 15, 22.

† According to Posidonius tin was found among the Artabri, the modern Galicia in Spain. This may be the source whence came the tin of Gades and the Phœnicians; while all the British tin was brought through France to the mouth of the Rhone. The 'Æstrymnides' would then be a fable of Himilcar (see 'Bunbury,' ii. p. 89); and 'Cassiterides' seems to have been a vague general term for the source of the tin trade, originated by Herodotus.

Alexander the Great and Aristotle,* about B.C. 330, and we may well suppose that the object was the discovery of the countries whence came those rare and valuable products which reached the Massalians by a long overland route and a descent of the Rhone.

Pytheas prepared for his perilous undertaking by carefully fixing the latitude of Massalia as a point of departure. His pre-eminence in his own day will be obvious when we recollect that he lived before the principal Greek astronomers, Eratosthenes and Hipparchus, and that none of his predecessors had demonstrated the methods which he adopted. The earliest way of calculating the distance of a place from the equator was by observing the length of the longest and shortest days. The ancient geographers divided the Earth into parallel zones, within which the longest day had a certain length, generally an hour: one zone from twelve to thirteen hours, the next from thirteen to fourteen, and so on. The zones were called "climates," from the Greek word *klima*, a slope or inclination. They were unequal in width, the zone in which the longest day was from fourteen to fifteen hours being 600 miles in width; while the zone in which the longest day was from nineteen to twenty hours has a width of only 125 miles. Pytheas used this system during his voyage; but in fixing the latitude of Massalia he adopted a more accurate method.

The Phocæan astronomer erected a large gnomon at Massalia,† divided into one hundred and twenty parts. He observed its shadow at noon on the day of the solstice, and found that its length was forty-two of the parts on the gnomon, less one-fifth—that is, forty-one and four-fifths to one hundred and twenty, or two hundred and nine to six hundred. This proportion gave $70^{\circ}. 47'. 50''$ for the altitude of the sun. The length of the longest day was fifteen hours fifteen minutes. Eratosthenes and Hipparchus found the obliquity of the ecliptic to be $23^{\circ}. 51'. 15''$,‡ which they deducted from the altitude. The complement of the result was the latitude of the place less the semi-diameter of the sun, namely, $43^{\circ} 3' 25''$. With the semi-diameter added, the result is almost exactly the latitude of the Marseilles observatory.

Another important point was to fix upon the nearest star to the pole as a guide for steering the ship. Pytheas found that there was no star on the pole, but that there were three very close to it.§ These would have been β Ursæ Minoris and α Draconis in those days; and Pytheas used one of these as his pole star.

It is probable that there was no other man, in the days of Alexander the Great, who could have prepared for a voyage of discovery by fixing

* The work of Pytheas was known to Dicaearchus, who was a pupil of Aristotle. The date of the voyages must, therefore, have been not later than the time of Aristotle.

† 'Cleomedes ap Lelewel,' p. 49.

‡ 'Eratosthenes ap Ptolemy Almag,' i. 2; 'ap Lelewel,' p. 49.

§ "Hipparchus in Arati phœnom," I. 5, from 'Lelewel,' p. 48 (n. 121).

the exact latitude of his point of departure, and by selecting correctly the star by which he should shape his course. For the rest, his countrymen were well able to furnish him with a serviceable vessel. From the temples of Artemis and Apollo in the citadel it was a short descent over rocky ground to the harbour, which, like the city, was protected on the land side by a strong wall. Here were the νεώσοικοι, or docks, and the armoury, or arsenal, called ὀπλοθήκη. A large Massalian ship was a good sea-boat, and well able to make a voyage into the northern ocean. She would be from 150 to 170 feet long—the beam of a merchant ship being a quarter, and of a war-ship one-eighth the length—a depth of hold of 25 or 26 feet, and a draught of 10 to 12. Her tonnage would be 400 to 500, so that the ship of Pytheas was larger and more seaworthy than the crazy little *Santa Maria* with which, eighteen hundred years afterwards, Columbus discovered the New World.

