Andrea to the church of S. Stefano. It was battered down during the bombardment of Genoa in the time of Louis XIV., was rebuilt with two additional stories, and is now the property of the city of Genoa.

Here Columbus was born, the date of his birth being fixed by three statements of his own, and by a justifiable inference from the notarial records. He said that he went to sea at the age of fourteen, and that when he came to Spain in 1485 he had led a sailor's life for twenty-three years. He was, therefore, born in 1447. The authorities who assign 1436 as the year of his birth rely exclusively on the guess of a Spanish priest, Dr. Bernaldez, Cura of Palacios, who made the great discoverer's acquaintance towards the end of his career.

The notarial records, combined with incidental statements of Columbus himself, also tell us that he was brought up, with his brothers and sister, in the Vico Dritto at Genoa; that he worked at his father's trade and became a "lanerio," or wool-weaver; that he moved with his father and mother to Savona in 1472; and that the last document connecting Cristofero Colombo with Italy is dated on August 7, 1473. But in spite of his regular business as a weaver, he first went to sea in 1461, at the age of fourteen, and he continued to make frequent voyages in the Mediterranean and the Archipelago—certainly as far as Chios.

When Columbus submitted his proposition for an Atlantic voyage to the Spanish sovereigns, they referred it to a committee, presided over by Father Talavera, which sat at Cordova, and condemned it as impracticable. It is generally supposed that the proposals of the Genoese were subsequently submitted to an assembly of learned persons at the University of Salamanca, and again condemned. The truth was quite different. Columbus was gifted with a charming manner, simple eloquence, and great powers of clear exposition. It was an intellectual treat to hear him recount his experiences, and the arguments for his scheme. Among those who first took an interest in his conversation, and then became a sincere and zealous friend, was the Prior of the great Dominican Convent of San Estevan, and Professor of Theology at Salamanca, who shrewdly foresaw that the most effectual way of befriending Columbus would be by affording ample opportunities of discussing the questions he raised. For this object there could be no better place than the University of Salamanca, where numerous learned persons were assembled, and where the Court was to pass the winter. The good Prior lodged his guest in a country farm belonging to the Dominicans, called Valcuebo, a few miles outside Salamanca. Hither the Dominican monks came to converse on the great deductions he had drawn from the study of scientific books, and from his vast experience, discussing the reconciliation of his views with orthodox theology. Later, in the winter, Columbus came into the city and held conferences with men of learning, at which numerous courtiers were present. These assembages for discussion—sometimes in the quiet shades of Valcuebo, sometimes in the great hall of the convent—excited much interest among the students and at Court. The result was, that the illustrious Genoese secured many powerful friends at Court, who turned the scale in his favour when the crucial time arrived. Such is the slight basis on which the story of the official decision of the Salamanca University against Columbus rests.

Captain Duro, of the Spanish Navy, has investigated all questions relating to the ships of the Columbian period and their equipment with great care; and the learning he has brought to bear on the subject has produced very interesting results. The two small caravels provided for the voyage of Columbus by the town of Palos were only partially decked. The *Pinta* was strongly built, and was originally lateen-rigged on all three masts, and she was the fastest sailer in the expedition; but she was only 50 tons burden, with a complement of eighteen men. The *Niña*, so-called after the Niño family of Palos, who owned her, was still smaller, being only 40 tons. The third vessel was much larger, and did not belong to Palos. She was called a "nao," or ship, and was of about 100 tons burden, completely decked, with a high poop and forecastle. Her length has been variously estimated. Two of her masts had square sails, the mizen being lateen-rigged. The crew of the ship *Santa Maria* numbered fifty-two men all told, including the admiral.

Friday, August 3, 1492, when the three little vessels sailed over the bar of Saltes, was a memorable day in the world's history. It had been prepared for by many years of study and labour, by long years of disappointment and anxiety, rewarded at length by success. The proof was to be made at last. To the incidents of that famous voyage nothing can be added. But we may at least settle the long-disputed question of the landfall of Columbus. It is certainly an important one, but it is by no means a case for the learning and erudition of Navarretes, Humboldts, and Varnhagens. It is a sailor's question. If the materials from the journal were placed in the hands of any midshipman in Her Majesty's Navy, he would put his finger on the true landfall within half an hour. When sailors such as Admiral Becher, of the Hydrographic Office, and Lieutenant Murdoch, of the United States Navy, took the matter in hand, they did so. Our lamented associate, Mr. R. H. Major, read a paper on this interesting subject on May 8, 1871, in which he proved conclusively by two lines of argument that Watling Island was the Guanahani or San Salvador of Columbus.

The spot where Columbus first landed in the New World is the eastern end of the south side of Watling Island. This has been established by the arguments of Major, and by the calculations of Murdoch, beyond all controversy. The evidence is overwhelming. Watling Island answers to every requirement and every test, whether based on the admiral's description of the island itself, on the courses and distances thence to Cuba, or on the evidence of early maps. We have thus reached a final and satisfactory conclusion, and we can look back on that momentous event in the world's history with the certainty that we know the exact spot on which it occurred—on which Columbus touched the land when he sprang from his boat with the standard waving over his head.

