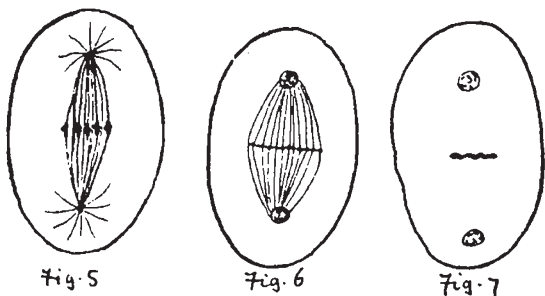


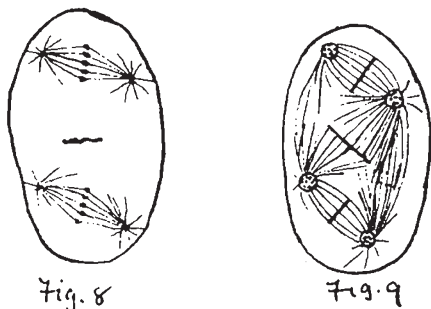
destinations, and whilst they are gradually forming into the daughter-nuclei, a curious change usually occurs at the equator of the spindle in the fibres which still stretch across the intervening space between the two poles. The threads become more numerous and present over the area mentioned a thickening of their substance, and by the fusion of the swellings a cell wall, dividing the original cell into two halves, may be formed. And whilst this is happening, there is evidence to show that the fibres themselves, which become strongly arched, are in a state of compression and thus the young wall is stretched to its utmost extent. The plane of equilibrium within the spindle depends on the shape of the cell; and thus at first, and whilst still plastic, one can predict what position it will



take up as regards the existing boundaries of the cell. Indeed the resemblance of such a nascent wall to a soap film has struck more than one investigator, and has been worked out in some detail by Wildemann.

The general relation of cell division to mechanical conditions is well illustrated during the development of pollen cells. In the monocotyledons the original pollen-mother-cell gives rise to the pollen grains by two succeeding divisions with an interval of rest between them. The first karyokinesis is followed by a partitioning of the cell, which is thus divided into two symmetrical halves, often hemispheres. When the latter finally divide, they also are symmetrically partitioned, though this, of course, can (and usually does) happen by means of walls which are not similarly orientated in both of the two first formed cells. In Dicotyledons, on the other hand, in which also there are two successive bipartitions of the nucleus, the appearance of the cell walls is deferred until the full number (four) of nuclei has been produced. And, just as might have been expected, the way in which the actual partitioning takes place is consequently modified. If spherical, as is commonly the case, the quadrinucleated cell is simultaneously divided into four tetrahedral cells by walls converging to the centre at an angle of 60°.

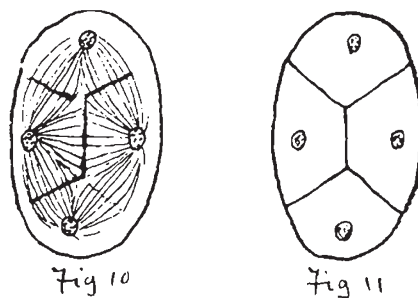
It would be difficult to find an example which more strongly witnesses to the influence of the form of the cell as governing



the disposition of the walls which partition it, than is furnished by the spore formation of a common liverwort, *Fegatella conica*. And as it also illustrates some other points touched upon in the preceding pages, this paper may be fitly brought to a close by a description of the more salient peculiarities attendant on the process. The spore-mother-cell, which ultimately gives rise to four spores, is shaped like an oval box flattened above and below. When its nucleus divides (Fig. 5), the two daughter-nuclei lie in the line of its major axis, and a rudimentary cell wall begins to be formed at the equator of the spindle (Fig. 6), after the fashion already indicated above. But, unlike most structures

of this kind, it does not extend to the peripheral walls owing, apparently, to the relatively small size of the spindle. As the two daughter-nuclei pass into the resting condition, the spindle fibres die away, and an interesting change comes over the character of the uncompleted division-wall. It ceases to be stretched out, and becomes somewhat crumpled and obviously thicker, whilst its area correspondingly diminishes (Fig. 7).