A Grecian ship was strongly built on regular principles, commencing from the *τρόπις*, or keel, a horizontal beam which in the older ships rose from the centre in a curve. Under it was the *κέλευσμα*, or false keel, and above the *δρύοχον*, or keelson. The stem (*στεῖρα*) and stern-post were inserted on the keel nearly at right angles, and from the keel also rose the ribs (*ἐγκοῖλια*), connected and strengthened by cross-beams (*στρωτήρ*). The upper deck, or *κατάστρωμα*, had bulwarks made of trellis-work. In large ships there was a lower deck, or *ἔδαφος*, above the hold (*κοῖλον*), with a second set of cross-beams (*ζυγόν*). The prow (*πρῶρα*) and poop (*πρύμνα*) were raised above the upper deck, and had half-decks, called *ικρίωμα*. The bow and stern were both pointed and identical in construction, the stem and stern-posts both ending in a volute, or the neck of a swan. But the bows were fitted with a beak or ram, level with the water-line, consisting of rafters let into the body of the vessel, and ending in a point shod with iron, in three blunt teeth. Two beams, supported by props, protruded from both sides of the beam. The hawse-holes on each side of the stern were bound with iron, and were called *ὀφθαλμοί*, or eyes.

The Grecian ships were further strengthened externally by a wooden ledge along the water-line, and also by four stout hawsers, called *ὑποζώματα*, passed round the hull below the water-line. Boards were placed over the ribs inboard. On the poop there was a tent-like house for the pilot and helmsman called the *σκηνή*, and there were two oar-like rudders or *πηδάλια*, on each side of the stern-post, which were worked by a tiller-rope, called *χαλινός*, running across the vessel, the rudders always being kept parallel. The mainmast, or *ἰσθὸς μέγας*, was stepped in the centre of the ship, and fitted with yards to which square sails were laced—a mainsail, maintopsail, topgallant sail, and even a triangular royal. The mast had stays (*πρότονοι*), backstays (*ἐπίτονοι*), and shrouds (*καλοί*). There were two smaller fore and after masts with

lateen sails, used for paying her off or for putting her up into the wind. The upper deck was covered with an awning, in fine weather, called *κατάβλημα*, where a flagstaff was also raised (*στηλὴς*) with a flag (*σημείον*).

The rowing-power of ancient galleys, supplementary to the sails, has been looked upon as the equivalent to the steam-power of modern times. In the Grecian ship there was a narrow gangway on both sides, called *πάροδος*, lower than the upper deck, and just above the rowlocks for the upper tier of oars. The rowing apparatus, or *ἐγκωπον*, was in the centre part of the ship, and the space for the *ἐρέται* or rowers was called *ζύγωσις*, the bench itself being *ζυγά*. The distance between the rowers was 4 feet, and in a large trireme there were fifty-four *θαλαμίται* or bottom rowers, fifty-eight *ζυγίται* or middle, and sixty-two *θρανίται* or upper rowers, making one hundred and seventy-four all told. The oars for the *θαλαμίται* were $7\frac{1}{2}$ feet long, and the length had to be increased by 3 feet in each ascending row. The oar (*κώπη*) passed through a circular *τρήμα* or rowlock, which was covered by a tarpaulin when not in use. The sailors or rowers were of course much more numerous than the *ἐπιβάται* or marines. The *κελευστής* or officer in command of the rowers had a lieutenant (*ἐπόπτης*), and not the least important person on board was the *τριηραύλης* or piper, by whose music the rowers kept time.

The anchor (*ἄγκυρα*), as shown on the most ancient coins, had two flukes, and a shank with a ring at the end for the cable. In some anchors there was also a ring at the meeting of the flukes, to raise or turn them if they had not caught the ground. The cable (*σχοινία ἀγκυρεῖα*) was worked by a *στροφεῖον* or capstan; and for going on shore there were boat-hooks (*κοντοί*) and gang-boards (*κλιμακίδες*).*

In the days of Alexander, a voyage of discovery beyond the Pillars of Hercules was as bold and daring a conception, as was a voyage in search of the Indies by the western route, in the days of Ferdinand and Isabella. We have seen that Pytheas, the first of the great explorers, like the illustrious Genoese of later times, prepared himself for his difficult task by long and patient study of the astronomical bearings of the question. Thus well-provided with all the knowledge of his time, he raised his anchor,† and commenced his coasting voyage towards the Sacred Promontory,‡ the western limit of the known world. The Grecian ships were supposed to make an average of about 500 *stadia* or 50 miles in a day's sail, the *stadium* being the unit of measurement for all geographical distances.§ Coasting along near the shore, the ship of

* This account of the structure and fittings of a Grecian ship is taken from the work of E. Guhl and W. Koner, translated by Hueffer, 'Life of Greeks and Romans.' Chatto & Windus: 1877.