The discoveries of Columbus, during his first voyage, as recorded in his journal, included part of the north coast of Cuba, and the whole of the north coast of Española. The journal shows the care with which the navigation was conducted, how observations for latitude were taken, how the coasts were laid down—every promontory and bay receiving a name—and with what diligence each new feature of the land and its inhabitants was examined and recorded. The genius of Columbus would not have been of the same service to mankind if it had not been combined with great capacity for taking trouble, and with habits of order and accuracy.

Columbus regularly observed for latitude with Martin Behaim's astrolabe or the earlier quadrant, when the weather rendered it possible, and he occasionally attempted to find the longitude by observing eclipses of the moon with the aid of tables calculated by old Regiomontanus, whose declination tables also enabled the admiral to work out his meridian altitudes. But the explorer's main reliance was on the skill and care with which he calculated his dead reckoning, watching every sign offered by sea and sky by day and night, allowing for currents, for leeway, for every cause that could affect the movement of his ship, noting with infinite pains the bearings and the variation of his compass, and constantly recording all phenomena on his card and in his journal. Columbus was the true father of what we call proper pilotage.

On his return his spirit of investigation led him to try the possibility of making a passage in the teeth of the trade wind. It was a long voyage, and his people were reduced to the last extremity, even threatening to eat the Indians who were on board. One night, to the surprise of all the company, the admiral gave the order to shorten sail. Next morning, at dawn, Cape St. Vincent was in sight. This is a most remarkable proof of the care with which his reckoning must have been kept, and of his consummate skill as a navigator.

In criticizing the Cantino map showing Cortoreal's coastlines, Mr. Markham showed that absurd mistakes had been made, not by the voyager or his pilots, but by the cartographer, and subsequent commentators. Vespucci's description of his "first voyage" in 1797, was subjected to very thorough criticism, and shown, in spite of the arguments of authors who have tried to support the veracity of that ingenious romancer, to have been a pure fabrication. Little or no credit could be given to Vespucci in any case, as he was forty-eight years old on first going to sea, and in those days apprenticeship from boyhood was indispensable for a knowledge of seamanship.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Science Examiners have issued the following Class Lists:—

Chemistry.—First Class: C. L. Fort (New), R. E. Hughes

(Jesus), G. Ingham (Merton), A. L. Ormerod (New). Second Class: D. Berridge (Wadham), P. Henderson (Queen's), A. E. Richardson (Wadham), F. R. L. Wilson (Keble). Third Class: C. J. M. Parkinson (Jesus), H. Wynne-Finch (New). Fourth Class: S. Wellby (Trinity).

Physiology.—First Class: P. S. Hichens (Magdalen), H. H. G. Knapp (non-Coll.), A. C. Latham (Balliol), E. Mallam (Magdalen), W. Ramsden (Keble). Second Class: G. J. Conford (Christ Church), E. Stainer (Magdalen). Third Class: S. B. Billups (non-Coll.). Fourth Class: J. S. Clouston (Magdalen).

Physics.—First Class: S. A. F. White (Wadham). Second Class: G. M. Grace (Jesus). Third Class: none. Fourth Class: F. W. Bown (University), J. C. W. Herschel (Christ Church).

Morphology.—First Class: R. W. T. Günther (Magdalen).

Botany.—Second Class: O. V. Darbishire (Balliol).

Women:—Louisa Woodcock is placed in the Second Class, Morphology.

University Extension.—In a Convocation held on Tuesday the following persons were declared on a scrutiny to be duly elected as delegates, under the provisions of the statute Of the delegates for the extension of teaching beyond the limits of the University:—H. J. Mackinder, M.A., Student of Christ Church; W. W. Fisher, M.A., Corpus Christi College, Aldrichian Demonstrator of Chemistry; J. F. Bright, D.D., Master of University College; A. Sidgwick, M.A., Fellow of Corpus Christi College; J. Wells, M.A., Fellow of Wadham College; and the Rev. W. Lock, M.A., Fellow of Magdalen College.

The Encænia.—In a Convocation holden in the Sheldonian Theatre on Wednesday, June 22, the degree of D.C.L. (*honoris causâ*) was conferred upon the following persons:—

His Excellency, William Henry Waddington, Ambassador Extraordinary and Minister Plenipotentiary from the French Republic at the Court of St. James, Honorary Fellow of Trinity College, Cambridge, Hon. LL.D.

His Highness the Thakore of Gondal.

The Very Rev. Henry George Liddell, D.D., late Dean of Christ Church.

Edward Caird, M.A., Professor of Moral Philosophy in the University of Glasgow, formerly Fellow of Merton.

W. M. Flinders Petrie.

The Rev. John Gwynn, D.D., Regius Professor of Divinity in the University of Dublin.

Daniel John Cunningham, M.D., Professor of Anatomy and Chirurgery in the University of Dublin.

Edward Dowden, LL.D., Erasmus Smith's Professor of Oratory in the University of Dublin.