Then, after a time, the two daughter-nuclei again divide (Fig. 8), and after this division, resulting in the production of four nuclei, preparations for the real partitioning of the cell begins. Whatever position they may have previously occupied, the nuclei now take up that shown in Figs. 9 and 11; and they are apparently compelled to do so by the action of the radiations, which extend from each one of them into the surrounding cytoplasm. Whilst they are settling down to their final positions, the original cell-plate, above spoken of, is caused to rotate through an angle of 90°, so that it now is parallel with, instead of at right angles to, the major axis of the elliptical cell. Its motion is clearly seen to be the result of a directive action on the part of the highly developed systems of radiating fibres, and when it has turned round it is seen to have lost its thick crumpled appearance, and to have become thin and tense. As soon as it has ceased to cut across the line of protoplasm between the nuclei belonging to opposite pairs, the radiations are seen to arrange themselves into a spindle form, just like that formed between the daughter-nuclei of each pair, a fact of considerable theoretical importance in the elucidation of the genesis of spindle structures generally. In the equators of these two newly differentiated spindles, as in each of the two normal ones, cell-plates are formed, four in all, and they become attached in pairs to the ends of the primary plate, now lying longitudinally in the cell (see Figs. 9 and 10), and thus the partition of the space is completed (Fig. 11). A point of special interest in



this case of *Fegatella* lies in the remarkable fact that we here meet with two perfectly different conditions of cell division, and that the transition from the one to the other can be followed in every stage. Theoretical requirements are here demonstrably satisfied in a manner such as we can seldom hope to equal in our attempts to solve the many problems with which cytology has to deal. J. B. FARMER.

VASCO DA GAMA.¹

WE are assembled this evening to commemorate one of the greatest events in the history of the world—the discovery of the ocean route to India by the Portuguese. Vasco da Gama completed the mighty enterprise on the day when the ghâts of India were sighted from the deck of his ship just four hundred years ago to-morrow. The credit of this discovery is due to the Portuguese people, to their constancy and heroic perseverance, even more than to the skill and ability of their leaders; and I think that many of the illustrious navigators of Portugal are equal in merit, and should be equal in renown. We contemplate the perseverance of this people and the continuity of their work during a century and a half of mighty effort, rather than a single stroke of genius. Yet it is right that Vasco da Gama, who forged the last link, should have the first place which Camoens has assigned to him, *primus inter pares*.

Prince Henry gave the first impetus, and during a quarter of a century he created a school of seamen who rounded Cape Bojador in 1435, Cape Blanco in 1443, Cape Verde in 1445, and

¹ Address delivered before the Royal Geographical Society, on May 16, by the President.

reached the Gambia in 1454. All this was done in the lifetime of the Prince Navigator. At his death the work was continued, with almost equal zeal, by the kings—his nephews—Alfonso the African, João the Perfect Prince, Manoel the Fortunate. Portugal was indeed fortunate in her sovereigns of the house of Avis, fit guides and leaders of the little hero nation, as Schlegel calls her. The ships of Alfonso reached Sierra Leone in 1462, made a colony at Lamina, on the coast of Guinea, crossed the equator, and sailed as far south as Cape St. Catherine. His son, "O Príncipe perfeito," sent Diogo de Azambuja to found the castle at Lamina, and Diogo Cam to push southward, until at length the Congo was reached.

The *padraos* were intended to be eternal monuments of Portuguese achievement. They were stone pillars with an inscription, and the arms of Portugal carved upon them—the well-known "cinco chagas," with the orle of the seven castles of Algarve. Each explorer was to plant one on a conspicuous point at his furthest point. The "*padraos*" were named after saints. That of Santo Agostinho (once planted in 13° 27' 15" S., south of Benguela) is now in the museum of the Geographical Society at Lisbon, as well as that once on Cabo Negro, in 15° 40' 30" S. Two of these "*padraos*" were on the arms granted to Diogo Cam, the discoverer of the Congo.

It was the ambition of each successive Portuguese voyager to plant a national monument beyond the furthest point reached by his predecessor. None had been so zealous in this glorious work as the family of Diaz, whose first sailor scions were trained in the school of Prince Henry. João Diaz rounded Cape Bojador, Dinis Diaz first reached Cape Verde, and Bartholomew Diaz was destined to complete the maritime fame of his family by being the first to round the southernmost point of Africa, planting "*padraos*" as he proceeded. In 1487, Bartholomew Diaz passed the Table mountain undiscerned amidst the stormy waves, rounded Cape Agulhas, the southernmost point of Africa, and reached the Great Fish river, which he named after his companion, João Infanta. It was with great reluctance that the gallant Diaz, complying with the urgent entreaties of his crew, shaped a course homewards; and then it was that he first sighted the cape, which received from him the name of Cabo Tormentoso, and which the King changed to the Cape of Good Hope. Covilham, exploring southwards from Egypt, had discovered the whole east coast of Africa as far as Sofala, and had sent a full report from Cairo to King João. So that there was nothing left to discover, except the bit of African coast from the Great Fish river to Sofala.