† In the end of December, according to Lelewel, p. 35.

‡ Cape St. Vincent.

§ Colonel W. Martin Leake contributed a valuable paper on the stadium as a linear measure to Vol. IX. of the Society's *Journal*. The original stadium was the length

Pytheas would first have come to the Massalian settlement at the mouth of the Rhone, and then to Rhoda and Emporium (the modern Ampurias) in the beautiful bay of Rosas, at the base of the Pyrenees. Next the temple of Artemis, crowning the lofty promontory now dedicated to St. Martin came in sight, where the Massalians had their *Hemeroskopion* or look-out station. There was a settlement called Artemisia (the modern Denia) at the foot of the heights, where the explorers could anchor and find rest. The last friendly haven would be at Mænaca, the modern Malaga. Sailing through the Straits of Calpe, the Greek mariners would scarcely venture to stop at Carthaginian Gadeira, although, in times gone by, the native ruler of the country had been on such cordial terms with Phocæa. But the cruel Semites since established at Gadeira were enemies of western civilisation, and Pytheas sailed slowly on to the Sacred Promontory, the end of the known world, very slowly, for the 48 leagues from Cadiz to Cape St. Vincent took him five sailing days.

Pytheas continued his coasting voyage to the north as far as Estrymnis (Cape Finisterre), the probable furthest point of Himilco, then eastward along the north coast of Iberia, and round the Bay of Biscay. His narrative is lost, but we gather that he described the coasts of Iberia, made valuable observations respecting the tides, and furnished information touching the best way of passing from Iberia to Celtica or Gaul. "He had acquired a practical acquaintance of the navigation along the north coast of Spain." His first recorded observation on the voyage had for its result that the longest day was fifteen hours, which would be in lat. $40^{\circ} 59'$ off Oporto.

Pytheas found that the north-western part of Gaul formed a long promontory called Calbion, the country of a tribe called the Ostimii, which stretched far to the westward. He even thought that it extended for 2000 *stadia* to the west of Cape Finisterre of Spain. But great allowances must be made for errors in longitude at a time when no means were known of estimating it, beyond guess-work. He mentions an island off the coast called Uxisama, evidently intended for Ushant. A second observation is given of sixteen hours for the length of the longest day, equal to 49° N., which is within 30 miles of the latitude of Ushant. The explorer left the north coast of Gaul, and shaped a direct course for a part of Britain which he called Cantion (Kent), the Cantium of Cæsar. This must have been the route, because he reported that the coast of Gaul, where he left it, was some days' sail from Cantion.

The Cantion of Pytheas was doubtless the modern Kent, although it

of the Olympic foot-race, equal to 600 Greek feet. The Greek foot, deduced from the stylobate of the Parthenon, is equal to 12.1375 English inches. This gives $8\frac{7}{10}$ stadia to a statute mile, 10 stadia to a geographical mile, and 600 stadia to a degree. A stadium was also $\frac{1}{2}$ of a Roman mile, equal to 625 Roman feet; and a Roman foot was 11.65 English inches, which gives the same result.

may be intended to include additional territory to the north. Here he stopped; and we are told that he not only landed, but travelled over a part of Britain on foot. He probably went westward to collect information respecting the tin trade, which in those days would have entailed a very difficult and perilous journey.*