The Rev. John P. Mahaffy, D.D., Professor of Ancient History in the University of Dublin.

Benjamin Williamson, M.A., Sc.D., Fellow of Trinity College, Dublin.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 2.—"On Current Curves." By Major R. L. Hippisley, R.E. Communicated by Major MacMahon, F.R.S.

(1) Starting with the equations

$$i = \frac{E}{R}\left(1 - e^{-\frac{Rt}{L}}\right)$$

and

$$i = \frac{E}{\sqrt{(R^2+p^2L^2)}}\sin(pt - \theta),$$

which represent the curves of currents in circuits *without* iron cores, according as the impressed E.M.F. is constant or varying as sin pt, we can determine the curves according to which the current rises and falls in circuits *with* iron cores, both for a constant impressed E.M.F. and for a sinusoidal E.M.F.

(2) In the first case, with constant applied E.M.F., we can determine by Lagrange's formula of interpolation the equation to the (B, H) curve of the particular core under consideration. This will be of the form

$$B = a_0 + a_1H + a_2H^2 + \ldots + a_nH^n,$$

where n is one less than the number of observed simultaneous values of B and H from which the equation is calculated. Substituting in the equation

$$E - \frac{dB}{dt} = Ri,$$

we get, after integration,

$$t = b_0 \log\frac{E}{E - Ri} - b_1 i - b_2 i^2 - \&c., \text{ to } n + 1 \text{ terms},$$

b_0, b_1, b_2, &c., being numerical. The paper gives b_0, b_1, b_2, &c., in terms of the constants of the circuit, &c.

The corresponding equation when the E.M.F. is removed and the current is dying away is

$$t = c_0 \log\frac{E}{Ri} - c_1 i - c_2 i^2 - \&c. + \text{a constant}.$$

From these two equations the curves can be plotted.

(3) This method is not applicable to the case in which the impressed E.M.F. is sinusoidal, on account of difficulties of integration. But both cases can be treated in another way:—Take a series of points on the (B, H) curve of the iron core, such that the chords joining them practically coincide with the curve itself. Let B_κ, H_κ, and $B_{\kappa+1}$, $H_{\kappa+1}$, be the co-ordinates of two consecutive points. The equation to the curve between these points is approximately

$$B = m_{\kappa+1}H + \text{constant},$$

where

$$m_{\kappa+1} = \frac{B_{\kappa+1} - B_\kappa}{H_{\kappa+1} - H_\kappa}.$$

Substituting in the equation

$$E - \frac{dB}{dt} = Ri,$$

we get, after integration,

$$t_{\kappa+1} = t_\kappa + \frac{m_{\kappa+1}L}{R}\log\frac{E - Ri_\kappa}{E - Ri_{\kappa+1}},$$

which is true to a very close approximation for any simultaneous values of t and i between the above limits. From this equation, by determining the various values of m, and remembering that t_0 and i_0 are both zero, we can determine in succession the times at which the current has the known values 0, $\frac{H_1}{L}$, $\frac{H_2}{L}$, . . . &c., and the current curve can be plotted.

On making $E = 0$ in the original differential equation, and observing the proper limits, we get

$$t_{n+1} = t_n + \frac{m_{n+1}L}{R}\log\frac{H_n}{H_{n+1}}$$

as the equation to the curve representing the dying away of the current when the E.M.F. is withdrawn; m_n, m_{n+1} being determined from the descending (B, H) curve.

(4) When the impressed E.M.F. is sinusoidal, we substitute for dB/dt in the equation

$$E\sin pt - \frac{dB}{dt} = Ri,$$

having determined the various values of dB/dt, as in the foregoing.

As by the present method the value of m changes *abruptly* from m_κ to $m_{\kappa+1}$, we must employ the *general* solution of the above, which for the interval t_κ, $t_{\kappa+1}$, is

$$i = \frac{E}{\sqrt{(R^2 + m_{\kappa+1}^2p^2L^2}}\sin(pt - \theta_{\kappa+1}) + A_{\kappa+1}e^{-Rt/m_{\kappa+1}L},$$

in order that the current at the commencement of the interval t_κ, $t_{\kappa+1}$, may have the same value which it had at the end of the interval $t_{\kappa-1}t_\kappa$. The complementary function

$$A_{\kappa+1}e^{-Rt/m_{\kappa+1}L},$$

enables us to insure this condition; for, by taking the constant $A_{\kappa+1}$ of such a value that the above equation is satisfied when $i = i_\kappa$ and $t = t_\kappa$, there is no abrupt change in the current. The complementary function, in fact, represents the gradual dying away of whatever excess or defect of current there would be in the circuit when m changes.

This equation is true for all values of i between i_κ and $i_{\kappa+1}$; and, therefore, enables us to find the time, $t_{\kappa+1}$, at which the current attains the known value $H_{\kappa+1}/L$.

By changing κ into $\kappa + 1$, we obtain similarly the time $t_{\kappa+2}$ at which the current has the value $H_{\kappa+2}/L$, and so on.

Thus the determination of $t_{\kappa+1}$ is made to depend upon t_κ, and