The goal was well in sight. The eastern side of Africa had been reached by Diaz, and was known through the report of Covilham. Thence the next explorer would stretch across to the shores of India. King João prepared for the final and crowning expedition by the building of two suitable ships, which were commenced under the superintendence of Bartholomew Diaz, the ablest and most successful Portuguese explorer of that age. But in 1495 the king died, and the great work remained to be achieved in the reign of his successor, King Manoel ("O Fortunado"), who was at the head of Portuguese affairs for the next fifty-six years. He continued the equipment of the expedition, which had been commenced by his predecessor.

Then it was that Da Gama appeared on the scene. Camoens introduces him—

"Vasco da Gama, valiant capityne,
For derring do the noblest volunteer;
Of notable courage and of noble strain,
Whom smiles of constant fortune love to cheer."

The Da Gamas came of an ancient, valiant, and loyal house, their ancestors having fought by the side of Alfonso III. in the conquest of Algarve from the Moors, and by the side of Alfonso V., "the Brave," at the battle of Salado. Estevan da Gama, their father, was chief magistrate of Sines; and here Vasco and his brothers were born. The little town of Sines is situated in a bay, about half-way between Lisbon and Cape St. Vincent. To the west are the blue waves of the Atlantic, but to landward an undulating sandy plain extends for several leagues. On the north side of the bay there is a granite ridge running out into the sea, and on the top of the cliff there is a small church built by Vasco da Gama towards the end of his life.

The four sons of Estevan da Gama appear to have been born and brought up at Sines; but I believe that little or nothing is known of them before the date of the great expedition. The two ships had been built, the *San Gabriel* of 120 and the *San*

Rafael of 100 tons; another vessel was purchased from a Lagos pilot named Berrio, and named after him; and a provision-ship of 200 tons was also got ready. Then it was that Vasco da Gama was selected by King Manoel to command the expedition. He was not more than twenty-eight years of age. His eldest brother, Paulo, was equally fitted for the post, and he insisted upon accompanying and serving under Vasco, in command of the second ship. They both looked upon Nicholas Coelho, who was captain of the *Berrio*, as their brother.

Paulo da Gama was one of the kindest and most lovable of men, and his presence in the fleet was an influence for good. The best trait in the character of Vasco was his love for and devotion to his elder brother.

All things were prepared for the great enterprise, and the ships were ready in the Tagus. The beautiful church of Belem was not then built on the beach of Restrello, but Vasco da Gama passed the night before his departure in prayer in a little chapel which had been erected there by Prince Henry. He embarked next morning, and the expedition sailed on Saturday, July 8, 1497; there were about 160 souls all told. Six *padraos* were taken out, to be set up on prominent headlands, but not one of them is now known to exist. The fleet was accompanied by the great navigator, Bartholomew Diaz, as far as the Cape Verde Islands. He was going out in a fast caravel, to take up his command of the new Portuguese settlement of Lamina, on the coast of Guinea.

In December the expedition reached the "Rio do Infante," the furthest point of Bartholomew Diaz on the eastern side of Africa, and entered upon new ground. There was a mutiny at this critical time. The men feared to proceed further, and wanted to return, according to Correa, who adds that Vasco da Gama put the master and pilot in irons for giving the same advice, and threw all their instruments overboard. His brother Paulo induced his crew to obey orders by argument and persuasion, and interceded for Vasco's prisoners. This mutiny is not mentioned in the "Roteiro."

The first experience of the explorers on entering the previously unknown ocean was the force of the current, so strong that they feared it might frustrate their plans, until a fresh stern wind sprang up, which enabled them to overcome it. This Agulhas current was first scientifically investigated by Major Rennell in 1777.

Vasco da Gama passed the coast, which was named by him "Natal," on Christmas Day, and was well received by the natives of Delagoa Bay. He was at Quillimane in January 1498; at Mozambique in March; and he reached Melinde on April 15. There was a terrible outbreak of scurvy off Mozambique, and again on the way home; and then it was that Paulo da Gama proved the guardian spirit of the expedition, giving up all his own private stores for the use of the sick, ministering to them, and warding off despondency by his words of encouragement and by his example.