Britain, in the third century before Christ, was almost in a state of nature. The valleys were covered with primeval forests, their lower parts were occupied by vast swamps, and it was only on the downs and hill ranges that there were *Gwents*, or open clearings. Still the Keltic tribes had been in possession for several centuries, and had made some advances in civilisation. They brought domestic animals with them, raised wheat and other cereals, and had iron tools and arms, wooden chariots with iron fittings, and ornaments of bronze and gold. Pytheas saw and made note of the farming operations and way of living among the natives of Cantion (Kent). Between this south-eastern district and the Gwent now comprising the downs of Wiltshire and South Hampshire there was the great forest of Anderida, extending from Hampshire to the Medway. Pytheas would have to pass this forest on his way to the western part of Britain (the present Cornwall), which was called *Belerion*.† Here he found the country of the tin, which was dug out of the ground in mines with shafts and galleries. The people were very hospitable, their commerce with foreign merchants having civilised them and softened their manners. The metal was carried by them in six days' journey to an island called Ictis (St. Michael's Mount), whence the traders from Gaul conveyed it across the Channel, and down the Rhone to Massalia. "This island is described as surrounded by the sea at high water, but connected with the mainland by a tract of sand left bare at low water, so as to render it a peninsula to which the tin was carried in waggons."‡ Pytheas no doubt gave a stimulus to this trade, and was probably the first to introduce coined money into Britain. After the discovery of the gold mines of Crenides, in 356 B.C., Philip of Macedon produced £250,000 worth of gold coin a year. The beautiful stater of Philip was everywhere diffused. It soon reached Massalia, whence it was circulated inland, and it was seized on by the Gauls as an object of imitation in about B.C. 300. Pytheas may well have

* If the account given by Diodorus of Belerion, Ictis, and the tin trade is, as is more than probable, taken from Timæus, it was derived from the work of Pytheas. In that case the journey on foot through Britain must have been to Belerion, and the coast opposite Ictis.

† Ptolemy has *Bolerium* for the Land's End. Posidonius seems to have been the first to use the name *Belerion* for the tin country.

‡ *Mietis* of Pliny, and *Vectis* of Ptolemy. Mr. Elton thinks it was Thanet (p. 34). Sir E. Bunbury considers that there is no reasonable doubt that it was St. Michael's Mount to which the description precisely answers. (ii. p. 197) Ptolemy gave the name of Vectis to the Isle of Wight.

brought the first staters of Philip to Britain, thus introducing the use of money. They were afterwards roughly imitated by the natives; but no British coin has an earlier date than B.C. 200.

Several pieces of information respecting the natives of Britain, related by Pytheas, have been preserved. In consequence of the rain and absence of sun, the former did not use threshing-floors, but threshed their corn in large barns. They stored the ears of corn in pits underground, and the part that had been longest in store was brought out daily and prepared for food. They made a fermented liquor from barley, which they used instead of wine; it was called *curmi*. As Columbus was the discoverer of tobacco, so his great predecessor, Pytheas, discovered beer. Pytheas also says that the Britons made another drink from honey. Their houses were of wood and thatch, and he mentions the war-chariots, but adds that the chiefs were generally at peace with each other. He believed the people to have been *autocthones*, or aborigines.

When Pytheas returned to his ship, in some haven of Cantion, he proceeded northwards along the coast of Britain; and his next observation gave seventeen hours as the length of the longest day. This would be in lat. $54^{\circ} 2' N.$, somewhere in the neighbourhood of Flamborough Head. Still coasting to the north, in his great voyage of discovery, he reached a point at the northern end of Britain where the length of the longest day was eighteen hours. The corresponding latitude is $57^{\circ} 58' 41'' N.$, which is that of Tarbett Ness, in Ross-shire. As he advanced to the Pole he found that the cultivated grains and fruits, and almost all domesticated animals, gradually disappeared. The people in the far north were reduced to live on millet, herbs, and roots. The intrepid explorer still pushed onwards to discover the northernmost point of the British Isles. Coasting along the shores of Caithness and the Orkney Islands, he finally arrived at a land where the length of the longest day was nineteen hours. This was in lat. $60^{\circ} 51' 54'' N.$, in Burra Fjord, on Unst Island, the northernmost of the Shetlands. Pytheas gives the name of *Orcas* to this extreme point of the British Isles—a name which in later times was transferred to the Orcades, or Orkney Islands. It was doubtless a native name.

It was at *Orcas* that Pytheas received information of an Arctic land called *Thule*, at a distance of six days' sail, and near the frozen ocean. Here the summer tropic and the Arctic circle are all one, that is there is no night at the summer solstice and the latitude would be $66^{\circ} N.$ * *Thule* may either have been Iceland, or the coast of Norway in the neighbourhood of Alstenoe and Vitsen-fjord. Pytheas does not say that

* He heard also that, during one season the night was continuous, and during another it was continuous day, 'Cosmas Indicopleustes,' ii. 149, and 'Geminus,' v. 22; ap 'Lelewel,' p. 37.