The King of Melinde supplied the Portuguese with an Indian pilot, a native of Gujarat, and on April 24 the voyage was commenced across the Indian Ocean, from the east coast of Africa to Malabar. Before starting, Vasco da Gama, with the hearty concurrence of the King of Melinde, set up one of the *padraos*, with the escutcheon of the *Quinas* carved on one side, and a shield bearing a sphere on the other. Beneath was King Manoel's name. It was placed on a hill above the town.

A voyage of twenty-three days brought the adventurous discoverers in sight of the mountains above Malabar—an event which Camoens thus relates:

"Pale shone the wave beneath the golden beam,
Blue o'er the silver flood Malabar's mountains gleam;
The sailors on the maintop's airy round
'Land! Land!' aloud with waving hands resound.
Aloof the pilot of Melinda cries,
'Behold, O Chief, the shores of India rise!
Elate the joyful crew on tiptoe trod,
And every breast with swelling raptures glowed.
Prone on his manly knees the hero fell;
'Oh, bounteous Heaven!' he cries, and spreads his hands
To bounteous Heaven, while boundless joy committs
No further word to flow."

Then the immortal poet, in words of fire, declares how this mighty deed was done, and by what kind of men:

"Not those who ever lean on ancient strain,
Imping on noble trunk a barren chain;
Not those reclining on the golden beds,
Where Moscow's zebelin downy softness spreads;

Not with the novel viands exquisite;
 Not with the languid wanton promenade;
 Not with the pleasures varied infinite,
 Which generous souls effeminate, degrade;
 Not with the never conquer'd appetite,
 By fortune pamper'd as by fortune made.
 But by the doughty arm and sword that chase
 Honour which man may proudly hail his own;
 In weary vigil, in the steely case,
 Mid' wrothsome winds and bitter billows thrown,
 Suffering the frigid rigours in th' embrace
 Of South, and regions lorn and lere, and lone,
 Swallowing the tainted rations scanty dole,
 Salted with toil of body, moi of soul.
 Thus honour'd hardness shall the heart prevail,
 To scoff at honours, and vile gold disdain.
 Whoso shall rule his life by reasons light,
 Which feeble passion ne'er hath power to hide,
 Shall rise (as rise he ought) to honour true.
 Mauge his will that ne'er hath stooped to sue."

And thus was the Portuguese empire in India founded by two of Portugal's noblest sons, Vasco and Paulo da Gama. Time will not allow us to linger with them on the coast of Malabar. On March 20, 1499, they cleared the Cape, and returned to Lisbon on September 13. But Paulo da Gama had died at Terceira, in the Azores. Equal to Vasco in heroism and constancy, Paulo excelled him in the more Christian virtues, and was, as I have already said, the guardian spirit of the voyage. When Vasco is remembered, Paulo da Gama should never be forgotten. They are equal in merit, and both equally deserve to have their memories honoured by their country, and by the civilised world.

True to the spirit of perseverance and energy which had led the Portuguese to this crowning success, a large fleet was despatched to India in the year after the return of Vasco da Gama, and in each succeeding year. Vasco da Gama commanded the fourth voyage in 1502, and on his return he was created Count of Vidigueira. Then followed the brilliant achievements of Alfonso d'Albuquerque, who occupied Goa, Ormuz, and Malacca, and established Portuguese power in India on a solid foundation. It was to last unchallenged for eighty years, when the disaster of El Kasr-el Kebir brought on what the Portuguese called the sixty-years captivity.

For twenty years Vasco da Gama was unemployed, living at a house in Evora, the walls of which were painted with figures of Indian animals and plants, and hence the street in which it stood is still called "Rua das Casas Pintadas." Here he brought up a family of six sons; but in 1524 he was called from his retirement to rule over Portuguese India. He went out with a large fleet, surrounded by all the pomp and circumstance of a viceroy, and he died at Cochin, on the scene of his discoveries, on Christmas Day 1524, aged 55.

Vasco da Gama is described as a man of middle stature; rather stout, and of a florid complexion. The portrait, which belonged to Count Lavrado, is given by Lord Stanley of Alderley, in his translation of the account of Da Gama's voyages in the "Lendas da India," of Correa. It is a copy of the portrait in the Museu das Bellas Artes at Lisbon, a photograph from which is given in Ravenstein's "Roteiro." It represents a handsome man, aged about fifty, with a white beard and severe expression, wearing a furred robe, and the cross of the order of Christ hanging from a chain round his neck. *His crest* was a girthed doe trippant, or. *Arms*—chequy of fifteen, or and gules; two bars argent; over all an escutcheon with the *quinas* of Portugal.

Luis Camoens, the great epic poet, is said to have been born in the year that Da Gama died; and Lord Stanley says, I think truly, that the name Vasco da Gama has left in history is due largely to the great genius of Camoens. "The discovery of India," says Schlegel, "the greatest event of modern times, could only be worthily celebrated by one who had himself passed a portion of his life in these regions. A warrior could only thus have written."

"At the proudest moment of that brief but glorious period of Portugal's greatness, one great national song broke forth, like the dying note of the fabled swan, a dirge for the departing hero-nation. The remembrance of her departed glory is enshrined in this immortal work, created by the divine genius of her national poet to immortalise her fame. The exquisite bloom and grace of the diction of Camoens are unparalleled among modern writers."

The most learned and accomplished English traveller of modern times, the late Sir Richard Burton, devoted twenty

¹ Schlegel.

years of his life to the study and translation of the "Lusiads of Camoens." He declared that he felt a glow of pleasure at having undertaken it—at having lived so long in contact with so noble a spirit as that of his master. He also took pride in the ambition of familiarising his fellow-countrymen with a workman and a work not readily to be rivalled in the region of literature. No single publication extant gives so full and general a portrait of Camoens, his life and his work, as that of Sir Richard Burton, and his translation is undoubtedly the most faithful and the best in our language. The Hakluyt Society, of which I have the honour to be President, has also laboured to make the achievement of Vasco da Gama better known in this country. In 1869 we brought out the "Lendas" by Gaspar Correa, translated and edited by Lord Stanley of Alderley; and this year, with a view to celebrating the present commemoration, we have published the "Roteiro" of the first voyage, which has been ably translated and edited by Mr. Ravenstein.

After the sixty years of captivity came to an end, Portugal rose like a phoenix from its ashes. The old alliance with England was renewed. It was commenced when the founder of the house of Avis, the great King Joao of Good Memory married that English princess, who bore him five noble sons, including Prince Henry the Navigator. Since 1640, the year of liberation, English and Portuguese have fought side by side on many a battle-field for freedom, we have formed alliances, and now our royal houses are nearly related. There are many reasons why England should feel warm sympathy for Portugal in the commemoration of the mighty deeds of her sons. The nation of heroic memories has a glorious history to be proud of; and by the commemoration of the discovery of India by Vasco da Gama, we hope that those memories will impress themselves even more strongly than ever on the minds of her sons, leading them on to an honourable and prosperous future. We wish health and happiness to his faithful Majesty, and success and prosperity to our old and tried ally, the noble Portuguese nation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—A proposal to establish a final honour school of agricultural science, the examination in which was to be partly of a practical character, with the condition that the candidates must have obtained honours or passed the preliminary examinations in natural science, was rejected by Congregation on Tuesday.

CAMBRIDGE.—Mr. H. Yule Oldham, of King's College, has been appointed Reader in Geography for five years from Midsummer 1898. Mr. A. C. Seward, of St. John's College, has been reappointed University Lecturer in Botany.

The grace for the recognition as a public hostel of St. Edmund's House, established as a place of general education for candidates for the Roman Catholic priesthood, has been rejected by 471 votes to 218.

MRS. ELIZABETH H. BATES, of Port Chester, N.Y., has left, by her will, property valued at 135,000 dollars to the University of Michigan.

A COURSE of six lectures on electric traction, by Prof. Schwartz and Dr. D. K. Morris, was commenced on Tuesday evening at the South-West London Polytechnic, Manresa Road, Chelsea, and will be continued on succeeding Tuesdays.

THE Town Council of the county borough of West Ham have made the following appointments on the teaching staff of the new Municipal Technical Institute: Head of the Chemical department, Dr. Harold A. Auden, of the Owens College, Manchester; Lecturer in Mechanical Engineering, Mr. John Duncan, of University College, Nottingham.

THE fifth annual report of the Technical Education Board, presented to the London County Council on Tuesday, is a document of fifty foolscap pages. It includes a general account of the work of the Board, showing the lines on which the work has been organised, and giving a survey of the provision for technical education which now exists in the metropolis. Several maps are appended at the end of the report, which give a general idea of the character and locality of the various institutions in