Thule was an island, nor that he visited it.* It is more likely to have been Norway, because Iceland was unvisited and unknown until long afterwards. The word Thule, in the forms Thyle, Thul, Tell, is ancient Saxon, meaning limit. Telle-mark is in Norway. Pytheas also received reports of the physical aspects of the region beyond Thule. His account has been turned into nonsense by 'Strabo,'† copying from the explorer's bitterly hostile critic Polybius. Yet even as we have it, the account is a good description of a dense fog at the edge of the pack, amongst sludge ice, which "can neither be travelled over nor sailed through." He might have seen such ice occasionally, at no great distance from the Shetlands.

Pytheas was thus not only the discoverer of Britain, but the first explorer who received information respecting the Arctic Regions. He was, as Professor Rhys has truly said, "one of the most intrepid explorers the world has seen." If, as we may infer from their approximate accuracy, the five observations for the length of the longest days were taken by the explorer himself,‡ the voyage must have occupied about six years. Sailing southwards from Orcas, Pytheas returned to Cantion, and continued the long voyage onward to Massalia, whence he soon set out on another expedition to examine the coasts of the continent from Gades to a river called the northern Tanais.§

Coasting round the Bay of Biscay, and along the coast of Gaul, as in the previous voyage, Pytheas continued to hug the continental shore instead of crossing to Britain. He passed the mouths of the Rhine, where the Ostioni dwelt, and entering the Gulf of Mentonomon, reached a river which he called the Tanais. The gulf appears to have been the bay formed by the coasts of Schleswig-Holstein on one side and Friesland on the other, and this northern Tanais is identified with the Elbe.|| The shores were inhabited by a tribe called Guttones. He

* Mr. Elton thinks that Pytheas sailed north of the Loffoden Islands to the North Cape (p. 67); but Sir E. Bunbury, in spite of a doubtful passage in Cleomedes, is inclined to the view that the explorer did not himself visit Thule.

† 'Strabo,' i. 157. "'Neither earth, water, nor air exist separately, but a sort of concretion of all these' (resembling marine sponge), 'in which the earth, sea, and all things were suspended' (thus forming as it were a link to unite the whole together). 'It can neither be travelled over nor sailed through.' (As for the substance, he affirms that he has beheld it with his own eyes; the rest he reports on the authority of others.)" The sentences in parentheses are probably interpolations of the critic.

‡ I cannot think, with Lelewel, that Pytheas merely obtained the length of the longest days from statements of natives.

§ Sir Edward Bunbury, M. Lelewel, and Mr. Elton, think that Pytheas did not return to Massalia before undertaking his second voyage, but that he sailed to the continent from Cantion, so that there was practically only one voyage. But the writer of the article 'Pytheas' in Smith's 'Dictionary of Greek and Roman Biography,' is of opinion that "the words are scarcely susceptible of such an interpretation," and holds that there were two distinct voyages.

|| Timæus says that the Argonauts went up the southern Tanais (Don), transported their boats overland, and went down the northern Tanais (Elbe).

was here told that, at a distance of a day's sail, there was an island called Abalon or Abaleia,* where the amber (*electrum*), which is an excretion of the condensed waves, is carried by the sea on to the shore, in the spring. It is used for fuel by the islanders, and was also sold by them to their neighbours the Teutones, through whose trading ventures it eventually reached Massalia, and became an article of commerce in the marts of the civilised world. Abalon was probably the western coast of Schleswig, whence a supply of amber used to be obtained, and perhaps this was also a trade route for the more distant sources of amber supply in the Baltic.

Pytheas lived to return to Massalia once more, and to write one, if not two books, describing the events and results of his memorable voyages. The work entitled 'On the Ocean'† is believed to have referred to the expedition to the British Isles; while the 'Periplus'‡ described the second voyage to the mouth of the Elbe. Both are unfortunately lost to us.

We know, from his observation at Massalia, that Pytheas could fix a latitude within a few minutes, when the declination and sun's semi-diameter are applied to the result. It is, therefore, logical to credit him with knowing where he was when he observed and recorded the length of the longest day on five different occasions. An opposite plan has been adopted by some critics. They first settle where he was, and then decide that his latitude was 100 miles out. For instance they first settle that the Orcas of Pytheas was Duncansby Head in $58^{\circ} 39'$, and then condemn him for putting Orcas in $60^{\circ} 50'$. A more logical course would be to assume that Orcas was in $60^{\circ} 50'$, and that consequently it could not be Duncansby Head, but that it must be a place in the latitude indicated by Pytheas. The distances in *stadia* and *day's sail* with which Pytheas is credited by Strabo must either be deductions by Eratosthenes and others from the data of Pytheas, or else corrupt readings. Most of them are preposterous, and in neither case can Pytheas be fairly made responsible for them.

We may now estimate his place among explorers. The Ionians of Phocæa and Massalia had been trained as daring mariners and thoughtful students for generations, alike in the mother city and in the colony; and all their admirable qualities seem to culminate in the life-work of Pytheas. His learning and his discoveries form the fitting crown of their history. The seal on the coins of Phocæa, and the lion on the coins of Massalia appear as emblems of the Arctic Regions and of the British Isles. In the fulness of time the cities which owned those emblems produced a son, who, through his great knowledge and intrepid

* Called "Basilis" by Diodorus, following Timæus.

† *Περὶ τοῦ Ὠκεανου*. 'Geminus, Elem. Astron. in Petav Uranol,' p. 22.

‡ *Περιπλους*. 'Marcianus in Geog. Min.,' i. 63, and 'Scholiast on Apoll. Rhod.,' iv. 761. References in Smith's Dictionary, art. 'Pytheas,' and in Lelewel, p. 25.

daring, became the discoverer of Britain, and the first bearer of tidings respecting the Arctic Regions. Pytheas was a geographer and an explorer in the highest sense. For he must have devoted long years to qualify himself for his great task, and his work had placed him in the first rank of nautical astronomers before he undertook his voyages into the unknown ocean. His learning, and the perilous character of his enterprise, make him comparable with Columbus, while Englishmen may well deem that his discovery was, beyond all comparison, the most important that any explorer has ever made.

In connection with the lamentable destruction of so many precious works of antiquity, one of the strangest things is the way in which fragments and scraps, which, from the loss of so much else, become of infinite value, have been drifted down the stream of time on to our distant shore. About the voyage of Himilco we should know nothing but for the chance of a poet of the fifth century having embodied notices of it in his verses, and for the still greater chance that some of these verses happened to escape destruction.* The chances by which our slight knowledge of the work of Pytheas have reached us are still more remarkable. The accounts of his astronomical observations, and of his voyages of discovery, necessarily attracted much attention from his contemporaries; and although Dicæarchus is said to have rejected some of his conclusions, they received fair treatment from the great astronomers Eratosthenes and Hipparchus; and his works were largely used by the historian Timæus, who was his contemporary. On the other hand Polybius condemned Pytheas as unworthy of belief, apparently because the discoveries of the man of action conflicted with the preconceived ideas of the theoretical geographer. Polybius flourished two hundred years after the time of Pytheas. He criticised Eratosthenes and Hipparchus severely for accepting the statements of the great Massalian astronomer and explorer.

Even though the books of Pytheas are lost, if we could have seen the comments of his critics, both favourable and hostile, we should have been able to gather a great deal more than we now know respecting his life-work. But the works of Eratosthenes, Hipparchus, and Timæus are also lost, and the attack of Polybius on Pytheas was contained in his missing books. Strabo, the geographer, like Polybius, was fond of criticising the work of his predecessors. He lived three hundred years after the time of Pytheas, but he adopted all the prejudices of Polybius, and his method caused him to make copious extracts, not only from Polybius, but also from Eratosthenes and Hipparchus respecting the work of their Massalian predecessor, with a view to its disparagement.

* '*Ora Maritima*,' describing the coast from Massalia to Gades, by Avienus Rufus Festus, who is believed to have flourished in the end of the fourth century A.D. It contains some extracts from a work on the voyage of Himilco, which is not quoted nor mentioned by any other writer. The voyage itself is just mentioned by Pliny.

It is from these extracts in Strabo that our knowledge of Pytheas and his voyages is mainly derived.

We have to choose between Eratosthenes and Hipparchus on one side, and Polybius and Strabo on the other. The illustrious astronomers were men with a scientific training, earnest searchers after truth, and capable of weighing evidence. Strabo, like Polybius before him, was intolerant of any statement which ran counter to his preconceived ideas. He would not have believed the god Hermes himself if he told him that he had been to the ends of the earth, much less "that charlatan Pytheas." His other argument is that "the veracity of a writer who has been false in describing countries with which we are well acquainted should not be too much trusted in regard to unknown places." This is true enough. Strabo, however, gives no instance of Pytheas's want of veracity respecting well-known places. But the criticisms of Pytheas by Strabo are satisfactorily disposed of by the fact that whenever Strabo specifies a falsehood or a blunder of Pytheas, the explorer is approximately right, and the theoretical geographer is wrong. If Strabo had treated the statements of Pytheas with the respect they deserved, instead of calling him a liar, his own ideas would have been more correct. He would not have placed Ireland to the north of Britain. He would not have expunged the peninsula of Brittany from his map. He would not have placed the north coast of France in the latitude of Bordeaux. As between Pytheas and Strabo, there can be no question now as to which of the two was the more correct geographer. Still we must be grateful to Strabo for having preserved nearly all we know of Pytheas, without looking too closely into his motives. Strabo fully acknowledges the merits of Pytheas as an astronomer and mathematician, and commends the accuracy of some few of his statements. Although the history by Timæus is lost, Diodorus Siculus, and Pliny, in his natural history, have handed down to us a few precious extracts from it, relating to the work of Pytheas.

It is in this curious way, chiefly indeed through the desire of Strabo to discredit his narrative, that the few particulars respecting the voyages of Pytheas have been passed down to us. They are all contained in the works of Strabo, Diodorus Siculus, and Pliny.*

The voyages of Pytheas have received much attention from the scholars of Germany† and France,‡ but I believe only two have

* In reading the works of these three authors I have used 'Geography of Strabo,' translated by Hamilton (Bohn ed.); 'Bibliothèque Historique de Diodore de Sicile. Traduit par Miot' (Paris, 1834); 'Histoire Naturelle de Pline. Traduction par Ajasson de Grandseque' (Paris, 1833).

† Fuhr, 'De Pythæ Massiliensi dissertatio' (Darmstadt, 1835). Brückner, 'Historia Reipublicæ Massiliensium.' F. A. Ukert, 'Geographie der Griechen und Römer' (Weimar, 1816-43, 5 vols.). Redslob, 'Thule: die Phöniciischen Handelswegen nach den Norden' (Leipzig, 1855). Bessel, 'Pytheas von Massilien' (Göttingen, 1858).

‡ D'Anville, 'Mémoire sur la navigation de Pythéas à Thule' (Mém. de l'Académie

adopted the views of Strabo; Gosselin* in France and Sir George Cornwall Lewis† in England. The grounds of the unbelief of Gosselin are that Pytheas omitted to mention certain things which his critic considers that he must have mentioned if he ever made the voyage.‡ As the books of Pytheas are lost it is as impossible for Gosselin to affirm that he did not mention these things as it is for the advocates of Pytheas to say that he did. But these imaginary omissions in a lost book supply no valid argument against the authenticity of the voyages. Pytheas probably did mention all the points enumerated by Gosselin.

The reason given by Sir George C. Lewis for concurring in the hostile judgment of Strabo was that he believed he had found the false statement of Pytheas in describing countries with which Strabo was well acquainted, to which that geographer referred without specifying it. Sir George C. Lewis found the offending assertion in one of the 'Scholia of Apollonius Rhodius.'§ There Pytheas is alleged to have said that if any person placed a piece of iron at the mouth of Stromboli with some money, he found in its place, next morning, a sword or any other article of iron he wanted. Stromboli, like Ætna, was supposed to be the workshop of Vulcan. He also said that the surrounding sea was once in a boiling state. It is not alleged that Pytheas asserted these things of his own knowledge. He very properly repeated the interesting myths that he had heard in his travels, and this practice, while adding to the value of his work, does not in the slightest degree justify a doubt of his own accuracy and good faith.

The general, indeed the almost universal opinion of scholars who have recently investigated the question is that Pytheas is worthy of credit, and that his voyages are authentic.|| Sir Edward Bunbury may be accepted as the highest and most reliable living authority on this

des Inscript. et Belles Lettres, tom. xxxvi., 436). Gassendi, 'Opera' (iv., 530). Bougainville, 'Eclaircissemens sur la vie et les voyages de Pythéas' (Mém. de l'Académie, tom. xix.).

* P. F. J. Gosselin, 'Recherches sur la géographie systématique et positive des Anciens' (1798-1813, 4 vols.). J. Lelewel, 'Pythéas de Marseille et la géographie de son temps' (Bruxelles, 1836). Aout, 'Etude sur Pythéas' (Pamphlet, Paris, 1866).

† Sir G. C. Lewis, 'Historical Survey of the Astronomy of the Ancients' (8vo, 1862.)

‡ "How explain his silence about the Cassiterides? Why, when he speaks of Thule, does he say nothing of the Orcades? How did he make a mistake of $2\frac{1}{2}^{\circ}$ in latitude in the extreme north of Scotland, when he had observed the latitude of Marseilles so well? Why did he not mention the tin trade with the Timii? Why does he not describe the bay between Cape Sacré and Calbion? Why does he say the tide ceases at Cape Sacré?"

§ The reference of Sir G. C. Lewis is to 'Schol. Apollon. Rhod.,' iv. 761; 'Schol. Callim. Hymn Dian.,' 47.

|| Smith's 'Biographical Greek and Roman Dictionary,' art. Pytheas; Sir E. H. Bunbury, 'History of Ancient Geography' (1879); Charles T. Elton, 'Origins of English History' (1882; second edit., 1890); Professor Rhys, 'Celtic Britain' (1884).

subject. The late Professor Freeman used to say that he always felt perfect confidence in any article under which he saw the initials E.H.B. Sir Edward's decision is that Pytheas really made the voyage, and that he brought back much useful information. We may, therefore, accept as an established historical fact, that Pytheas of Massalia obtained the first information respecting the Arctic Regions, and that he was the discoverer of the British Isles.

A JOURNEY FROM THE SHIRE RIVER TO LAKE MWERU AND THE UPPER LUAPULA.*

By ALFRED SHARPE.

ON July 21st, 1892, I left Zomba and reached Mpimbi on the Upper Shiré the same day, and was there joined by Mr. John Kydd, who accompanied me on my journey. From Mpimbi we went up the Shiré River by boat to Fort Johnston, where we found the ss. *Domira*, and shipped our goods on her for Karonga.

On August 1st we left Fort Johnston in the *Domira* for the north, taking twenty-nine Zanzibari police as an escort; also one donkey. While at the Fort I took observations for latitude, the result of which was $14^{\circ} 25' 46''$ S. On August 4th we reached Bandawe, and there recruited carriers for the journey. I succeeded in getting one hundred and ten men, and with these we went on in the *Domira* to Karonga, where we arrived on the 11th. At Bandawe I took observations for latitude which placed the Mission Station in $11^{\circ} 53' 36''$ S. The calculations for all the observations taken by me throughout my journey are enclosed herewith. On Lake Nyasa I worked for latitudes with the meridian altitude of the sun. After leaving Karonga I used the stars Vega, α Pavonis, and α Gruis.

At Karonga I had the opportunity of purchasing a steel section-boat, one which Captain Stairs had brought with him on his expedition and sold to the African Lakes Company at Karonga. It subsequently proved invaluable to me. On August 21st I reached the African Lakes Company's "Fife" Station, half way across to Lake Tanganyika. This station, which includes a population of four or five hundred natives, is surrounded by a stockade, a bank, and a deep ditch, and is impregnable to any attack by natives or Arabs. This place is on the north-eastern borders of the Awemba country, and Mr. McCulloch (who is in charge of the station) has succeeded in opening up friendly relations with several of the important Awemba chiefs, who had hitherto kept out of all dealings with us (the English), and endeavoured to close their country to us. The Awemba have always been urged by the Arabs to

* Map, p. 576.